Research and Data Needs for Very Long-Term Dry Storage

AREVA Perspective
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Agenda

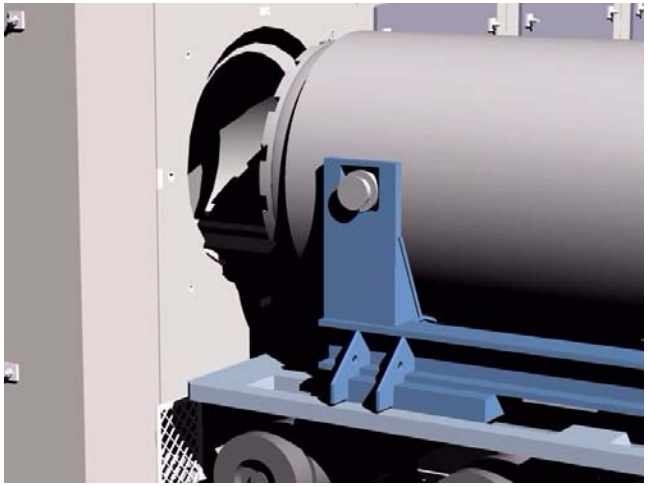
- Review of Current Dry Storage Systems
- Design Criteria, Environmental Conditions, Design Life
- Analysis Performed; Materials Utilized
- ISFSI License Renewal Activities
- Inspection Activities
- Conclusions

Current Storage Technology

- Over 36,000 commercial fuel assemblies currently in dry storage in the US
- Most spent fuel is contained in welded stainless steel canisters stored within concrete overpacks
- Vertical and horizontal configurations
- Some fuel stored in transportable metal casks with bolted closures using metallic seals and overpressure tanks to monitor and ensure that in the event of a seal failure, no leakage to the environment will occur

Typical Dry Storage System Designs

Typical Dry Storage Systems



Design Life

- License period based on Nuclear Waste Policy Act which initially contemplated availability of a licensed repository for the disposal of spent fuel by 1998
- License period for 20 years, and in general the systems were evaluated for a design life of 50 with extension potential to 100 years
- Originally licensed at a site level, today most licenses are generic
- Utilities have successfully extended their ISFSI licenses for up to an additional 40 years for a total of 60 years
  - HB Robinson
  - Surry
  - Oconee (in process)
  - Calvert Cliffs (in process)
- Regarding the Dominion license renewal, the NRC staff determined that the 40-year renewal exemption request was a policy decision and not a technical one, because the safety evaluations have indicated sufficient technical information had been provided for the 40 year exemption

Materials

- A review of the materials utilized and environmental conditions indicate that the dry storage systems should be capable of lasting 100 years or longer without significant degradation
- Beyond 100 years, there is not much data to determine the effects of environmental conditions on the storage systems. (Some ISFSI's are located in relatively harsh coastal environments)
- Typical materials utilized for dry storage:
  - Stainless steel or alloy carbon steel with low temperature ductility for containment boundary.
  - Polymer shielding material
  - Reinforced concrete for shielding, missile resistance, weather protection
  - Aluminum for heat transfer
  - Borated products for criticality control (Boral, Borated Aluminum, Metal Matrix Composites and Borated Stainless Steel)
  - Corrosion resistant coatings

Design Criteria

- Rigorous design criteria to withstand seismic events, tornadoes, tornado missile impact, very high and low temperatures and temperature fluctuations, credible fires, floods, and burial in debris.
- Most storage systems are also designed for transport. In the transport configuration the systems are designed to withstand 30 foot drops onto an unyielding surface, 1 meter drops onto a puncture bar, immersion, and fire.
- All systems are passive, and exposed to very low stresses during normal operation.
- Generally designed in accordance with the ASME B&PV Code, Section III, ACI 349 and ACI 318 and other standard industry codes.

Analyses

- **All safety analyses are evaluated by NRC to ensure the methods of analyses are acceptable and that there is sufficient conservatism in the analysis to provide reasonable assurance that public health and safety are protected**
  - **Structural**
  - **Thermal**
  - **Criticality**
  - **Containment**
  - **Shielding**

License Renewal

- License renewal for ISFSI's follows the process for nuclear plants. Scoping, aging management reviews and time limited aging analysis are performed
- For evaluation of the fuel rod cladding, the license renewal applications have referenced EPRI Topical Reports TR-108757, Data Needs for Long-Term Dry Storage of LWR Fuel and TR-1003416, Technical Bases for Extended Dry Storage of Spent Nuclear Fuel
- These reports are based on examination of fuel which was stored in a Castor Cask for 15 years
- Results of examination showed that little if any degradation of the fuel occurred during storage

HSM License Renewal

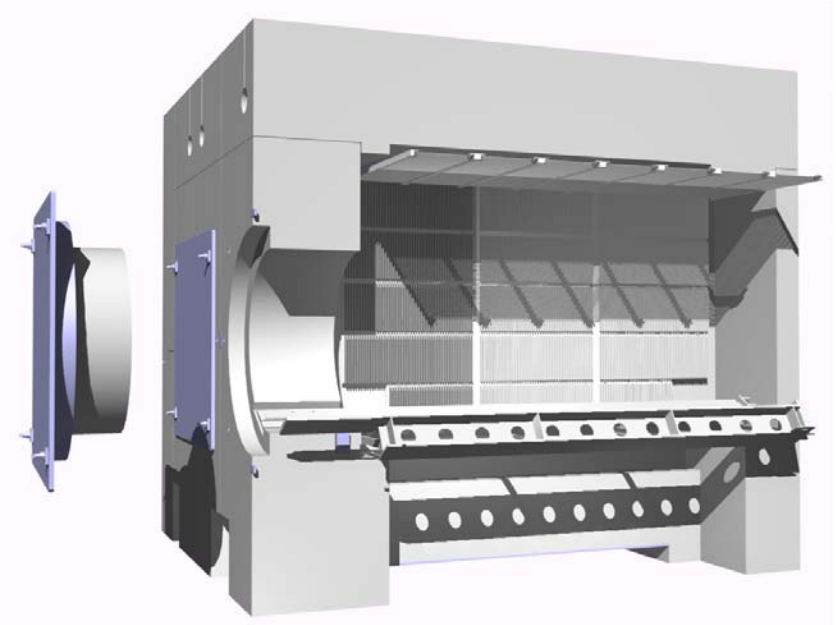
- Potential degradation for the HSM's include:
  - loss of material due to general corrosion and pitting of the accessible steel surfaces
  - Cracking, change in material properties and loss of material
- Aging management programs address:
  - Visual inspection of the accessible concrete and exposed steel
  - Radiation and contamination monitoring
  - Remote inspections of the interior concrete and steel surfaces
    - Baseline inspections are performed on a selected number of interiors with cameras and/or fiber optic technology
  - Surveillances required to maintain the air inlets and outlets free from obstruction

Metal Cask license renewal

- Dominion submitted license application for renewal of its ISFSI at Surry on April 29, 2002
- Surry ISFSI in operation has been continuous since the mid-80's and has multiple systems including the Castor V/21, Castor X/33, Westinghouse MC-10, NAC 1-28 and TN-32. The ISFSI is Currently utilizing NUHOMS® system under general license
- All metal casks have double seals for each closure and utilize an overpressure system to monitor potential leaks
- Outer seals are subject to more severe environmental conditions
  - During storage, 6 seals failed, but no leakage of radioactive material
  - Design and material changes were made to correct this issue
- During 2000- 2001, 40 casks underwent 6 visual inspections each
  - Only minor cases of corrosion or coating degradation were seen
  - No indication of cask polymer neutron shield materials becoming ineffective

Inspections

- Methods exist to perform periodic in-service inspections
  - For example, the NUHOMS® System is easy to inspect due to the large air cavity and the horizontal orientation with no required lifts
  - The HSM interior can be examined by boroscope
  - Exterior of DSC can be examined for degradation or contamination by pulling the canister back into the transfer cask
- A NUHOMS® module was inspected at Oconee by boroscope after 5 years storage
  - No adverse indications noted



Conclusion

- Interim Spent Fuel Storage Facilities (ISFSIs) were intended to be temporary
- Most dry storage systems can be subjected to periodic in-service inspection to ensure that no significant degradation has occurred.
  - Beyond 100 years, the storage systems may begin to see degradation which could reduce the system effectiveness
- The storage systems are designed such that they can either be moved back into the spent fuel pool or loaded into another canister and overpack.
- Casks and Overpacks can be replaced or refurbished

Conclusion

- Leaving the spent fuel onsite for extended periods of time was never intended and is not responsible
- ISFSIs can safely operate past 100 years by implementing an aging management program
- More responsible options exist
  - Recycling and final disposal need to be pushed forward