Spent Fuel Storage Integration in the United States

Planning for Storage and Transportation

IAEA International Conference on the Management of Spent Fuel from Nuclear Power Reactors

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Topics to be discussed

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- Background of U.S. Dry Storage
  - Canister types
  - Decommissioned reactor sites
  - Damaged fuel criteria
- Canister loading issues
  - Loading damaged fuel
  - Welding/NDE issue
  - Vendor Safety Review
- Conclusions

U.S. ISFSI Locations

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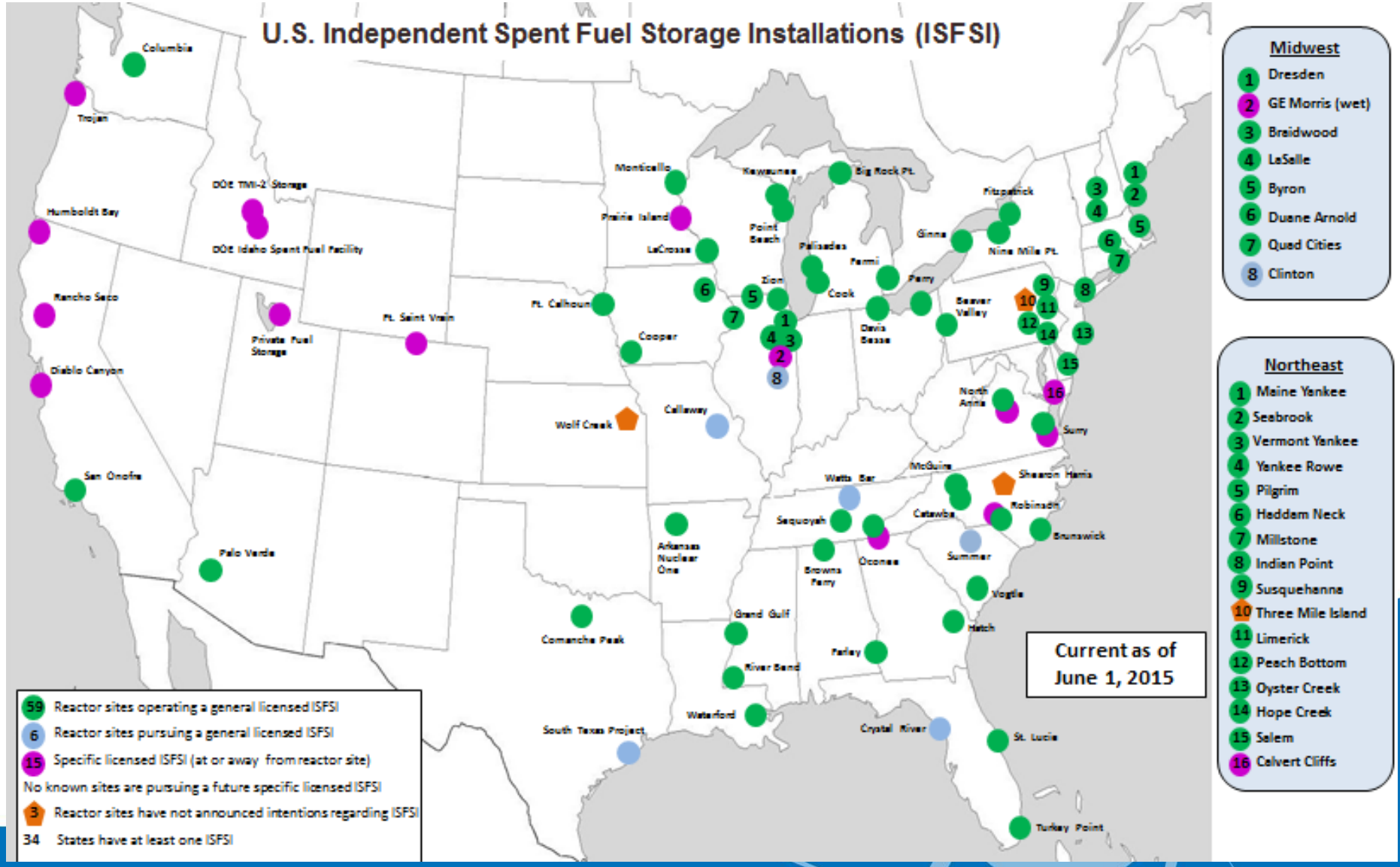

ISFSI Overview

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- U.S. Independent Spent Fuel Storage Installations, abbreviated as ISFSI, are where the spent fuel canisters are stored in radiation shielding overpacks also called casks.
- The ISFSI can be licensed by the NRC using a site-specific license or can be licensed for reactor sites using a general license.
- Most current U.S canisters use welded lids, although some canisters use bolted lids

Initial Storage Plans

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- Plans were to store the spent fuel for nominal amount of time in spent fuel pool (SFP) then send to Department of Energy (DOE) for reprocessing
- Moratorium on reprocessing of spent fuel issued in 1977, SFP's continue to fill up
- Licensees re-rack the SFP's with high density racks to gain space for storage and time
- Ultimately the licensees turn to dry fuel storage to allow continued reactor operation

Dual-Purpose Canisters

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- Initial canisters were storage-only
- In late 1990's the canister types licensed by the NRC shifted to using a General License canister for dual-purpose use
- Dual purpose canisters licensed for storage under 10 CFR Part 72 could also be transported using a transportation overpack under 10 CFR Part 71

- The spent fuel could be transported to the final repository or interim storage site using the dual-purpose canister

Multi-Purpose Canisters

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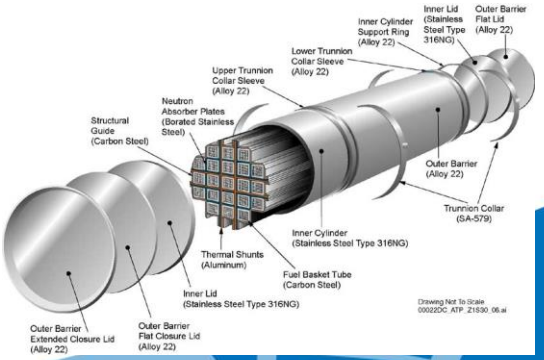
- Multi-purpose canisters were proposed by DOE in Yucca Mountain Repository application
- DOE awarded contract to develop canister licensed for storage, transportation, and disposal
- Canister was called a Transportation, Aging, and Disposal (TAD) canister
- Specified to hold 21 PWR or 44 BWR assemblies to minimize heat load generated during disposal period



Decommissioned Reactors

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- Decommissioned reactor sites do not have spent fuel pools to repackage or unload spent fuel canisters and do not have the overhead cranes to transfer canisters into transportation overpacks
- Some decommissioned and reactor sites have methods to transfer canisters:
  - Specially fabricated facilities
  - Cask Transfer Facilities

Damaged Fuel Assemblies

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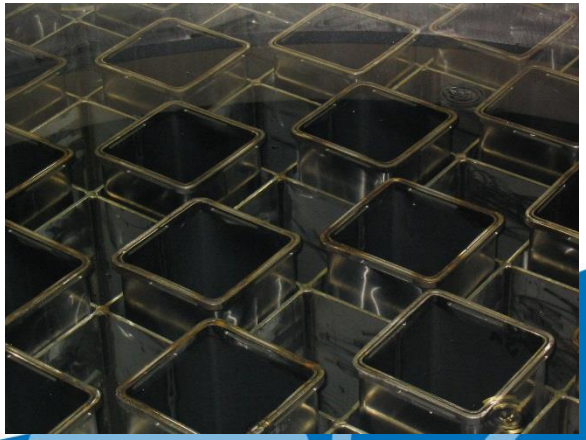
- One of the key attributes for placement of fuel into a canister is whether the fuel is damaged
- Damaged fuel assembly contains defects in the cladding greater than pinhole leaks or hairline cracks and/or cannot be handled by normal means
- Damaged fuel must be placed in damaged fuel can inside canister authorized for damaged fuel



Damaged Fuel Assemblies

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- Failure to place a damaged assembly in damaged fuel can or inside a canister authorized for damaged fuel will place the canister out of compliance and will result in:
  - Needing to remove damaged fuel assembly (may need to cut or remove lid)
  - Needing to request exemption from NRC to use the canister for storage-only use
  - Will result in needing to repackage spent fuel in another canister for transportation

Methods to Identify Damaged Fuel Assembly

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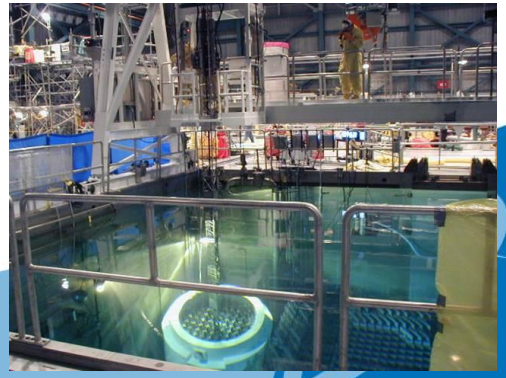
- Visual examination of all 4 sides of assembly
- Review reactor core operating chemistry for evidence of leaking assemblies
- In-mast sipping of the discharged fuel assemblies for evidence of leakage
- Vacuum sipping of older fuel assemblies
- Ultrasonic Testing (UT) of the fuel assembly for evidence of water in the pins



Canister Loading Issue #1

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- Contractor performed UT testing on older fuel and issued preliminary report indicating fuel assemblies were not damaged
- Secondary contractor review identified that 13 of the fuel assemblies were in fact damaged (contained water)
- Licensee had loaded 5 of the 13 assemblies into canisters not licensed for damaged fuel
- Exemption granted by NRC for storage-only use of the canister

Canister Loading Issue #2

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- License had examined older fuel assemblies using UT technique and loaded into dual-purpose canister
- During drying process using heated helium, Krypton-85 gas was exhausted from drying equipment indicating damaged fuel assembly
- Licensee continued to dry and then weld canister with damaged fuel assembly inside
- Exemption granted by NRC for storage-only use of the canister

Canister Loading Issue #3

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- Licensee performed spent fuel classification using another agency's definition of damaged fuel, which allowed much larger cladding defects
- Site-specific licensee issued that included NRC definition of damaged fuel
- Licensee incorrectly loaded 6 damaged fuel assemblies (based on fuel classification) into 5 canisters not authorized for damaged fuel storage
- License amendment granted by NRC for storage-only use of the canisters

Canister Loading Issue #4

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- Licensee was welding 6th canister during a loading campaign when the NRC inspector identified issue with non-destructive examination process
- Licensee found that all 6 canisters (1 in process and 5 located on the ISFSI pad) were inoperable
- Licensee requested exemption, NRC requested additional data to support justification
- Licensee performed volumetric examination (phased array) of closure welds and is reviewing data

Canister Issue #5

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- Cask Vendor removed requirement for helium leak test during canister fabrication process using 10 CFR 72.48 safety review
- NRC determined that vendor needed prior approval to remove helium leak test
- Over 100 canisters had been loaded with spent fuel before the issue was discovered by the NRC
- Each licensee had to provide data to NRC indicating canisters were not affected and cask vendor had to leak test canisters that had not been loaded

Conclusion

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- The dry cask industry continues to mature as evidenced by loading canisters with:
  - Higher heat loads/burn-up assemblies
  - Higher capacity
- However, the industry is not so advanced that errors cannot occur
- The industry must remain vigilante and exchange operating experience with fabrication and loading processes associated with dry fuel storage

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QUESTIONS ?