A Brief History of US Spent Nuclear Fuel Storage

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PLEASE NOTE

This presentation provides an overview of the history of spent fuel storage and its future.

It does not reflect the official Spent Nuclear Fuel policy or position of any federal or state agency.

Original Spent Fuel Management Model

- Nuclear Power Plants operate ~1 year between refueling
  - Most or all used (spent) fuel assemblies replaced by new assemblies for next reactor core
  - Spent Fuel temporarily stored in Spent Fuel Pools for ~5 years after use
- US Atomic Energy Commission (later Department of Energy) collects Spent Fuel
  - Reprocess (extract fissile U / Pu isotopes for) Spent Fuel & incorporate into new fuel assemblies
  - Dispose of remaining radioactive waste in a long-term repository

No significant progress occurred on this latter part.

The Original Spent Fuel Management Model

- Due to Nuclear Non-Proliferation concerns, the Carter Administration eliminates commercial spent nuclear fuel reprocessing
- Spent Nuclear Fuel storage is only legal option
- By 1982, the nuclear power industry directed to expand onsite spent fuel storage capabilities. It responds with:
  - Longer times between refueling (18 to 24 month fuel cycles)
  - Fuel assemblies used for 2 to 3 fuel cycles
  - Enhanced Spent Fuel Pool storage strategies
  - Subsequent dry cask storage options developed for older fuel

Nuclear Waste Policy Act of 1982 (NWPA)

- Originally set 10 potential national storage sites:
  - Hanford National Laboratory (Eastern Washington State)
  - 2 sites in Utah & 2 sites in northern Texas
  - Yucca Mountain (former nuclear weapons test site in Nevada)
  - Additional sites in Louisiana & Mississippi
- DOE would chose 3 "Finalist" sites by 1985
- The President to select repository site from 3 Finalists
- Subsequent Amendments to NWPA eliminates 9 of the original 10 potential sites (enacted December 1987)
- Current "As Amended" NWPA identifies Yucca Mountain as only possible national repository site

Recent Yucca Mountain History

- NWPA calls for a geological Spent Nuclear Fuel Disposal Facility at Yucca Mountain Site
  - Should have opened in January 1998
  - DOE files for NRC license to construct & operate Yucca Mountain Facility in June 2008
  - In March 2010 DOE requests License Application withdrawal (application deemed unworkable by Obama Administration)
  - NRC suspends YM Licensing activities in September 2011
  - August 2013 Court Order restarts NRC's YM Licensing Activities
    - Safety Evaluation Report (SER) issued in January 2015
    - Environmental Assessment issued in May 2016

Current Yucca Mountain Status

- Differences in FY 2018 DOE Budget Proposals
  - Trump Administration calls for Yucca Mountain Licensing restart and "robust" Consolidated Interim Storage (CIS) program
  - US House approves DOE & NRC Yucca Mountain Licensing Activities funding, but no CIS program funding
  - US Senate Energy & Water Appropriations Subcommittee approves pilot CIS program funds, but no Yucca Mountain funds
- The Continuing Resolution currently funding the US Government contains no budget for DOE or NRC Yucca Mountain Licensing Activities
- DOE currently awaiting resolution of budgetary impasse before proceeding on Spent Fuel Disposal options

Current Spent Fuel Storage Responsibilities

- NWPA makes nuclear power plant owners responsible for safely storing spent fuel onsite.
- DOE responsible for providing long-term geological spent fuel storage facility:
  - DOE takes ownership of spent fuel once it leaves a nuclear power plant site
  - DOE responsible for shipping spent fuel to a national repository

Current Spent Fuel Storage Responsibilities

- Because of the missed January 1998 deadline for a national spent fuel storage facility, nuclear plant owners pursue damages (through settlement or litigation) for continued spent fuel storage costs at US nuclear power plant sites.
  - Typically $8 to $10 million annual storage cost per site
  - ~90% cost recovery (legal fees not included)
  - ~$500 Million paid out annually
    (from US Treasury “Judgement Fund”)
  - The Nuclear Waste Fund established by NWPA is untouched by these settlements or litigations.

Current Spent Fuel Storage Options

Onsite Storage is presently only option in use

- Spent Fuel Pool storage (aka “wet” storage)
- Dry Cask Storage (systems approved by NRC)
  - Requires ~5 years of storage in Spent Fuel Pool first (shorter times possible with NRC approval)
  - Multiple manufacturers available
    - Holtec (stores fuel vertically)
    - NAC International (stores fuel vertically)
    - AREVA / NUHOMS (stores fuel horizontally)
  - Horizontal & Vertical Storage Options
  - Above Ground & Underground Storage Options

    (Underground option rejected at VY due to water table concerns)

Potential Spent Fuel Storage Options

- Complete Licensing of Yucca Mountain geological repository (then complete construction & open)
  - NRC anticipates 3 to 5 year effort, after licensing effort restarts, to resolve current licensing contentions
  - New licensing contentions possible (extending resolution efforts)
  - Estimated availability between 2028 to 2048 (no consensus)
- Identify a new geological repository site (suspended 2017)
- NWPA allows for Consolidated Interim Storage until a long-term geological spent fuel storage facility opens, as well as Monitored Retrievable Storage
  - Currently 2 potential CIS facilities being evaluated by NRC
  - No MRS facilities proposed
- Additional options possible only if fuel reprocessing allowed

What is Consolidated Interim Storage?

- Dry Cask Storage on a larger scale, but:
  - Relocates spent fuel from multiple nuclear power plant sites to a single, dedicated facility
  - Accepts fuel contained in several different Storage System designs
  - Includes onsite Multi-Purpose Canisters handling facility
  - Multi-Purpose Canisters holding spent fuel are not reopened
  - Priority given to fuel from shut down / decommissioned sites
  - Storage at otherwise fully decommissioned former power plant sites could decommission
  - Potentially available as early as 2025
- Two Proposed CIS facilities currently before the NRC:
  - Waste Control Specialists (WCS) / Andrews County, TX
  - Holtec – Eddy/Lea Alliance / Eddy & Lea Counties, NM

Waste Control Specialist (WCS) Proposal

- Facility would be in Andrews County, TX
  (adjacent to Low Level Waste facilities)
- Above ground storage proposed
  - AREVA / NUHOMS (horizontal) & NAC International (vertical) fuel canisters to be accepted in Phase 1 (no Holtec systems at present)
  - Facility would open in 8 phases
    (i.e. 8 large storage pads, ~320 acres out of over 14,000 available)
  - 5000 Metric Tons of Heavy Metal (Uranium) per phase (40,000 MTU)
  - Phase 1 availability scheduled for 2025
  - Proposal has completed NRC Acceptance Review
  - NRC detailed technical review began, but suspended at WCS request due to WCS's financial conditions

Holtec – Eddy/Lea Proposal

- Facility would straddle Eddy & Lea County line, NM (between Carlsbad, NM and TX state line)
- Below ground storage proposed
  - Uses existing Holtec HI-STORM UMAX storage system
  - Multiple construction phases of 10x10 UMAX Dry Cask Arrays
  - 4000 HI-STORM UMAX Casks proposed in total (on ~1000 acre site) (75,000 MTU to be stored in total)
  - Phase 1 construction calls for two 10x10 Arrays, available by 2025
  - Priority given to HI-STORM stored fuel at shutdown sites
  - Selected AREVA / NUHOMS & NAC International fuel canister designs to be accepted in later phases
  - Proposal still undergoing NRC Acceptance Review
  - NRC has requested additional information to complete Acceptance Review