

Vermont Yankee  
Decommissioning Citizen Advisory Panel  
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# Nuclear Spent Fuel Dry Cask Storage



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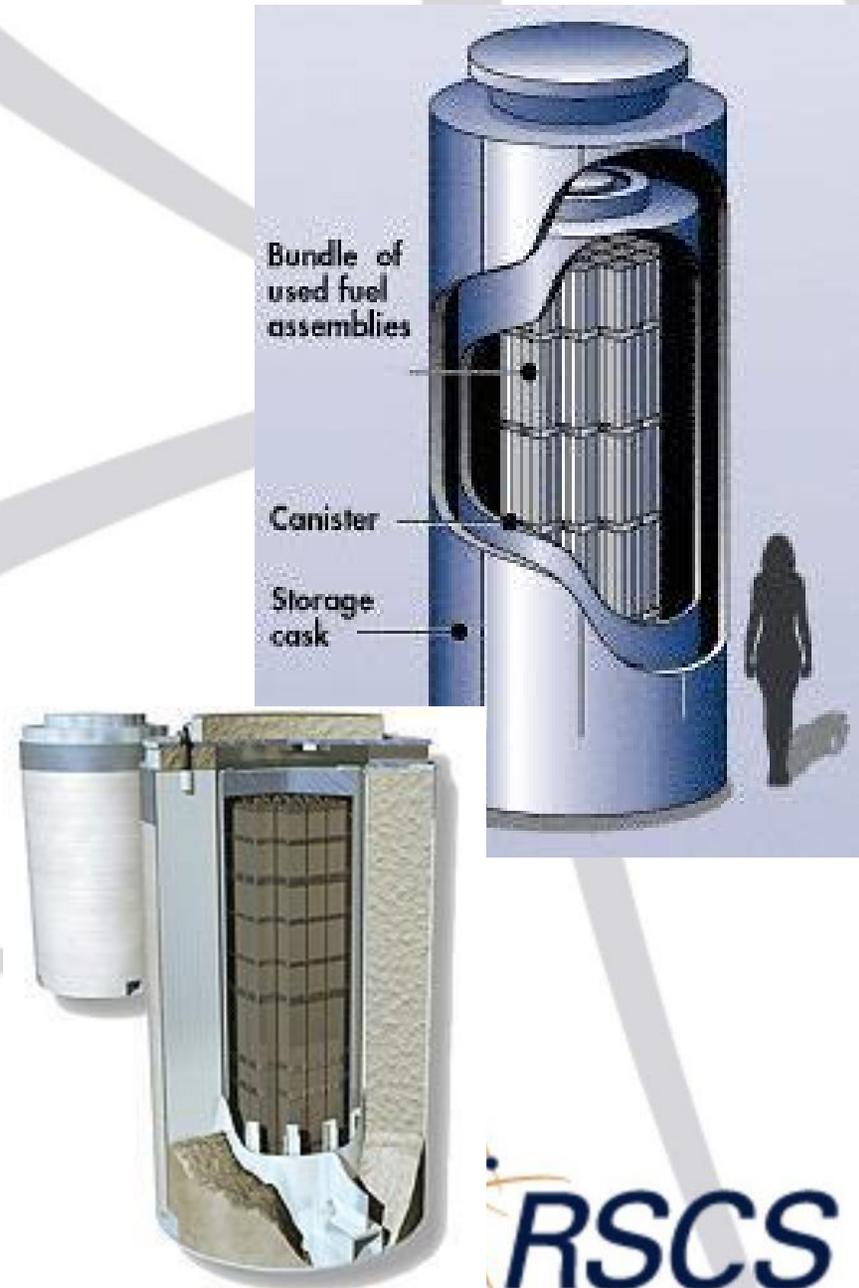
# Dry Cask Storage Terminology and Purpose

- ISFSI: Independent Spent Fuel Storage Facility
- Designed for Intermediate Storage of Spent Nuclear Fuel



# General Design Characteristics

- Thick metal or steel-reinforced concrete outer shells and a sealed inner metal cylinder.
- Fuel passively cooled through bottom and top vents. A typical cask radiates similar heat as a home-heating system.
- Designed to resist floods, earthquakes, tornadoes, projectiles and temperature extremes.



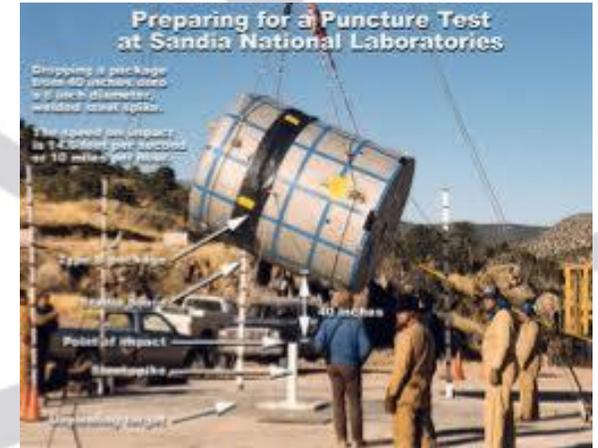
# Design Considerations

- Tip-Over Impact
- Thermal Stress
- Criticality Analysis
- Security
- Radiation Shielding  
(neutron and gamma)



# Accident Testing at Sandia National Lab

- Tractor-trailer carrying a container ran into a 700-ton concrete wall at 80 miles per hour
- Broad sided a container by a 120-ton train locomotive traveling 80 miles per hour
- Container dropped 2,000 feet onto soil as hard as concrete, traveling 235 miles an hour at impact.
- Post-crash assessments demonstrated that the containers would not have released their contents.



# Spent Fuel Dry Storage Licensing

- Licensed under both specific and general NRC licenses
  - 59 systems with general licenses
  - 15 systems with specific licenses
  - 6 sites pursuing a general license
- Systems are licensed for 20 years with possible renewals up to 40 additional years
  - Required reviews and inspections
- NRC currently developing an extended storage program to support long term storage up to 300 years

# NRC Required Licensing Tests

- A 30-foot free fall onto an unyielding surface
- A 40-inch fall onto a 6 in. dia. steel rod
- A 30-minute engulfing fire at 1,475 °F
- Submerged to 3 ft of water for 8 hrs
  - Also, by a separate test, containers are submerged under 50 feet of water for eight hours.



# Multiple Currently Approved Designs

**BNG Fuel Solutions Corp.**  
**2 Storage Designs**

**Holtec International**  
**3 Designs**

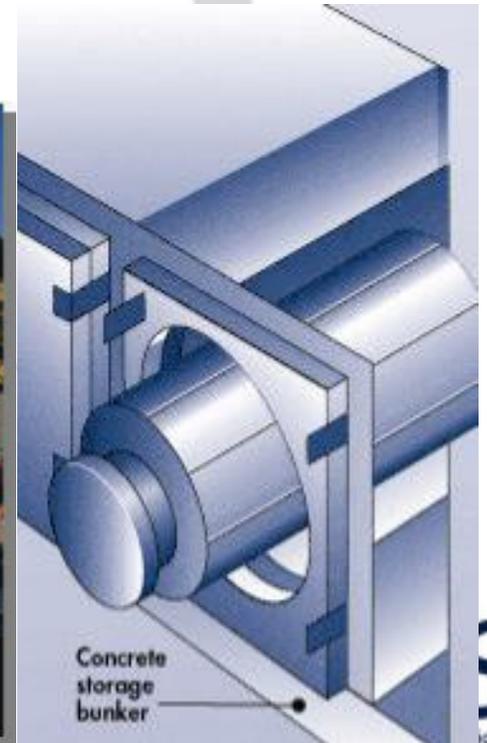
**Transnuclear, Inc.**  
**5 Storage Designs**

**NAC International, Inc.**  
**3 Storage Designs**

- Each design has Certificate of Compliance (CoC) Approved by NRC
- Some designs have multiple models approved under the CoC

# Various Storage Configurations

- Upright on Pad
  - Most common
- Horizontal in Building
- Upright Underground

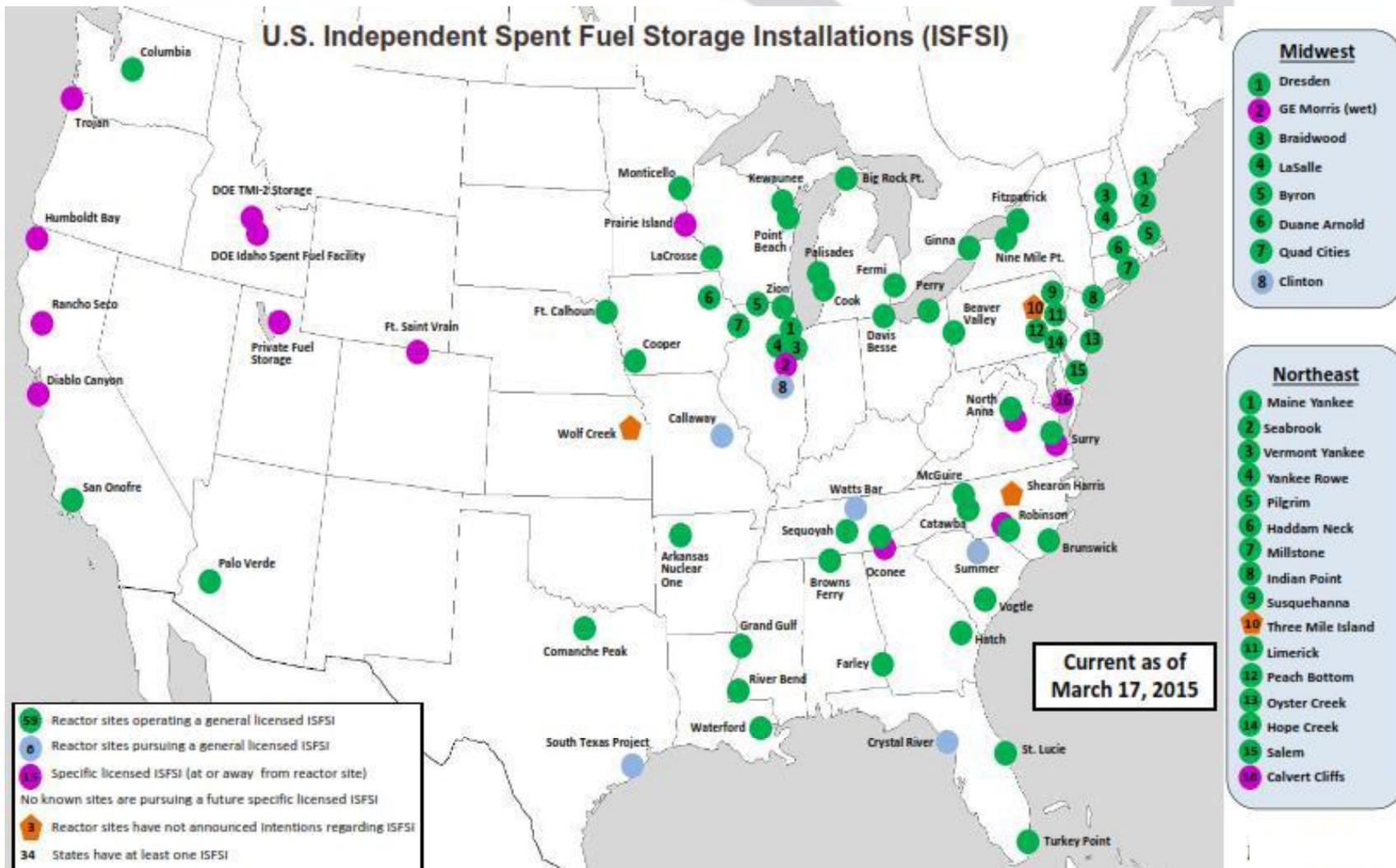


# Dry Cask Storage History

- First dry cask system licensed in 1986 at the Surry Nuclear Power Plant in Virginia
- No known or suspected attempts at sabotage
- No releases of radiation
- Tests have confirmed systems are providing safe and secure storage



# Dry Cask Storage in US



# Dry Cask System Selection Considerations

- Wet Fuel Storage and loading configuration
- Fuel Handling and Movement
- Cask Design and Storage
- Cask Movement
- ISFSI Design and Protection



# Pool to Pad Process

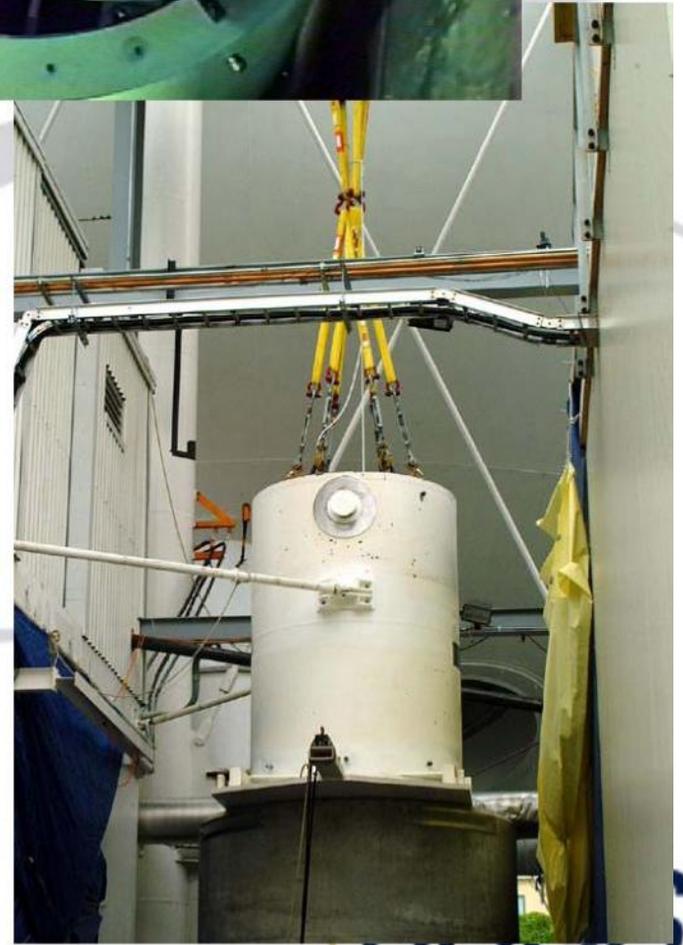
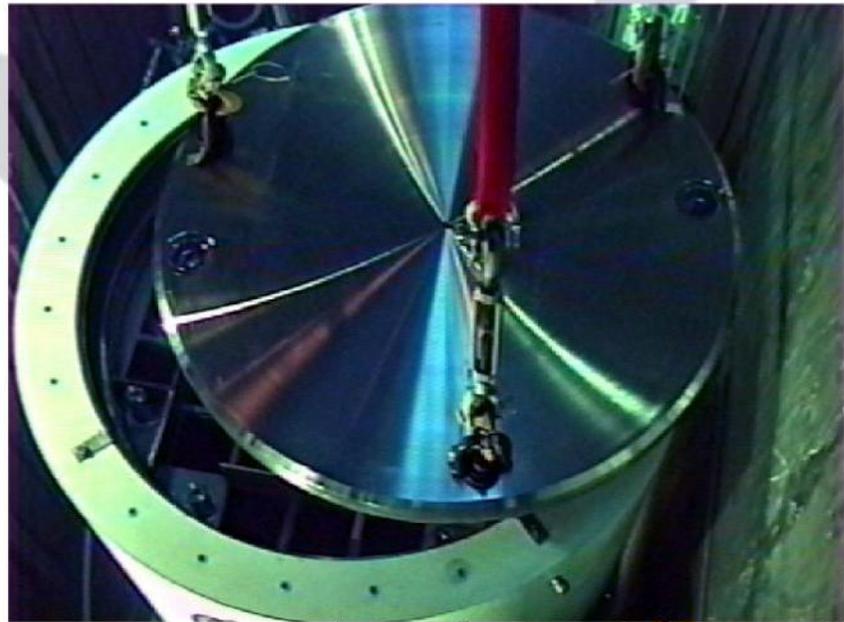
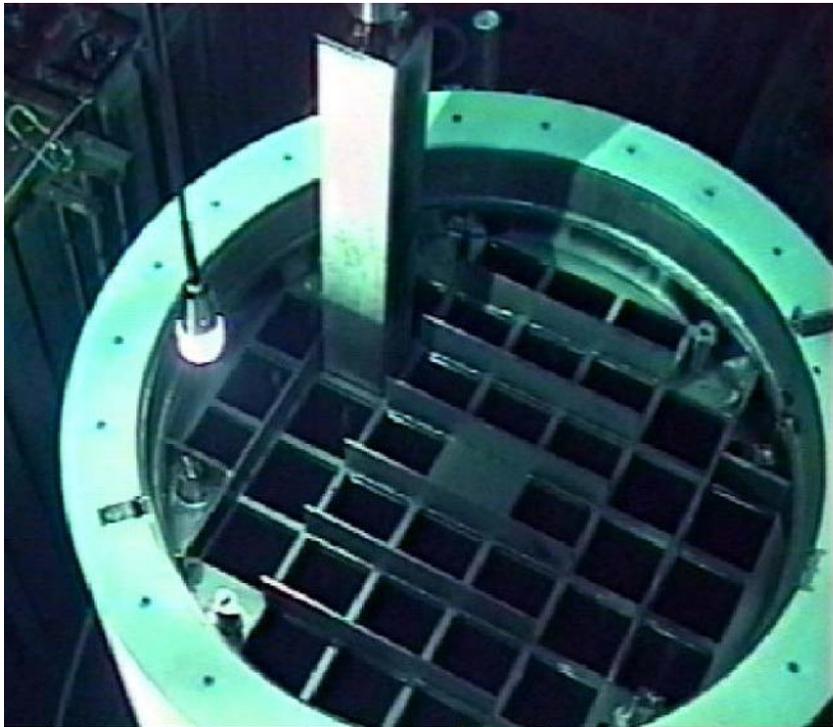
- After Placement in Inner Container, Fuel is Vacuumed-Dried
- Helium Used as Fill Gas. No air, no water, no hydrogen.
- Container is Welded with Robotics and Inspected
- Placed into Outer Casks
- Moved to “Pad”



Inner Container

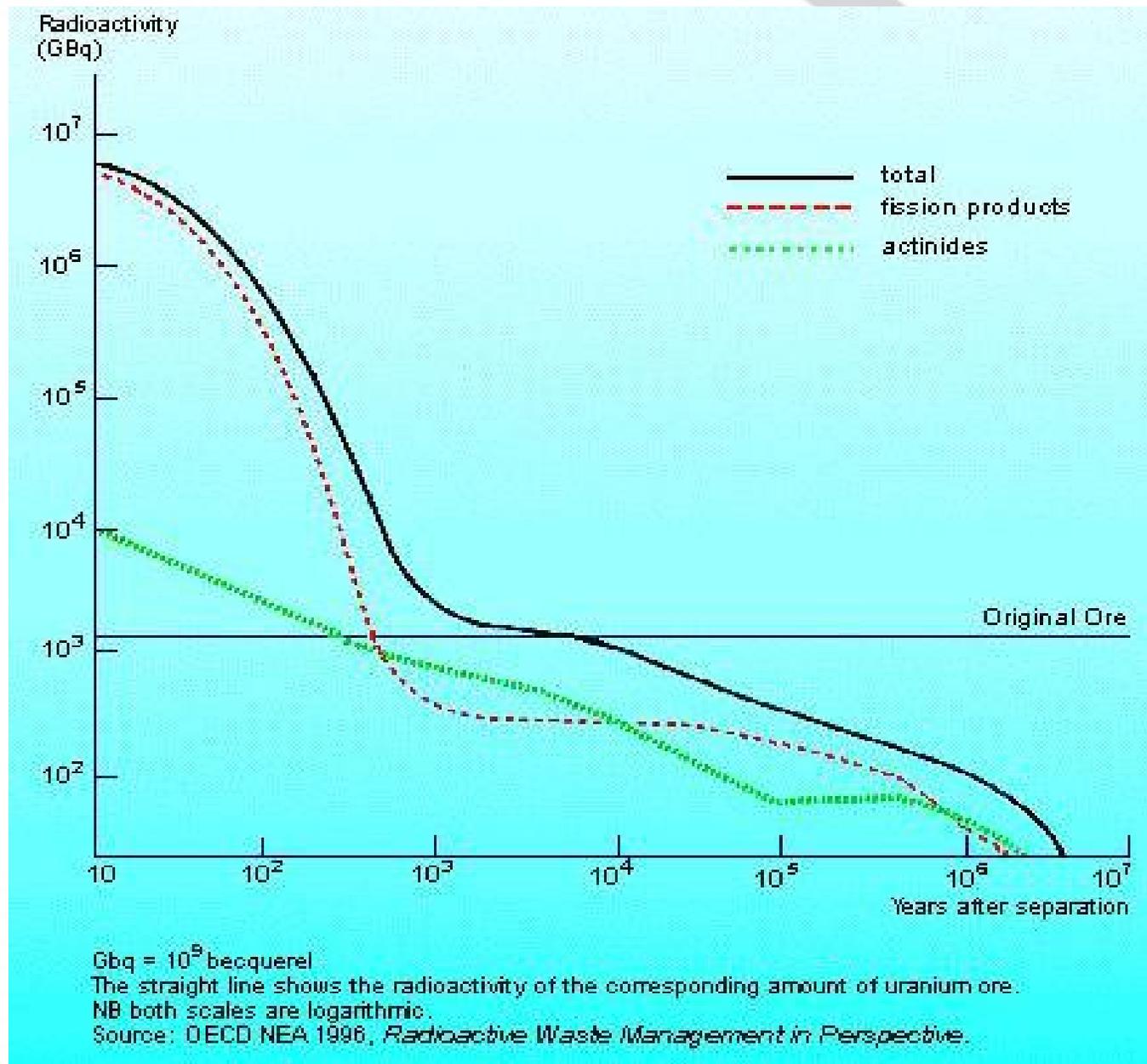


Robotic Welding Following Fuel Load





# Fuel Radioactivity Over Time



# Security

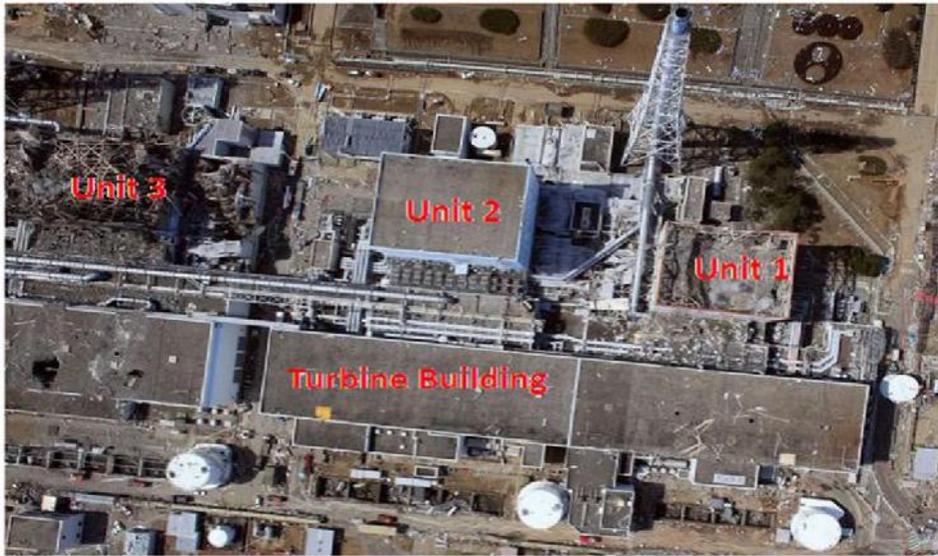
- Dry Cask Storage is less complex and passive compared to Spent Fuel Pools
  - No liquids or cooling systems to maintain
- Dry Cask Storage Facilities are subject to similar security requirements as operating nuclear plants
- NRC continues to evaluate the security of nuclear facilities, including ISFSIs, in light of current security threats

# Hostile Action Studies

- Sandia subjected a steel and concrete cask (similar to Holtec's Hi-Storm) to a device 30 times more powerful than a typical anti-tank weapon. **No Release**
- Another study involved the effects of a large commercial jet at 350 mph, impacting dry cask storage containers. **No Release**
- Other analyses evaluated hypothetical F-16 strikes on Holtec casks. **NRC: "No credible hazard to public health and safety". Holtec: 'Confinement Maintained'**



# Fukushima Daiichi



# Fukushima Daiichi

- 408 fuel assemblies in Dry Cask Storage within a building
- Casks were not compromised or damaged from the 9.0 earthquake and tsunami.
- Storage Building was damaged.



# Questions?

