

# Radioactive Waste Presentation



# Radioactive Waste: Definitions

- High-level radioactive waste - spent reactor fuel or wastes from reprocessed spent fuel.
- Low-level radioactive waste - waste that is not high-level waste or waste that contains transuranics (U, Pu) or uranium or thorium mill tailings.

# Low-Level Waste Classification (10 CFR 61.55)

There are three classes of LLW based on the type and concentration of the radionuclides present in the waste:

- Class A – most low level waste is in this category. The concentration of radionuclides is the lowest and it is comprised mostly of radionuclides with short half-lives;
- Class B – has concentrations that are greater than Class A but less than Class C,
- Class C – has the highest concentration permitted for disposal in a LLRW disposal site. Class C waste has to be enclosed in an intruder barrier system to protect against any inadvertent intruder for at least 500 years.

# Low Level Radioactive Waste

- **Liquid wastes from fission and activation products in reactor coolant or spent fuel pools**
- **Solid wastes, known as “dry active waste” or DAW from material that became contaminated in the facility, and**
- **Gaseous wastes from fission products**



# Liquid Radwaste Treatment

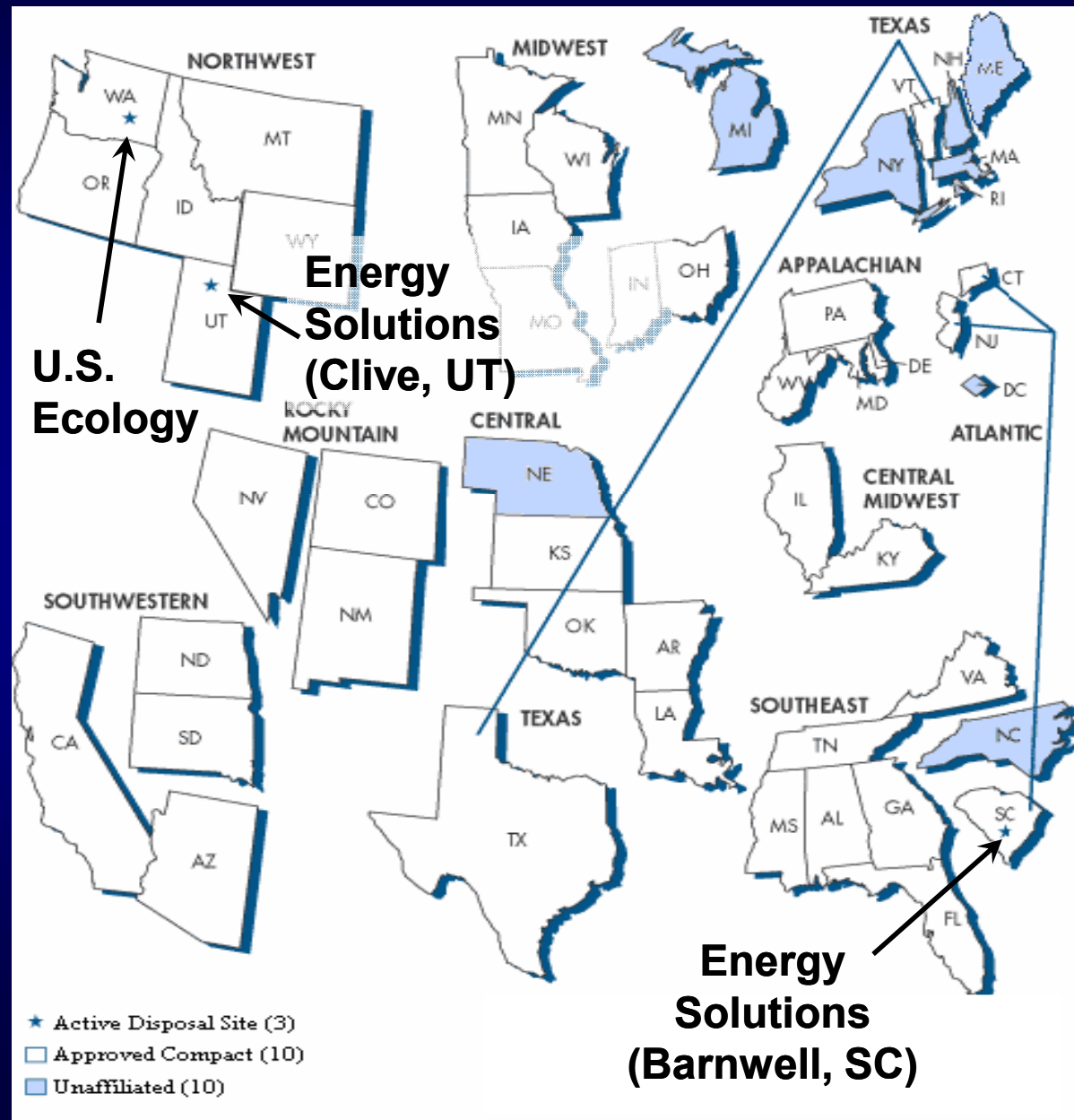
- Wastes containing liquids are dewatered before shipment to a disposal site. Resins used for removing radionuclides in reactor coolant are dewatered in containers called “high integrity containers,” or HICs.
- HICs are placed in transport containers for shipment to a disposal site. At the site they are removed from the shipping container and placed in a concrete vault for burial.
- Dose rates may be up to 5,000 rad/hr.



# Low Level Radwaste Disposal



# State Compacts



- In 1980, Congress passed the LLRW Policy Act, which established the compact system to encourage states to collaborate in building disposal facilities for LLRW
- Currently, only three disposal facilities are in operation

# Waste Disposal - 2008

Disposal Site	Volume Received (ft <sup>3</sup> )	Activity Received (Ci)
Energy Solutions (Clive, UT)	2,040,296	4,694
Energy Solutions (Barnwell, SC)	22,278	762,018
US Ecology (Richland, WA)	22,792	16,452
<b>TOTAL</b>	<b>2,085,366</b>	<b>783,164</b>

**\* Clive - 98% of the total waste volume**

**\* Barnwell - 97% of the total activity**

# Entombment of Waste



**Dewatered resin containers are being lowered by crane into concrete entombments which provide the stability required for Class B and Class C low-level waste.**

# Waste Burial



**A plastic liner is placed over the disposal site to preclude water intrusion.**

# Low Level Waste: Current Events



- **Energy Solutions proposal to import low-level radioactive waste from Italy. Waste would be processed in Tennessee and disposed of in Utah. Waste that does not qualify for disposal would be returned to Italy.**
- **Barnwell facility closed to all but members of the Atlantic Compact in 2008. This means there are no disposal sites open to receive Class B and C waste from nationwide generators.**
- **Waste Control Specialists in TX received a license in late 2009 to begin construction of a disposal facility that will receive Class A, B, and C wastes from nationwide generators.**

# High Level Waste

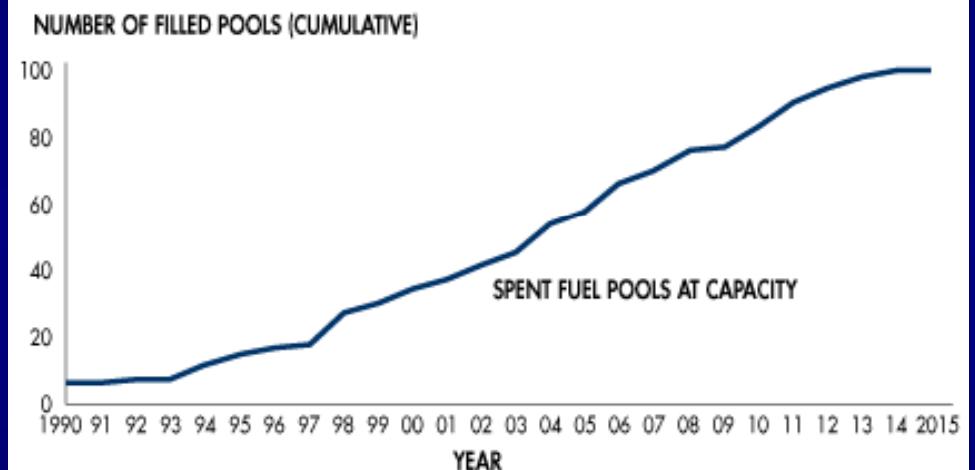
- **Waste that is greater than class “C” (GTCC) may not be disposed at low-level radioactive waste disposal sites.**
- **Spent reactor fuel is high level waste.**
- **Spent fuel is currently stored in spent fuel pools and in on-site storage facilities.**



# The Full Pool Problem

- One third to one fourth of the fuel in a commercial power reactor is replaced every 12-18 months with new fuel.
- This spent fuel that is removed from the reactor core is placed in underwater storage pools.

Figure 42. Nuclear Fuel Storage Pool Capacity

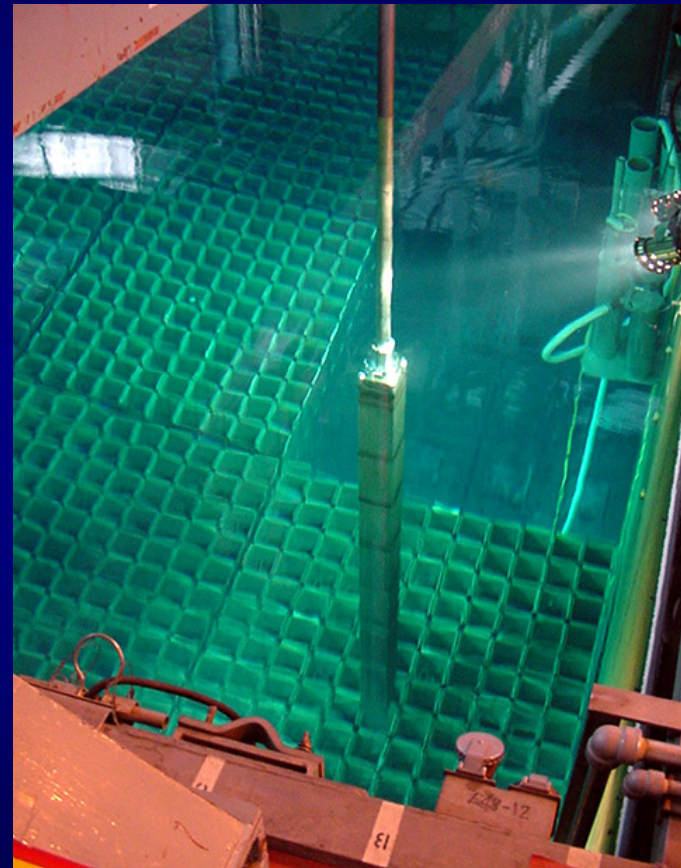


Note: All operating nuclear power reactors are storing used fuel under NRC license in spent fuel pools. Some operating nuclear reactors are using dry cask storage. Information is based on loss of full-core reserve in the spent fuel pools.

Source: Energy Resources International and DOE/RW-0431 – Revision 1

# High Level Radwaste

- Disposal of high level waste like spent fuel must be conducted in a geologic repository as specified in 10 CFR Part 60
- Yucca Mountain is discussed in 10 CFR Part 63, “Disposal of High-Level Radioactive Waste At Yucca Mountain, Nevada”



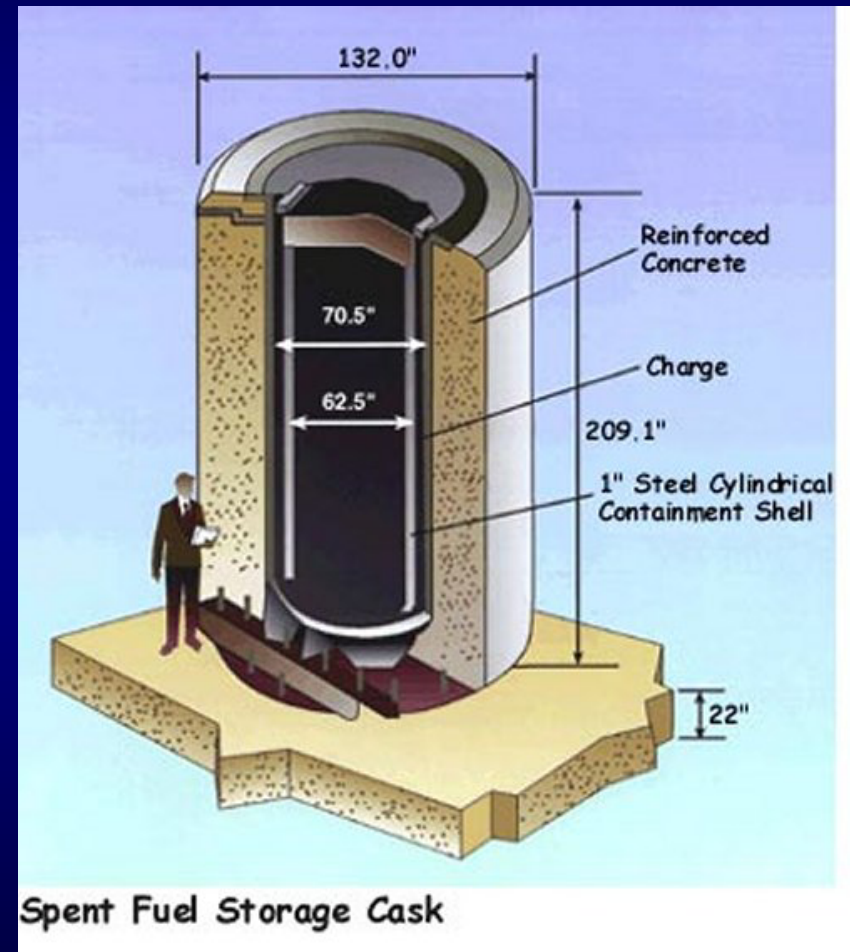
## HOWEVER ...

# Yucca Mountain No More ?

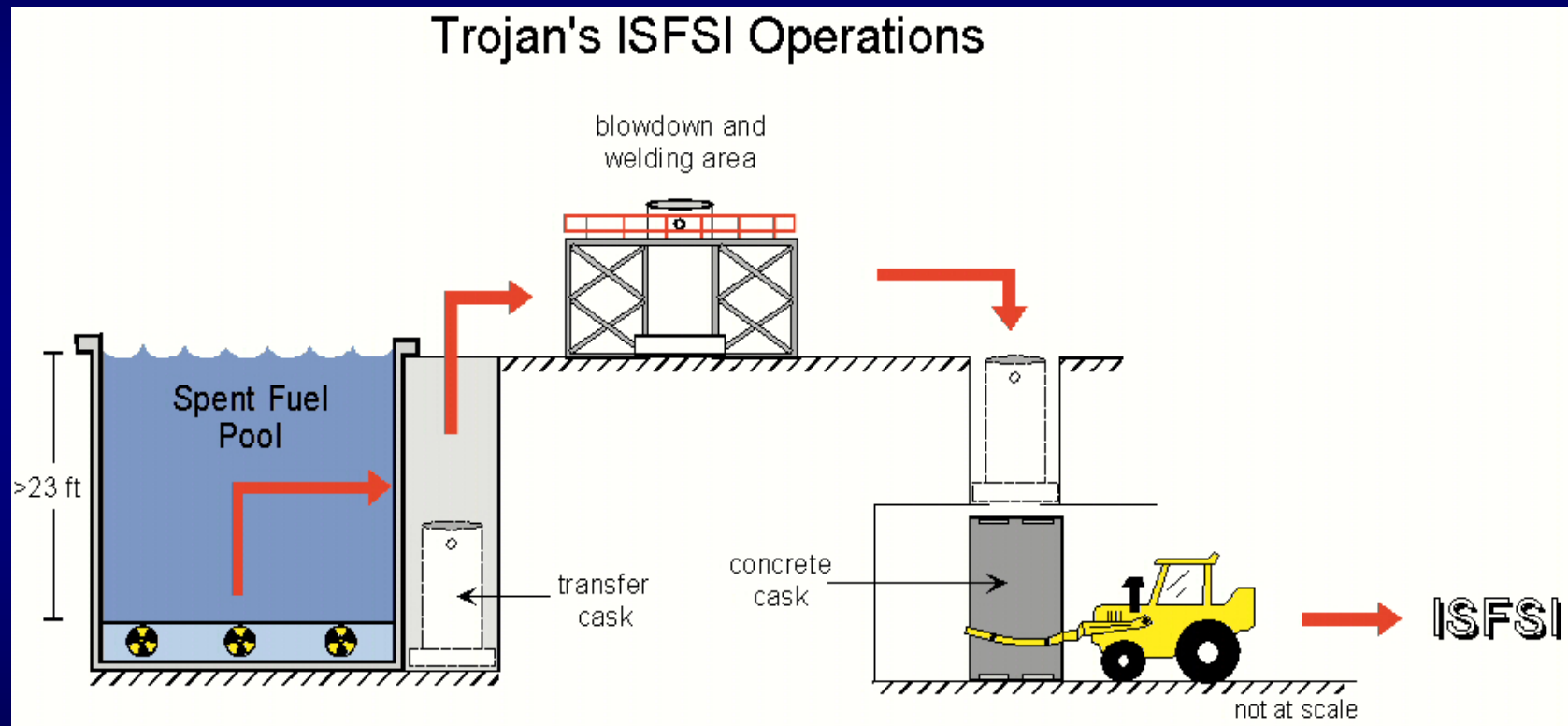
- **DOE submitted a petition to the NRC on March 3, 2010 to withdraw its license application for Yucca. DOE filed its petition "with prejudice," which would prevent it from being refiled.**
- **NRC's Atomic Safety and Licensing Board has not officially granted DOE's motion to withdraw the license application.**
- **Energy Secretary Steven Chu has announced the formation of a Blue Ribbon Commission on America's Nuclear Future that will provide recommendations on managing used fuel and nuclear waste.**

# The ISFSI Initiative

- To provide space in spent fuel pools for fuel being removed during outages, “older” spent fuel is taken out of the pool and placed in an Independent Spent Fuel Storage Installation, or ISFSI.
- The storage casks must meet rigorous testing and design requirements.



# Spent Fuel Pool Transfer





# Storage Cask Loading

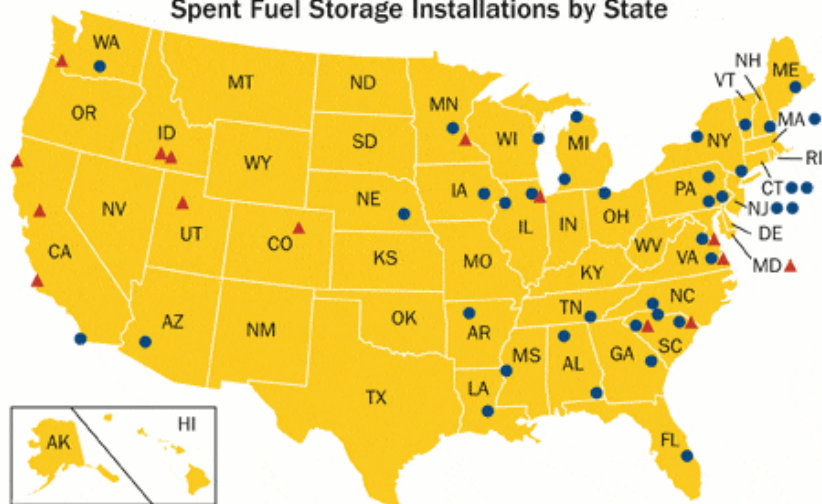


# Storage Configurations



# ISFSI Site Status: June 2009

Figure 44. Licensed/Operating Independent Spent Fuel Storage Installations by State



33 States have at least one ISFSI

- ▲ Site-Specific License (15)
- General License (39)

## ALABAMA

- Browns Ferry
- Farley

## ARIZONA

- Palo Verde

## ARKANSAS

- Arkansas Nuclear

## CALIFORNIA

- ▲ Diablo Canyon
- ▲ Rancho Seco
- San Onofre
- ▲ Humboldt Bay

## COLORADO

- ▲ Fort St. Vrain

## CONNECTICUT

- Haddam Neck
- Millstone

## FLORIDA

- St. Lucie

## GEORGIA

- Hatch

## IDAHO

- ▲ DOE: TMI-2 (Fuel Debris)
- ▲ Idaho Spent Fuel Facility

## ILLINOIS

- ▲ GE Morris (Wet)
- Dresden
- Quad Cities

## IOWA

- Duane Arnold

## LOUISIANA

- River Bend

## MAINE

- Maine Yankee

## MARYLAND

- ▲ Calvert Cliffs

## MASSACHUSETTS

- Yankee Rowe

## MICHIGAN

- Big Rock Point
- Palisades

## MINNESOTA

- Monticello
- ▲ Prairie Island

## MISSISSIPPI

- Grand Gulf

## NEBRASKA

- Ft. Calhoun

## NEW HAMPSHIRE

- Seabrook

## NEW JERSEY

- Hope Creek/Salem
- Oyster Creek

## NEW YORK

- Indian Point
- FitzPatrick

## NORTH CAROLINA

- McGuire

## OHIO

- Davis-Besse

## OREGON

- ▲ Trojan

## PENNSYLVANIA

- Limerick
- Susquehanna
- Peach Bottom

## SOUTH CAROLINA

- ▲ Oconee
- ▲ Robinson
- Catawba

## TENNESSEE

- Sequoyah

## UTAH

- ▲ Private Fuel Storage

## VERMONT

- Vermont Yankee

## VIRGINIA

- ▲ Surry
- ▲ North Anna

## WASHINGTON

- Columbia

## WISCONSIN

- Point Beach

Note: Data are current as of June 2009

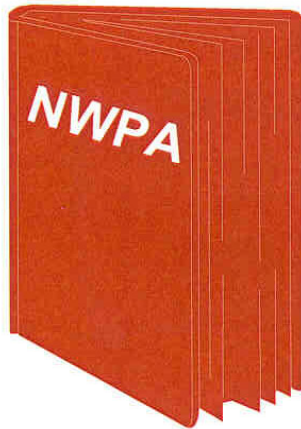
NRC-abbreviated unit names used

Source: U.S. Nuclear Regulatory Commission



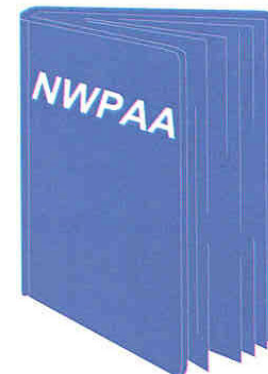
# Yucca Mountain: NWPA

1982



- 1982 - Congress established the Nuclear Waste Policy Act (NWPA) for the disposition of high-level radioactive waste and commercial spent nuclear fuel

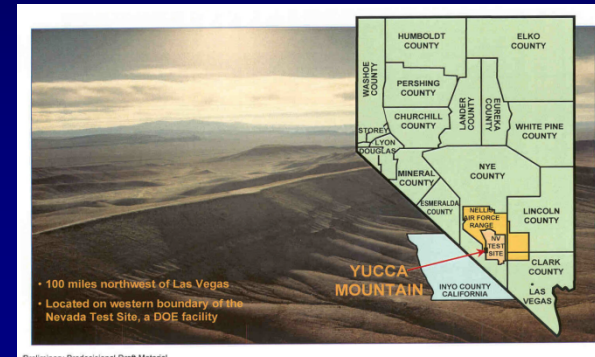
- 1987 - NWPA as amended eliminated all sites but Yucca Mountain to be characterized for a potential repository



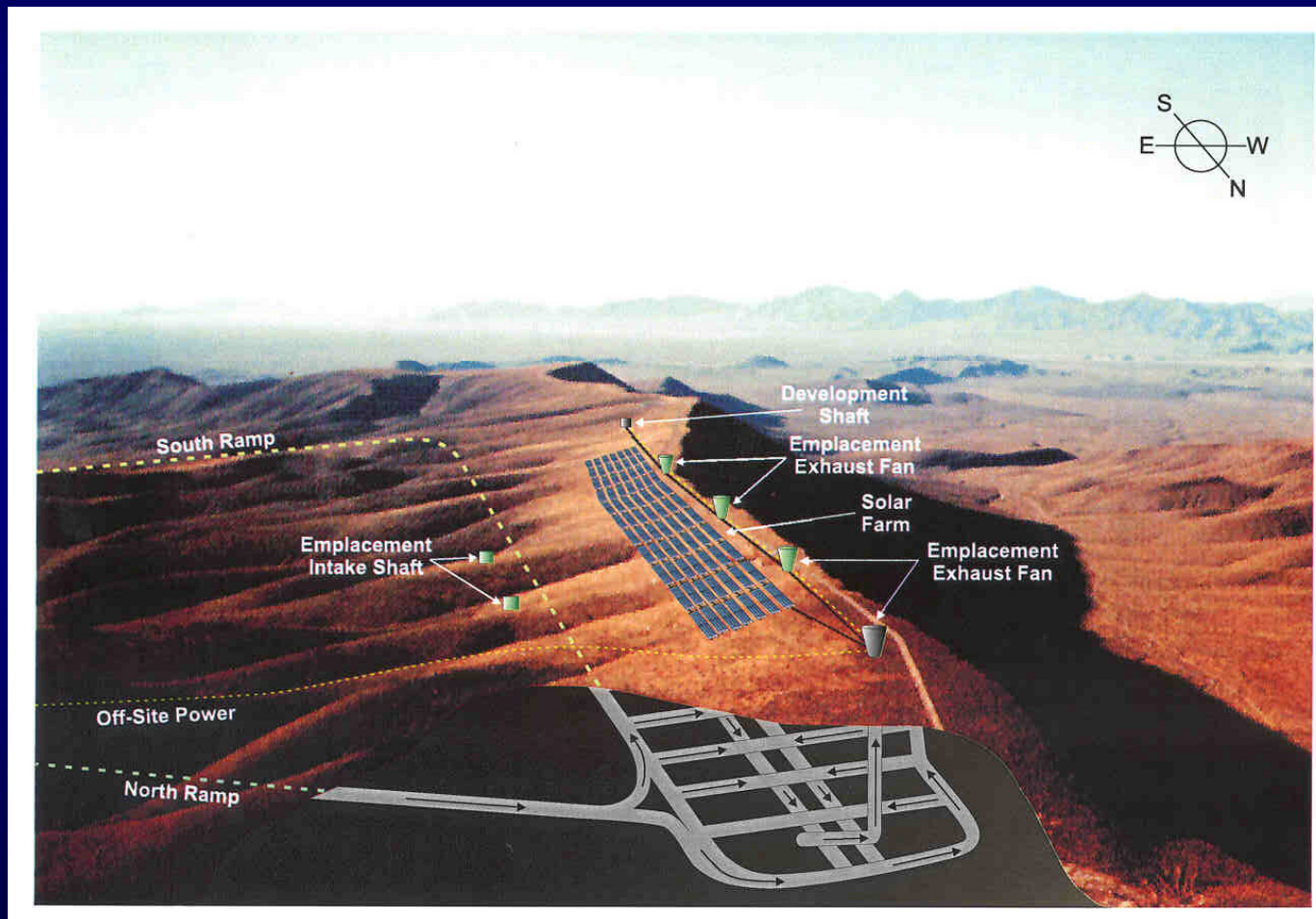
1987

# Yucca Mountain

- 90 miles northwest of Las Vegas and adjacent to the Nevada Test Site.
- Larger than the state of Rhode Island, the Nevada Test Site is approximately 1,375 square miles, making it one of the largest restricted areas in the US.
- The site is surrounded by thousands of acres of protected land used as a wildlife range and for military purposes, creating an unpopulated area of some 5,470 square miles.

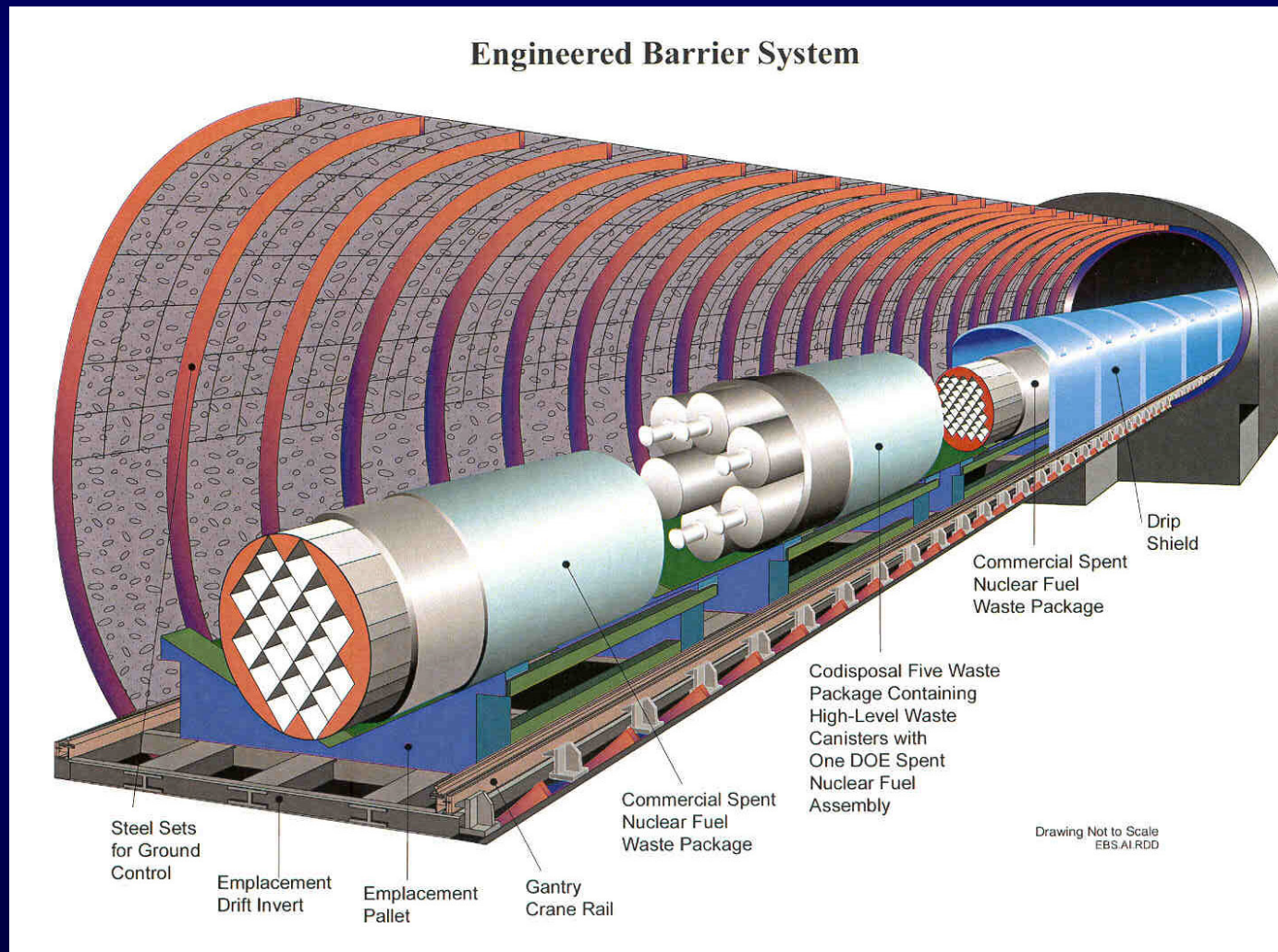


# Yucca Engineering Concept

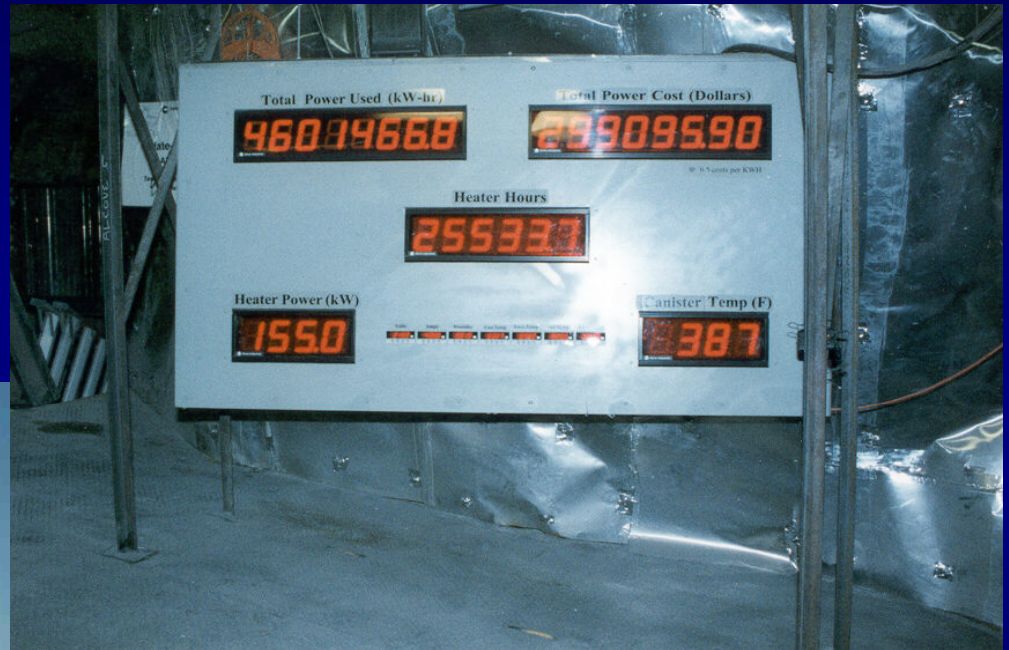




# Engineered Barriers



# Yucca Mountain



# Yucca Mountain Issues

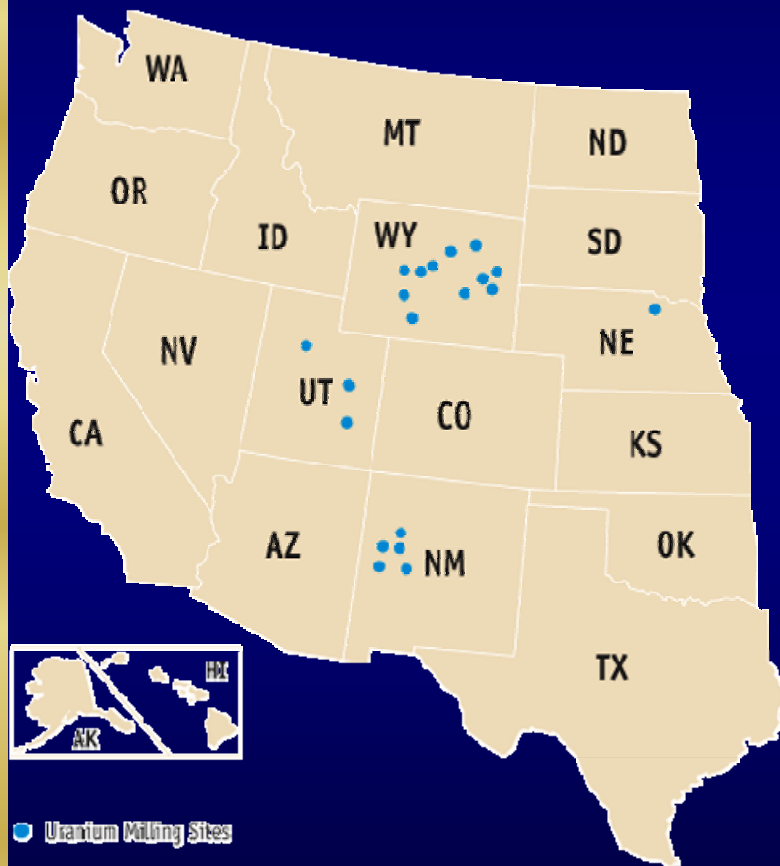
- **Nuclear Waste Fund 2007 has \$20.7 billion balance funded by tax paid by ratepayers. About \$750M is added each year. About \$11B has been spent.**
- **Licensee's have been compelled to develop ISFSIs with a concomitant cost – should temporary storage be established? If so, where?**
- **The U.S. District Court of Appeals (District of Columbia Circuit) ruling (No. 01-1258), decided on 7/9/04 that EPA must use a compliance time period that is “based upon and consistent with” the proposal of the National Academy of Science which corresponds to the greatest risk of radiation exposure rather than the 10,000 year period used by EPA.**



# THE END



# Uranium Mill Facilities



## Uranium Milling Facilities

### In Situ Leach Facilities

- Cogema Mining, Inc. Irigaray/Christensen Ranch, WY
- Power Resources, Inc. Smith Ranch-Highlands, WY
- Crow Butte Resources, Inc. Crow Butte, NE
- Hydro Resources, Inc. Crown Point, NM

### Conventional Uranium Milling Facilities\*

- Umetco Minerals Corp. Gas Hills, WY
- Western Nuclear, Inc. Split Rock, WY
- Pathfinder Mines Corp. Lucky Mc, WY
- American Nuclear Corp. ANC, WY
- Pathfinder Mines Corp. Shirley Basin, WY
- Exxon Mobil Corp. Highlands, WY
- Bear Creek Uranium Co. Bear Creek, WY
- Kennecott Uranium Co. Sweetwater, WY
- Homestake Mining Co. Homestake, NM
- Rio Algom Mining LLC Ambrosia Lake, NM
- United Nuclear Corp. Churchrock, NM

**\*All but the Kennecott Uranium Company, Sweetwater, WY mill are in decommissioning.**