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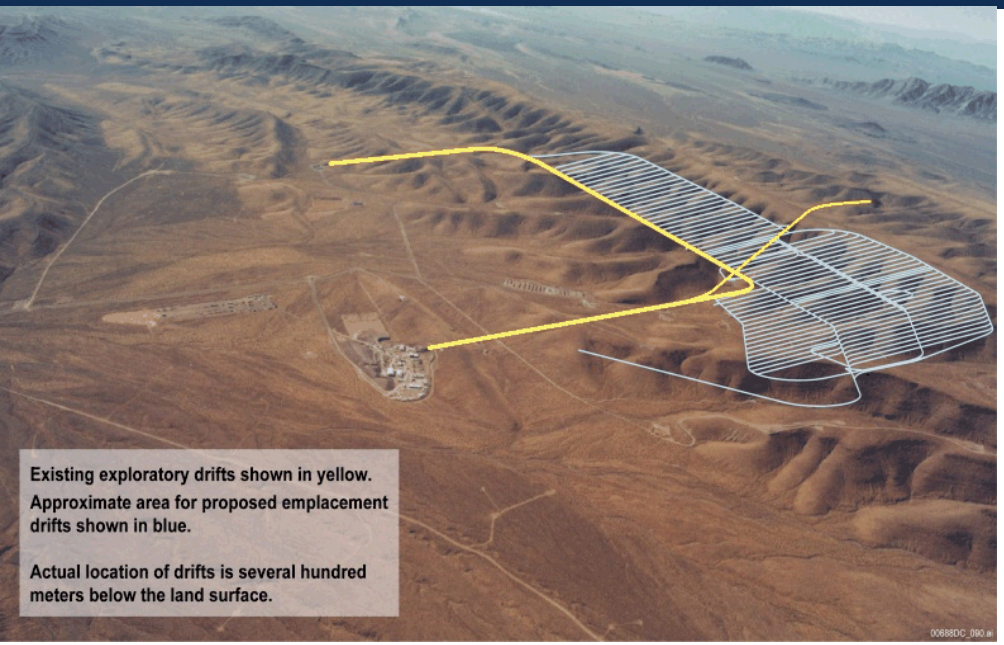

Background on Yucca Mountain and Solutions for Management of Spent Nuclear Fuel and High-Level Waste

Peter Swift
Senior Scientist, Sandia National Laboratories
April 18, 2017

NLDC Working Group:

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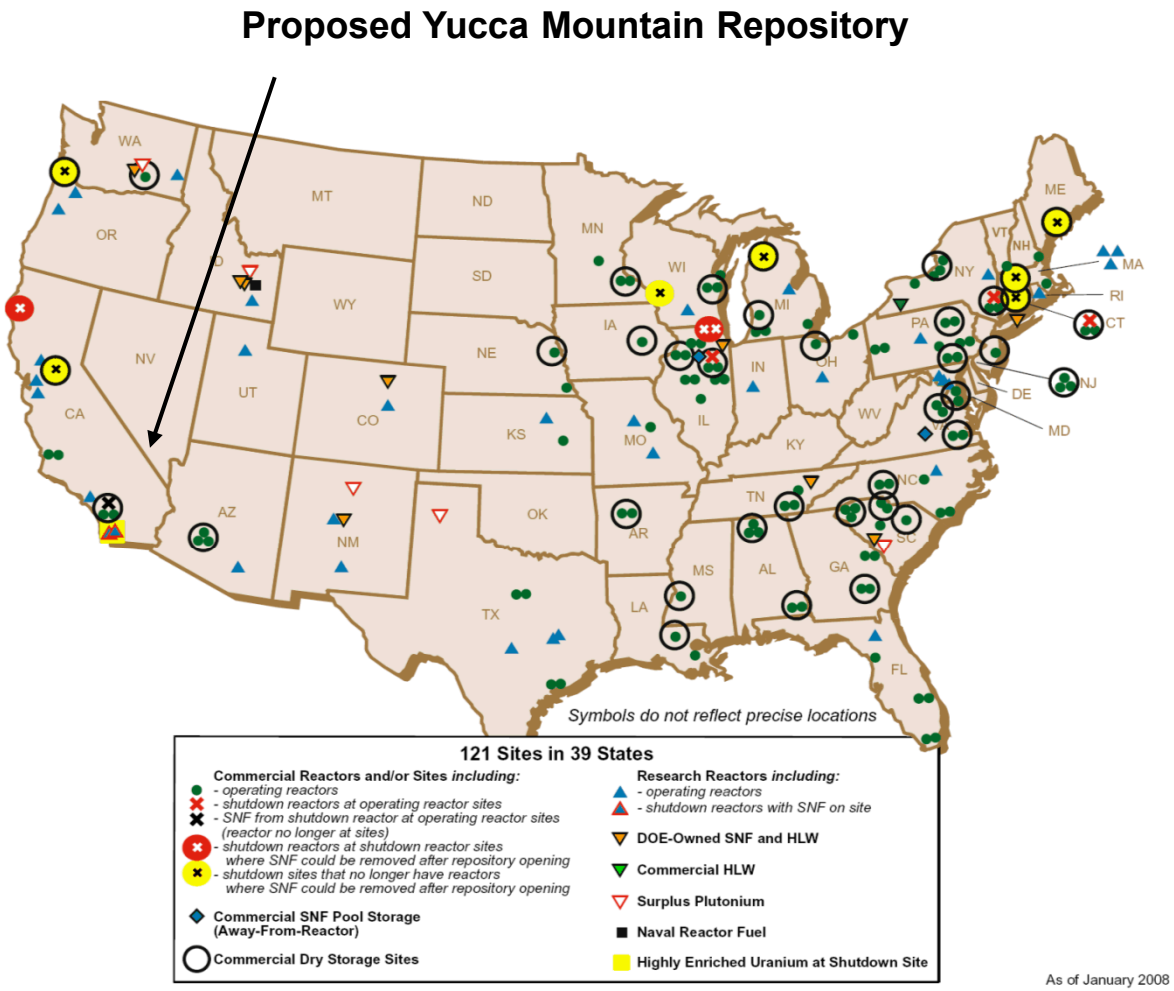
U.S. DEPARTMENT OF ENERGY

Summary and Outline

- Overview of Yucca Mountain design and purpose
  - Yucca Mountain license application included about half of the total amount of spent nuclear fuel and defense high-level waste projected by mid-century
  - Yucca Mountain is technically suitable
- What would it take to restart Yucca Mountain licensing?
  - Joint effort by DOE, M&O, legal team, and the national lab team
  - Also requires action by the Nuclear Regulatory Commission
- Making significant progress on Spent Nuclear Fuel disposal requires effective integration across transportation, storage and disposal.

The Yucca Mountain Mission



Office of Civilian Radioactive Waste Management (OCRWM) Mission:

To manage and dispose of high-level radioactive waste and spent nuclear fuel in a manner that protects health, safety, and the environment; enhances national and energy security; and merits public confidence.

Waste for Yucca Mountain

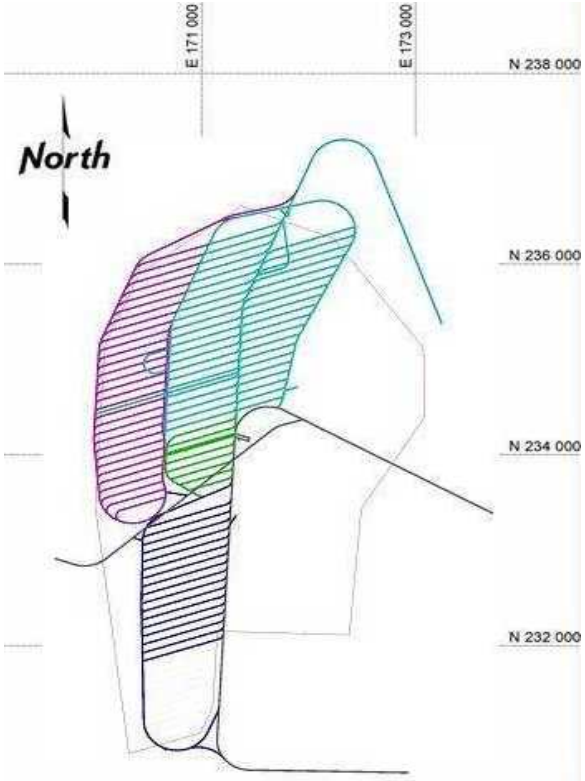
Commercial Spent Nuclear Fuel:
63,000 MTHM (~7500 waste packages)

DOE & Naval Spent Nuclear Fuel:
2,333 MTHM
(~400 naval waste packages)
(DSNF packaged with HLW)

DOE & Commercial High-Level Waste:
4,667 MTHM
(~3000 waste packages of co-disposed DSNF and HLW)

DSNF: Defense Spent Nuclear Fuel
HLW: High Level Radioactive Waste
MTHM: Metric Tons Heavy Metal

Yucca Mountain Subsurface Design



Emplacement drifts

5.5 m diameter

approx. 100 drifts, 600-800 m long

Waste packages

~11,000 packages

~ 5 m long, 2 m diameter

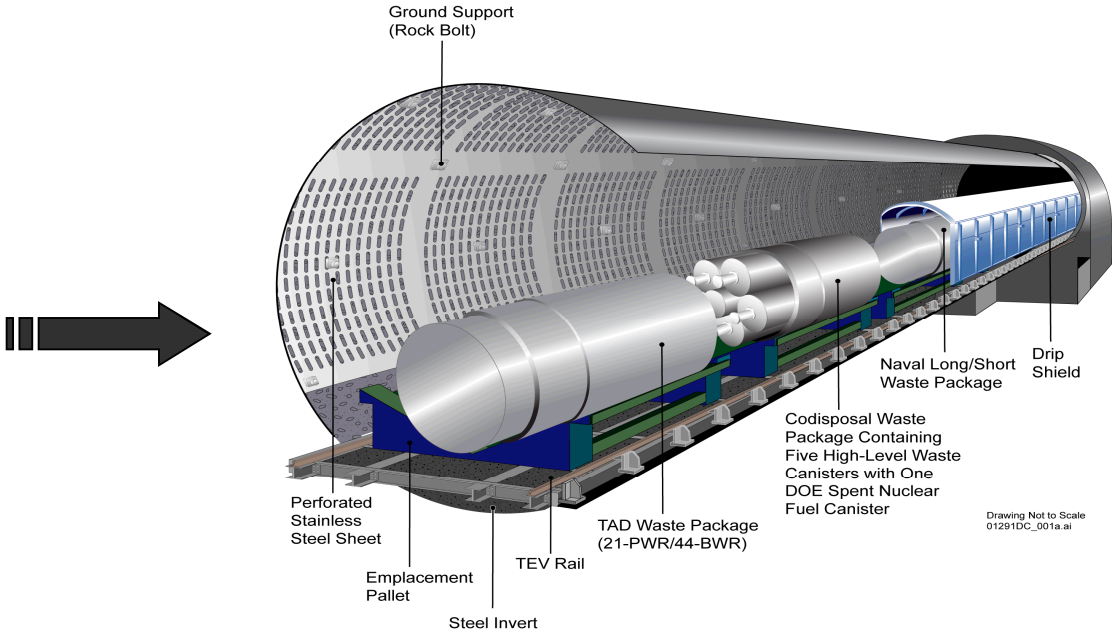
outer layer 2.5 cm Alloy 22 (Ni-Cr-Mo-V)

inner layer 5 cm stainless steel

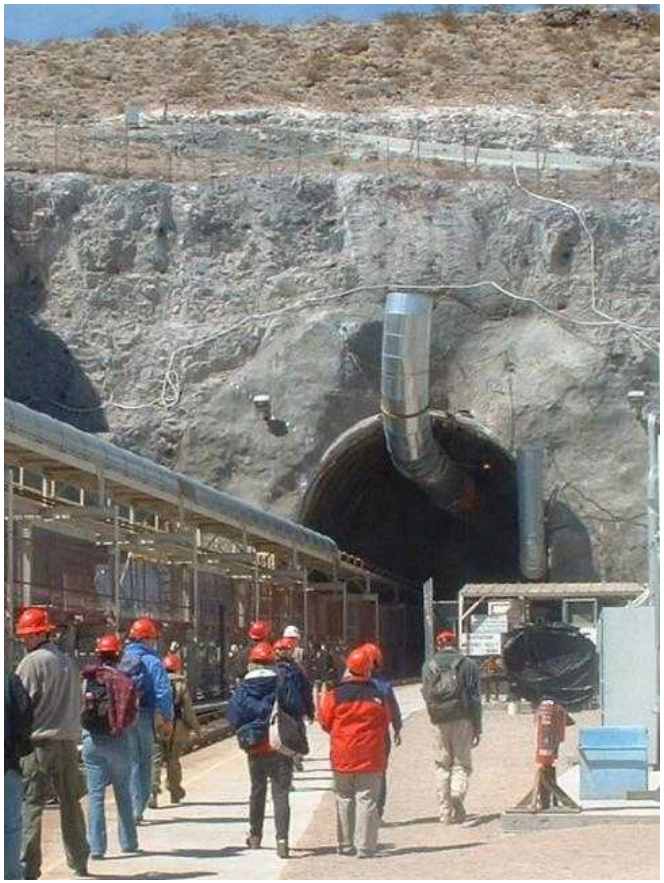
Internal TAD (transportation, aging, and disposal) canisters for commercial spent fuel, 2.5 cm stainless steel

Drip shields

free-standing 1.5 cm Ti shell



Yucca Mountain Exploratory Studies Facility



Yucca Mountain Surface Facilities

North portal access to underground facilities

DOE/RW-0753 Figure GI 1-6

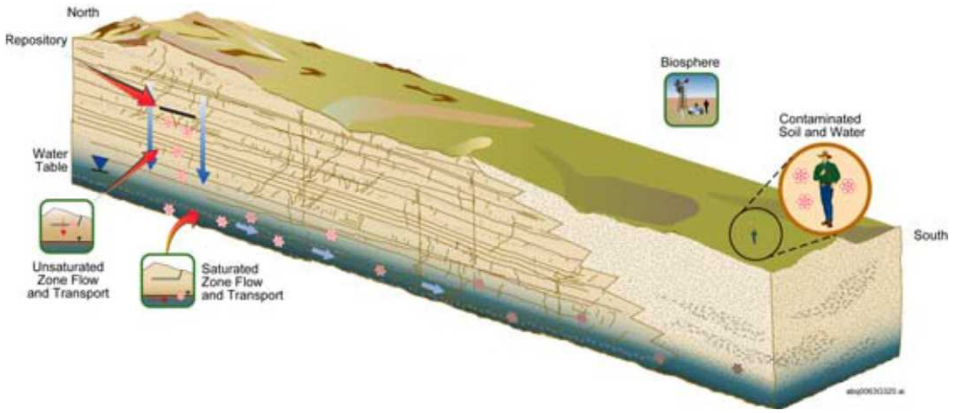
Facilities needed for initial operations shown in brown, including

- Rail car and truck buffer areas
- Initial handling facility
- Wet handling facility
- Canister receipt and closure facility
- Aging pad

Multiple non-nuclear facilities, including control facilities, security, maintenance, utility, power, backup power, fire control, water and sanitation, transportation, etc.

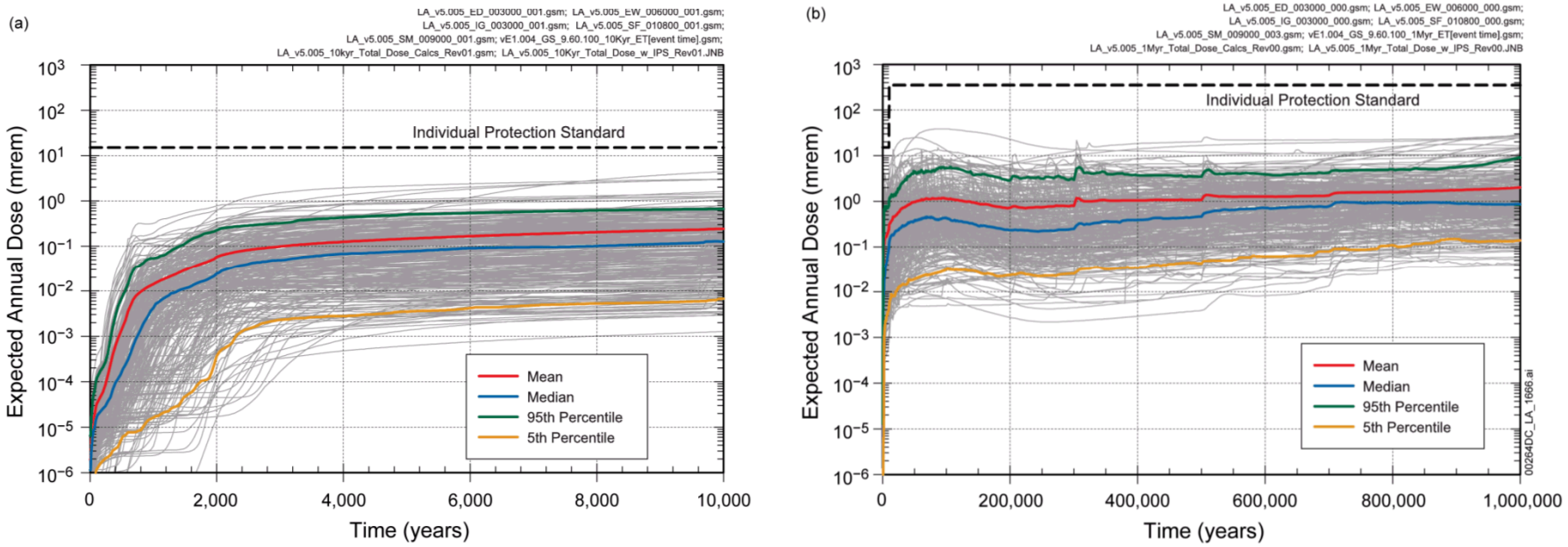
Long-Term Performance of Yucca Mountain

- Water provides the primary release mechanism
  - Precipitation infiltrates and percolates downward through the unsaturated zone
  - Corrosion processes degrade engineered barriers, including the waste form



  - Radionuclides are mobilized by seepage water and percolate downward to the water table
  - Lateral transport in the saturated zone leads to biosphere exposure at springs or withdrawal wells

Long-Term Performance of Yucca Mountain



DOE/RW-0573 Rev 1 Figure 2.4-10

10,000 years

10,000-year Standard:
Mean annual dose no more than 0.15 mSv (15 mrem)

TSPA-LA estimated 10,000 yr maximum mean annual dose: 0.0024 mSv (0.24 mrem)

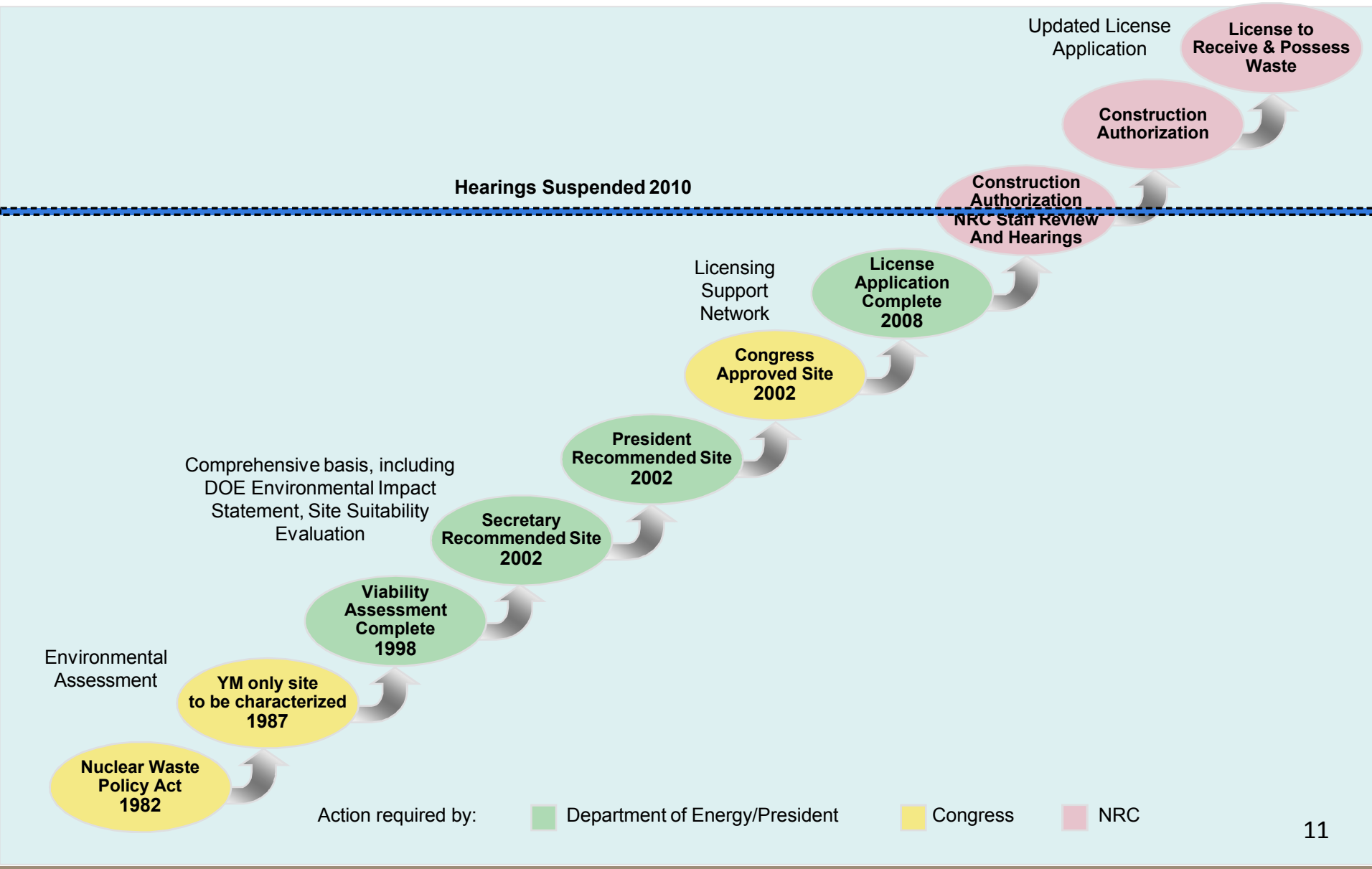
1,000,000 years

1,000,000-year Standard:
Mean annual dose no more than 1 mSv (100 mrem)

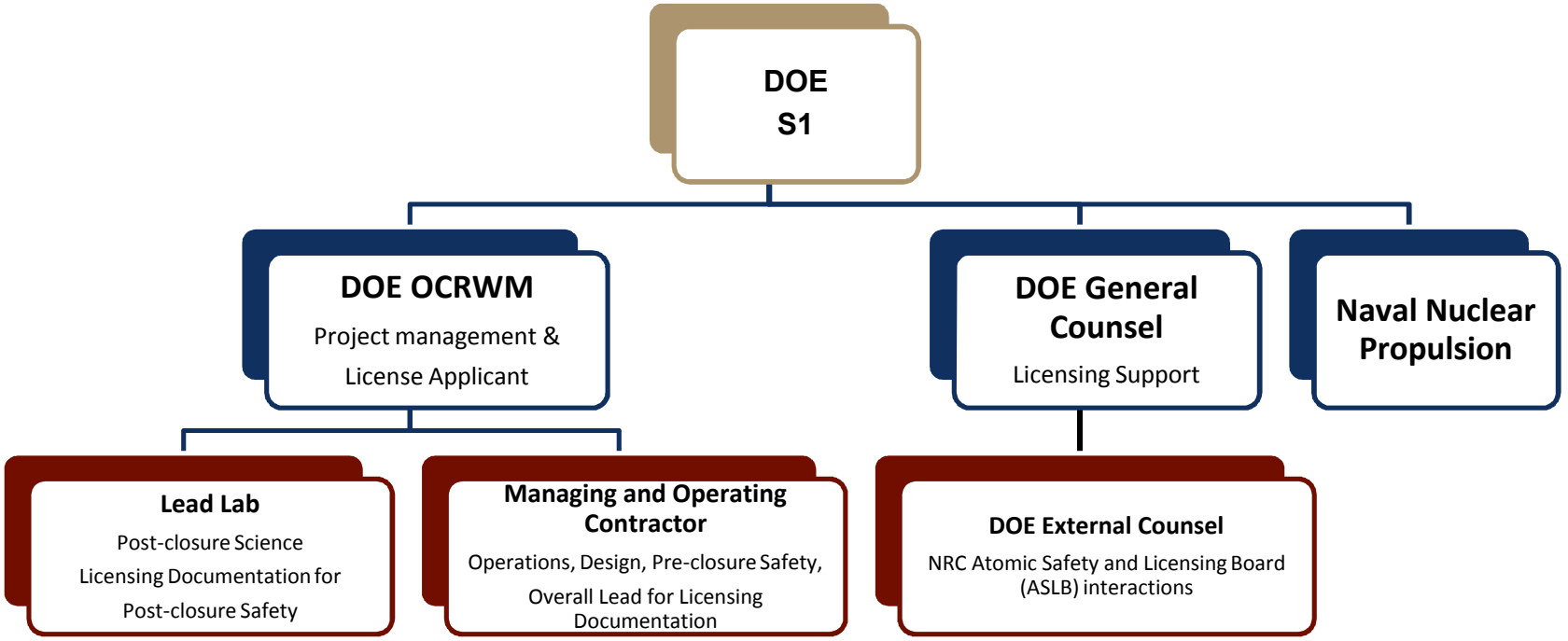
TSPA-LA estimated 1,000,000- yr maximum mean annual dose: 0.02 mSv (2.0 mrem)

Restarting the Yucca Mountain Licensing Proceedings

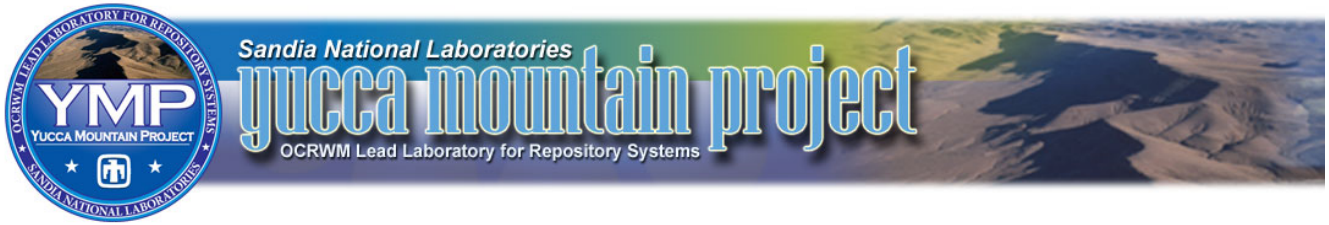
Yucca Mountain under the NWPA



YMP Participants in 2006-2010



Regulator: NRC Atomic Safety and Licensing Board
Intervenors with Standing in Licensing Hearings: State of Nevada, State of California, Nuclear Energy Institute, seven NV counties, one CA county, Timbisha Shoshone Tribe, one intertribal Native American council
Advisory technical oversight: Nuclear Waste Technical Review Board



Sandia National Laboratories

The Lead Laboratory provided management and integration services for all YMP science R&D in support of DOE's License Application and its defense in the NRC's review and licensing process

- Commitment to using "best in class" resources and capabilities wherever they reside
- Strong focus on providing effective support for the License Application

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- Longenecker & Associates
- RESPEC
- RHYM
- SAIC
- Sala & Associates
- Stoller
- URS

University of Nevada, Reno

TEXAS The University of Texas at Austin

UNLV University of Nevada Las Vegas

DRI Desert Research Institute

NRC Staff Conclude DOE Met Requirements

"The NRC staff has found that DOE has met the applicable regulatory requirements, subject to the proposed conditions of construction authorization … except for the requirements in 10 CFR 63.121(a) and 10 CFR 63.121(d)(1) regarding ownership of land and water rights, respectively. The NRC staff is not recommending issuance of a construction authorization at this time because the ***NRC staff determined that DOE has not met these regulatory requirements regarding ownership and control of the land*** where the GROA would be located and certain water rights. In addition, a supplement to DOE's environmental impact statement has not yet been completed." [*emphasis added*]

From Volume 5 of the *Safety Evaluation Report Related to Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain* (NUREG-1949, vol. 5, January 2015)

None of the NRC staff's proposed licensing conditions are unanticipated. NRC staff completed the EIS supplement in May 2016.

Fastest Path to Opening Yucca Mountain

DOE

NRC

Institutional Framework

- Quality Assurance
- IT
- Records
- Nuclear Safety Culture
- Maintain Databases
- Procurement
- Personnel

Frequent Dialog

- Nevada
- Congress
- Local Communities
- Nuclear Industry
- Public Utilities
- Other Stakeholders

Federal Team

1. Establish Mission-Focused Organization
2. Ensure interim storage & transportation
3. Obtain Land Permits

Lead Lab

1. Provide Post-Closure Safety Experts
1. Defend the License Application /Post-Closure Safety Analysis

M&O Contractor

1. Complete Final Design of Facility
2. Defend Pre-Closure Safety Analysis

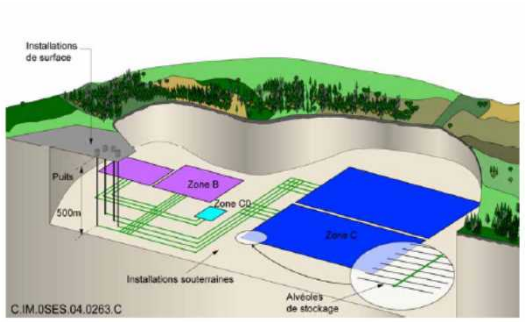
Legal

1. Defend the License Application (300+ Contentions)

1. Reconstitute Safety Licensing Board
2. Reconstitute Legal Team to adjudicate 300+ contentions
3. Re-open hearing facilities

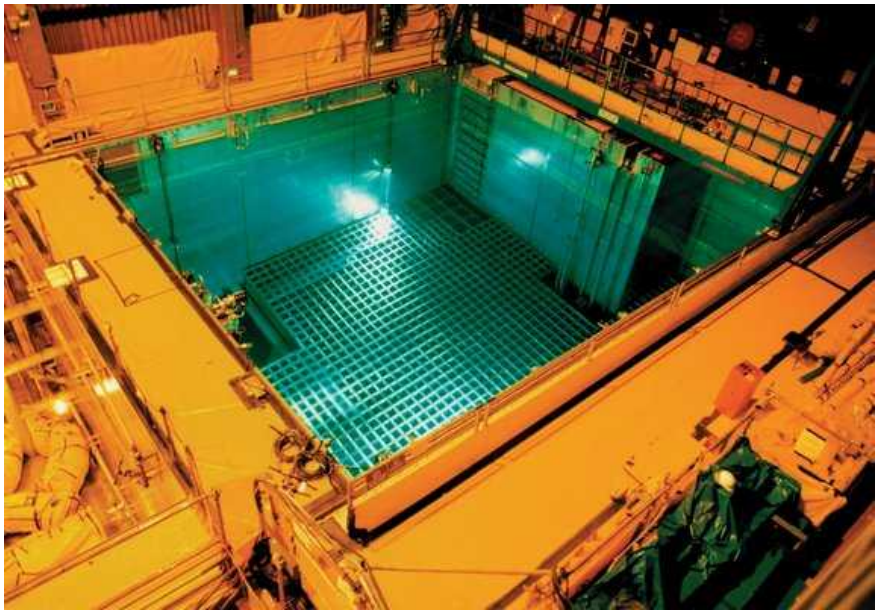
Construction Authorization

Integration Across Storage Transportation & Disposal



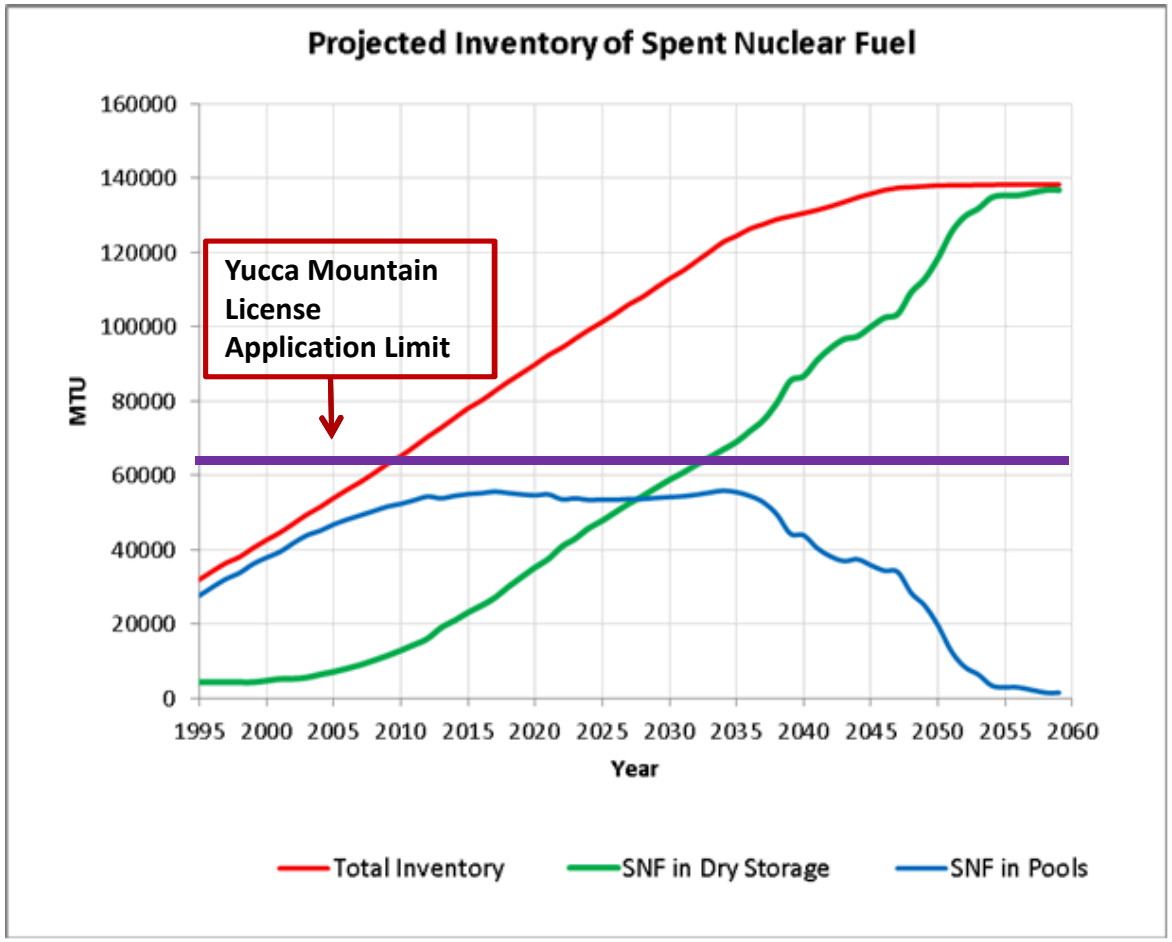
Standard Industry Practice

On-site storage of spent nuclear fuel is the only option available

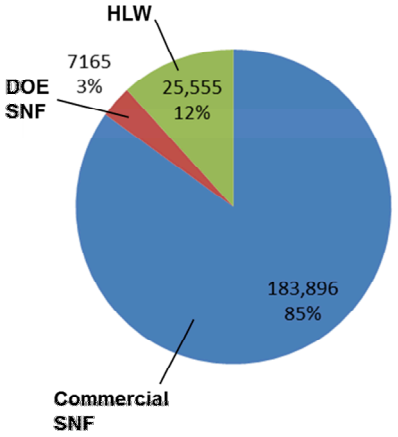


Future Projections

Projection assumes full license renewals and no new reactor construction or disposal



Projected Volumes of SNF and HLW in 2048



Volumes shown in m^3, assuming constant rate of nuclear power generation and packaging of future commercial SNF in existing designs of dual-purpose canisters

Storage and Transportation R&D and Design Will Enhance Regulatory Confidence

Provide technical support for:

- Extended storage of used nuclear fuel
- Fuel retrievability and transportation after extended storage
- Transportation of high-burnup spent nuclear fuel

Security for Interim Storage

Source: www.us.arevablog.com/2015/07/29/cisf/

Conclusions

- Yucca Mountain is technically suitable
- Yucca Mountain is the fastest path to permanent disposal of spent nuclear fuel and high-level waste
- Some spent nuclear fuel and high-level waste will remain in temporary storage for decades regardless of when Yucca Mountain opens