U.S. Department of Energy
Office of Civilian Radioactive Waste Management

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The National Repository at Yucca Mountain

Presented to:
EM High Level Waste Corporate Board

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Office of Civilian Radioactive Waste Management

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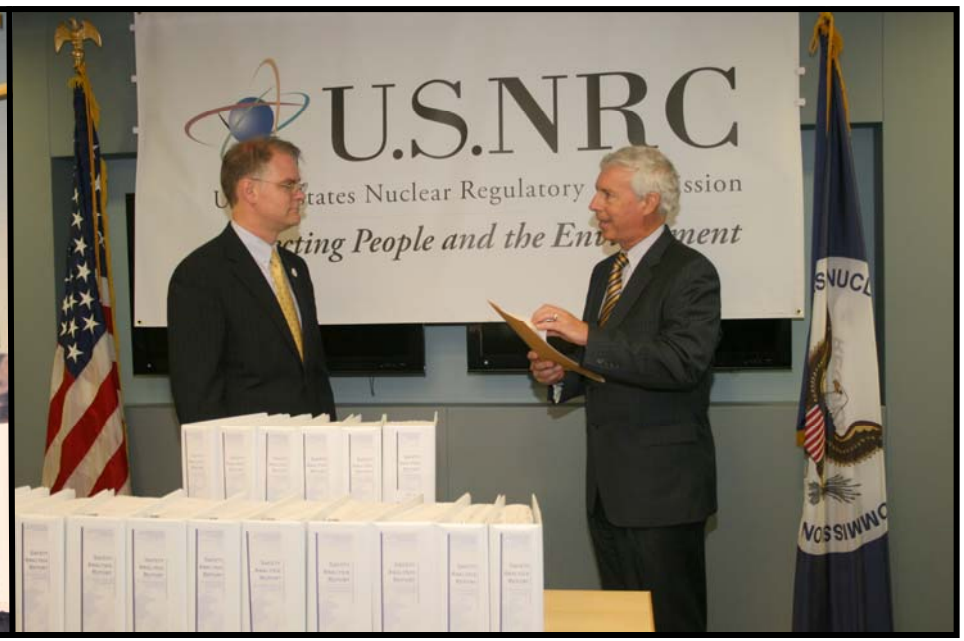
Idaho National Laboratory

Solving a national problem now

- **On June 3, 2008, the U.S. Department of Energy submitted an application to the U.S. Nuclear Regulatory Commission for a license to construct a repository at Yucca Mountain**

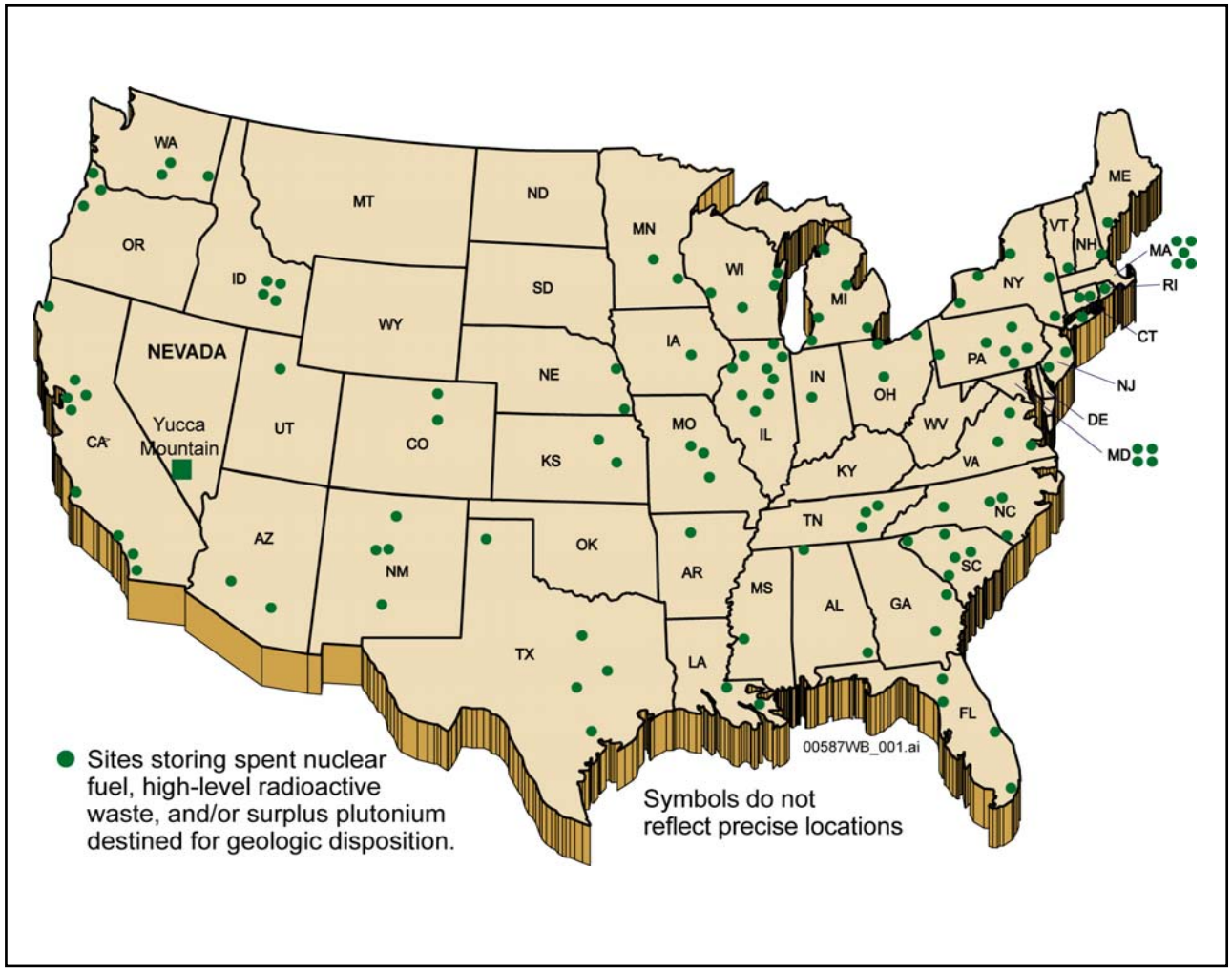


Repository license application

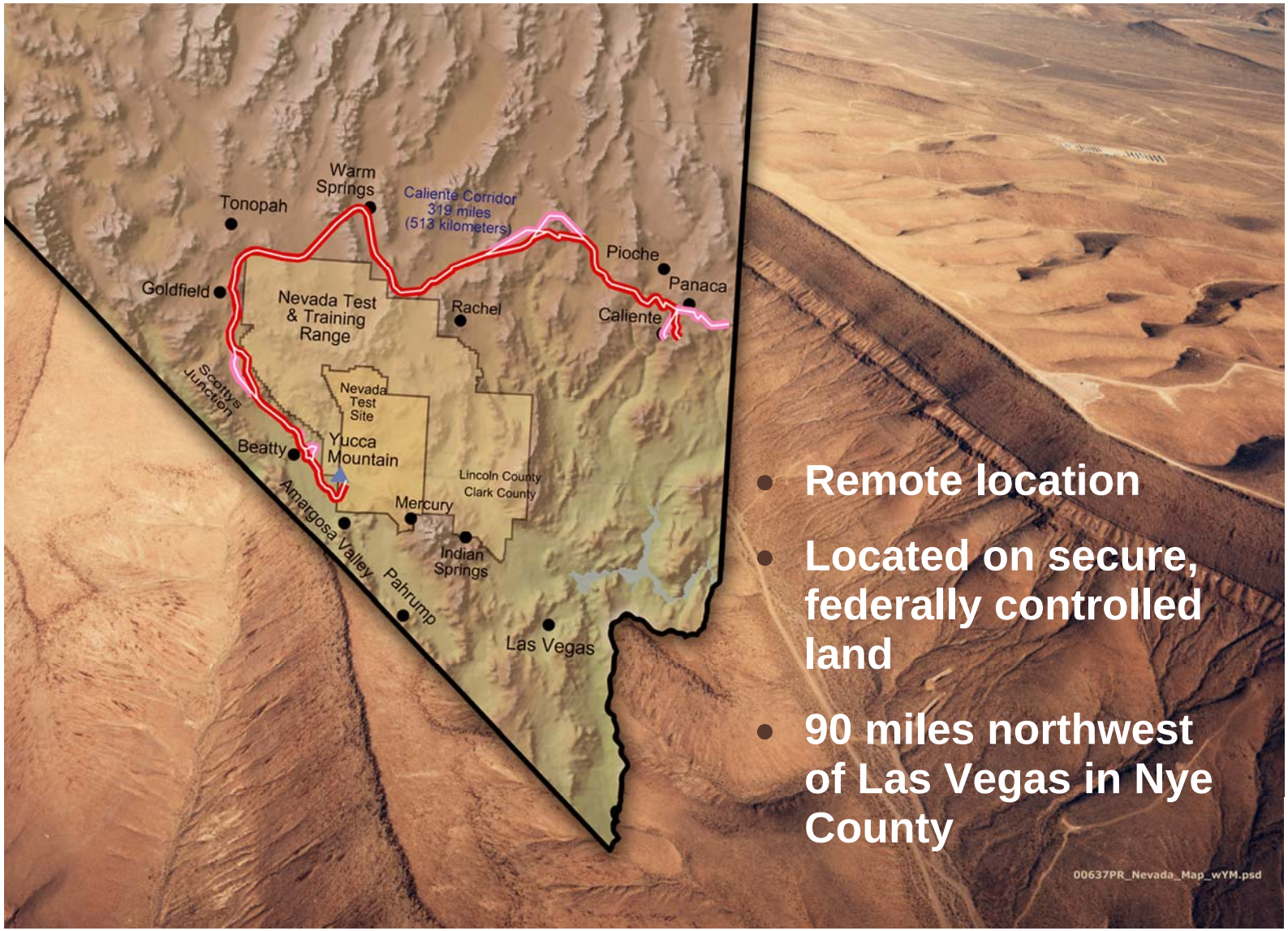
- **The LA seeks authorization to construct the nation's first geologic repository**
- **It is a culmination of more than 25 years of scientific research and engineering**
- **The LA describes DOE's plan to safely isolate spent nuclear fuel and high-level radioactive waste in tunnels deep under-ground at Yucca Mountain**

Repository meets a pressing national need

- **Spent nuclear fuel and high-level radioactive waste have been accumulating in the United States since the 1940s**
- **Currently, waste destined for Yucca Mountain is stored in temporary facilities at 121 sites in 39 states**

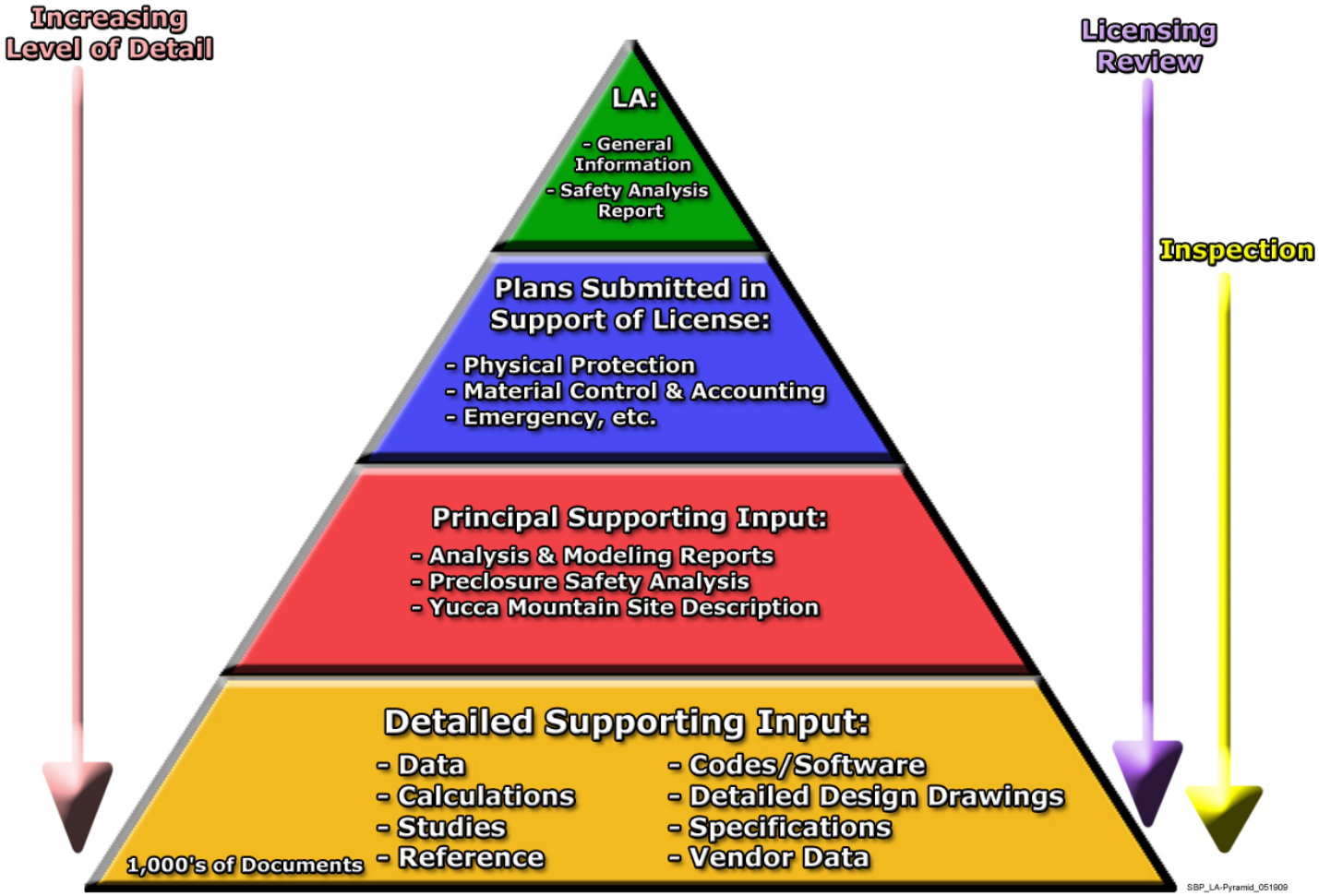


Yucca Mountain, Nevada



- Remote location
- Located on secure, federally controlled land
- 90 miles northwest of Las Vegas in Nye County

License Application Content and Supporting Documents



LA components

- **The LA is accompanied by a final EIS, as well as 200 key supporting documents**
- **The LA comprises 17 volumes:**
  - **Total number of pages – 8,646**
  - **Total number of figures – 2,830**
  - **Total number of tables – 930**
  - **Number of inches thick – 78**
  - **Weight of each complete copy – 110 pounds**

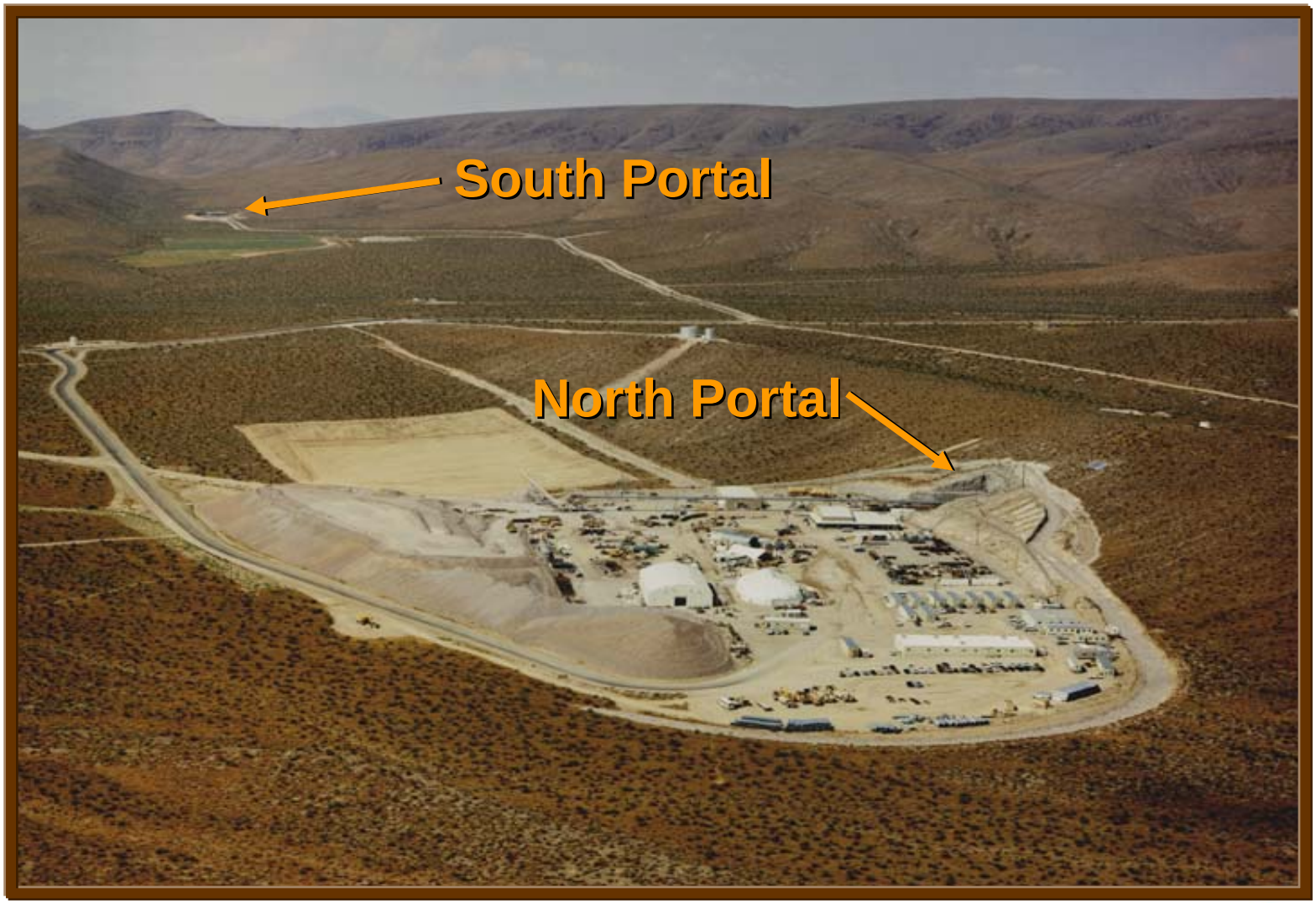
Contents of the license application

- **The license application includes General Information and a Safety Analysis Report (SAR)**
- **The General Information includes:**
  - **A general description of the repository and its operations**
  - **Schedules for construction, receipt, and emplacement of waste**
  - **A description of the physical protection plan for safeguarding the facility**
  - **A description of the material control and accounting program to be implemented to track radioactive materials movement at the repository**
  - **A description of site characterization studies**

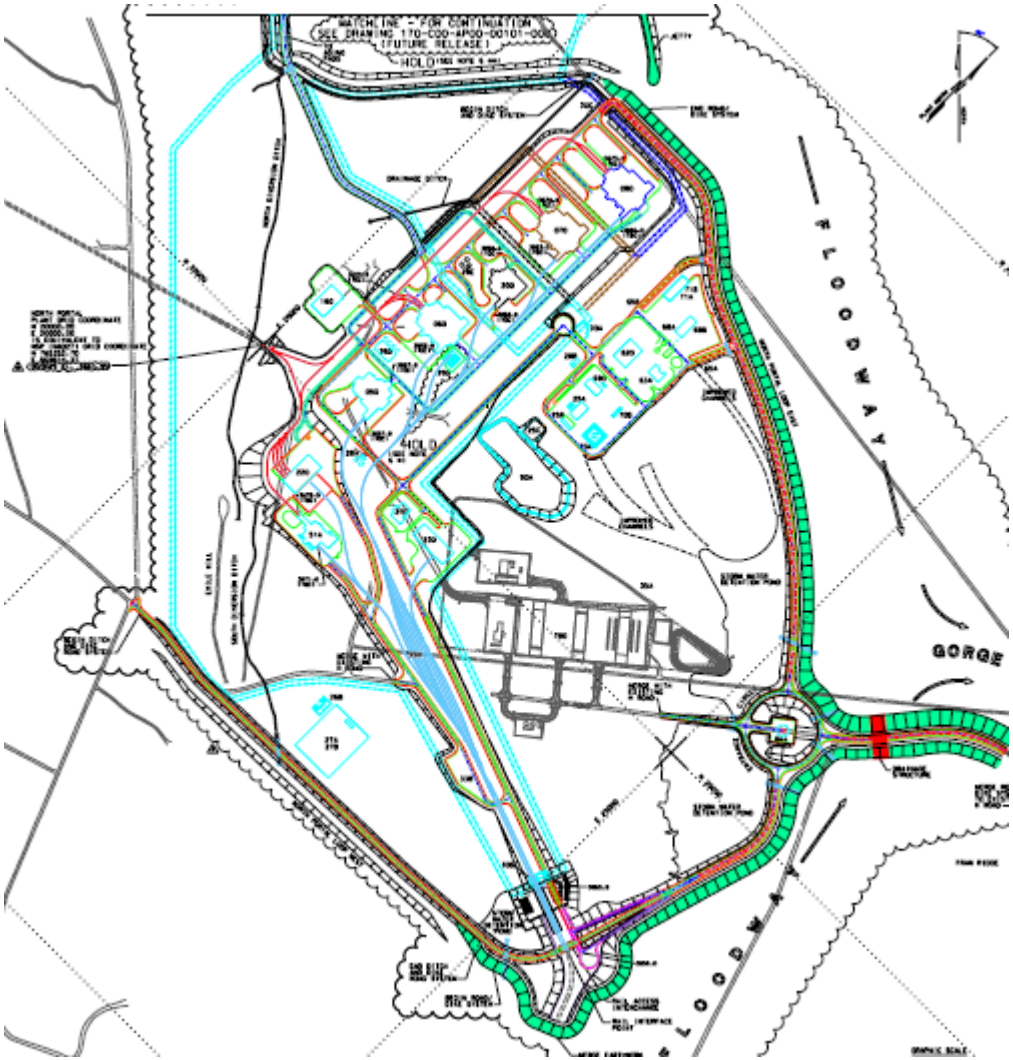
Contents of the license application (continued)

- **The SAR is the principal technical document in the licensing process**
- **The SAR discusses why the repository is considered safe and how it complies with NRC regulations**
- **Major topics of the SAR include:**
  - **Preclosure Safety Analysis**
  - **Postclosure Safety Analysis**
  - **Programmatic Requirements**

Yucca Mountain Surface at Repository Facility Portals



Site overview



Nuclear facilities

- Initial handling facility
- Wet handling facility
- Canister receipt and closure facility 1
- Canister receipt and closure facility 2
- Canister receipt and closure facility 3
- Receipt facility

Balance of plant facilities

- Low-level waste facility
- Emergency diesel generator facility
- Heavy equipment maintenance facility
- Central control center facility
- Warehouse and non-nuclear receipt facility
- Utility, security, and administration facilities

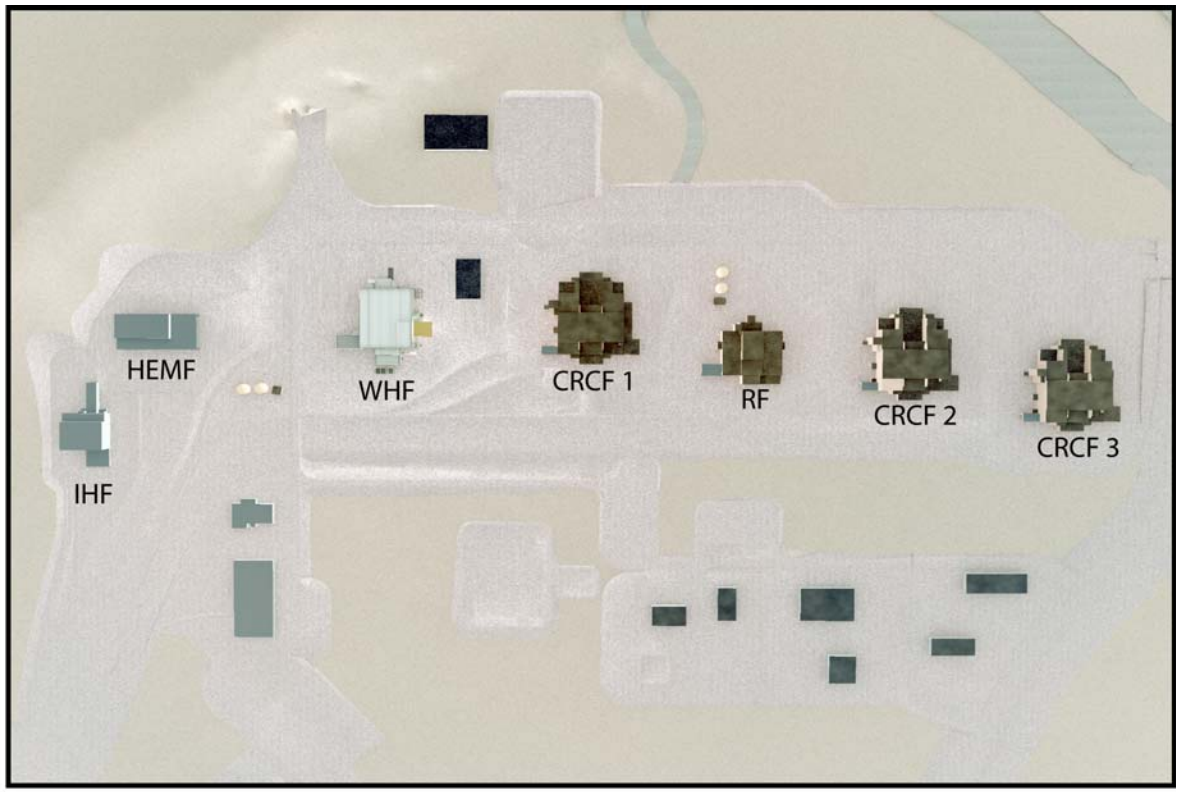
Surface design

- **The revised surface design provides maximum flexibility in the development of a simple, clean, safe, primarily canister-based repository**
  - **Based on the use of modular waste handling facilities and processes – expansion as needed**
  - **Incorporates commercial waste handling experience**
  - **Can receive by truck and standard rail**
  - **Can handle multiple forms of wastes**
  - **Can accommodate multiple sizes of transportation, aging and disposal canisters**
    - **Canisters would require less handling than individual spent nuclear fuel assemblies at the repository**

Surface facilities layout

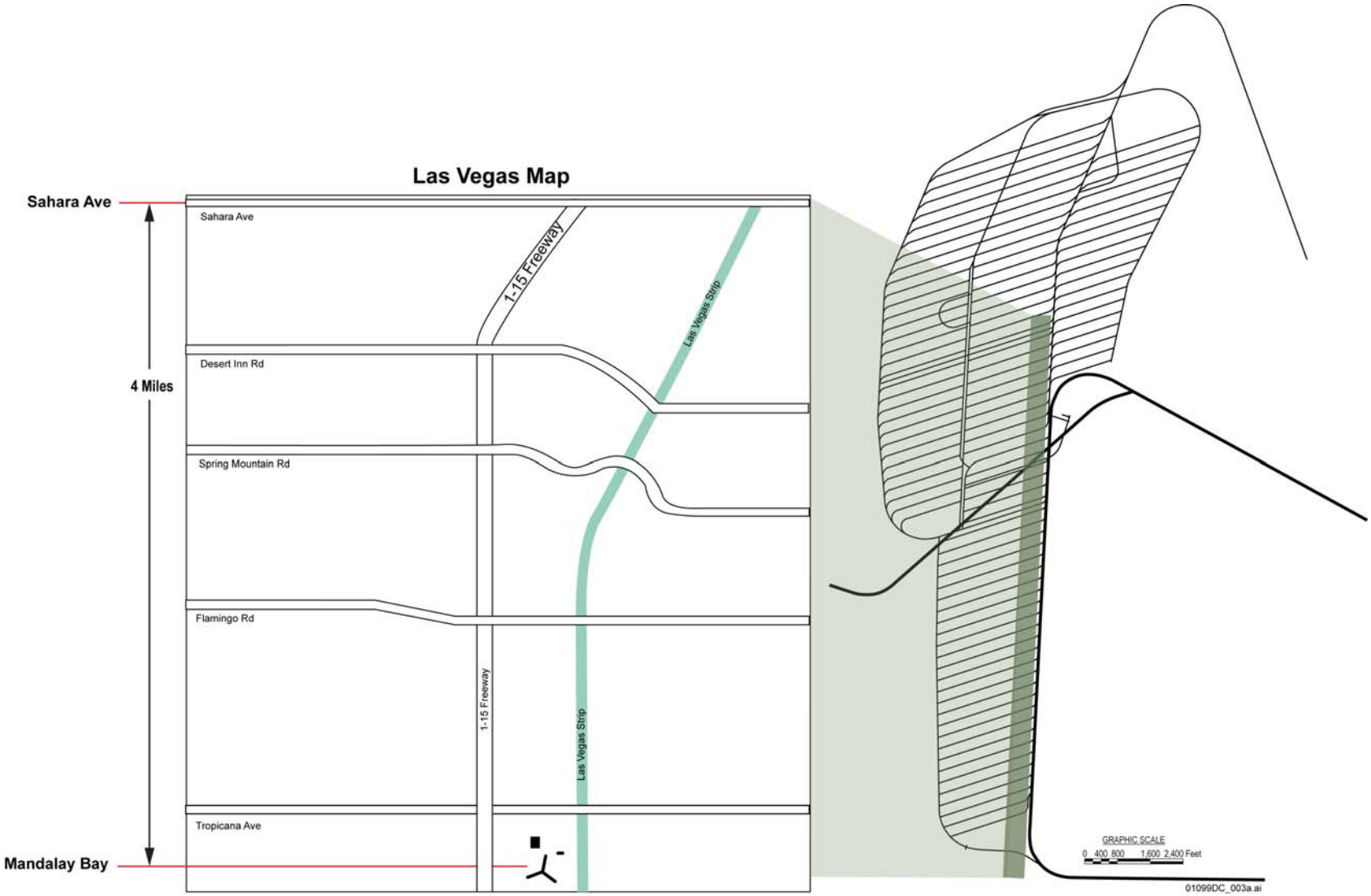
- **This image shows the relative size of the planned surface facilities compared with a large football stadium**

Los Angeles Memorial Coliseum

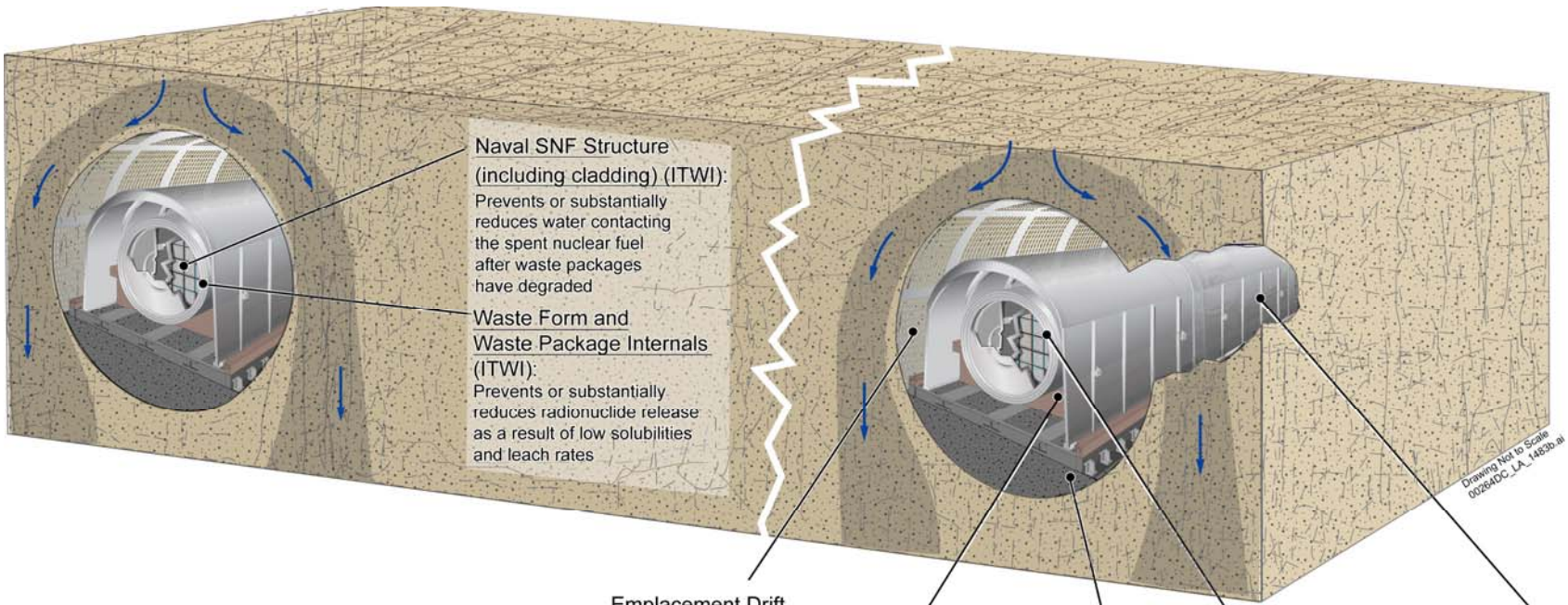


Planned Surface Layout

Repository is longer than the Las Vegas Strip



Engineered Barrier System



Emplacement Drift (ITWI):
Provides a stable environment for other Engineered Barrier System features

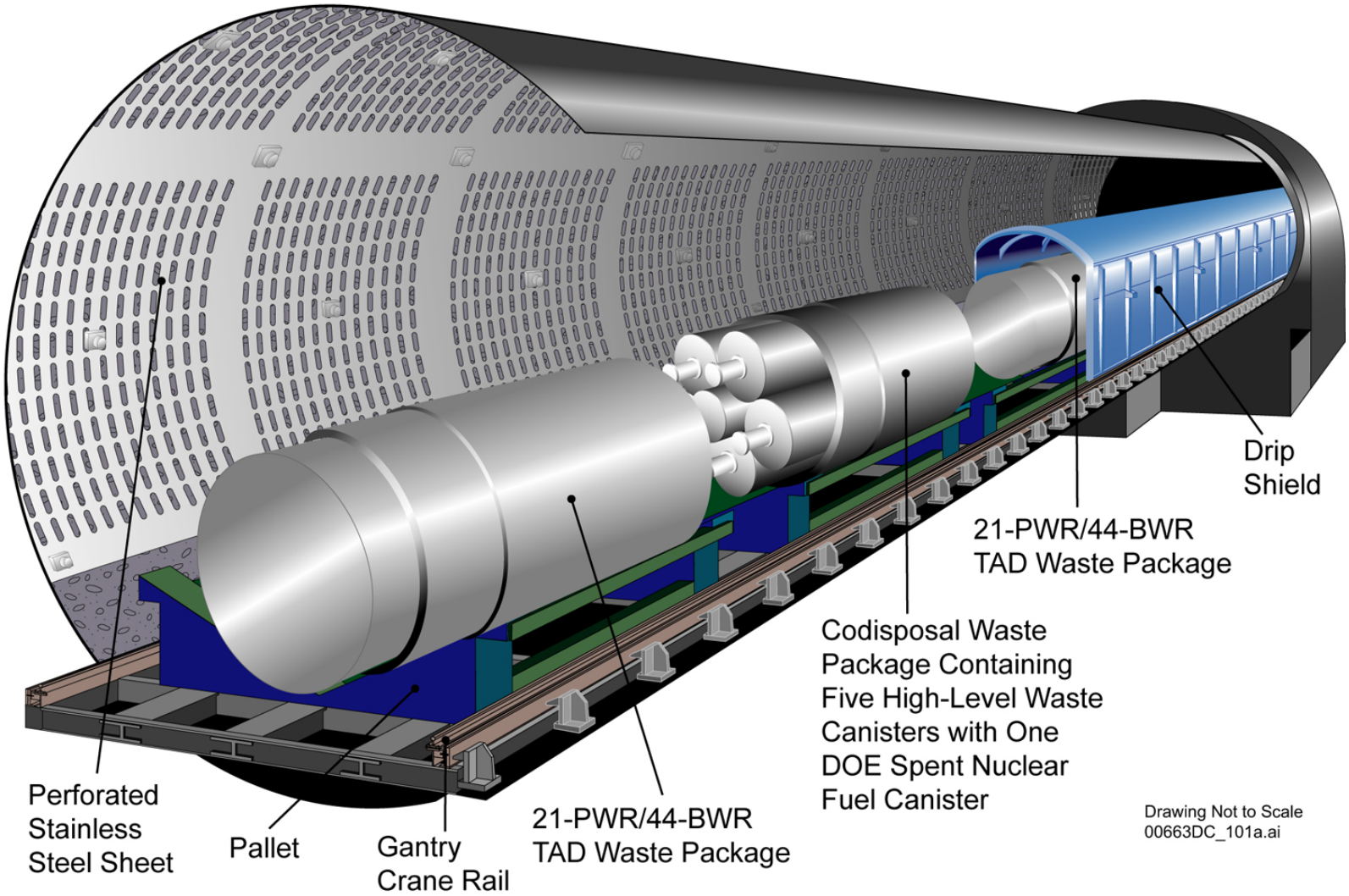
Pallet (Non-ITWI):
Supports the waste package and minimizes external mechanical and chemical interactions

Invert below the Waste Packages (Non-ITWI):
Reduces transport of radionuclides out of the Engineered Barrier System

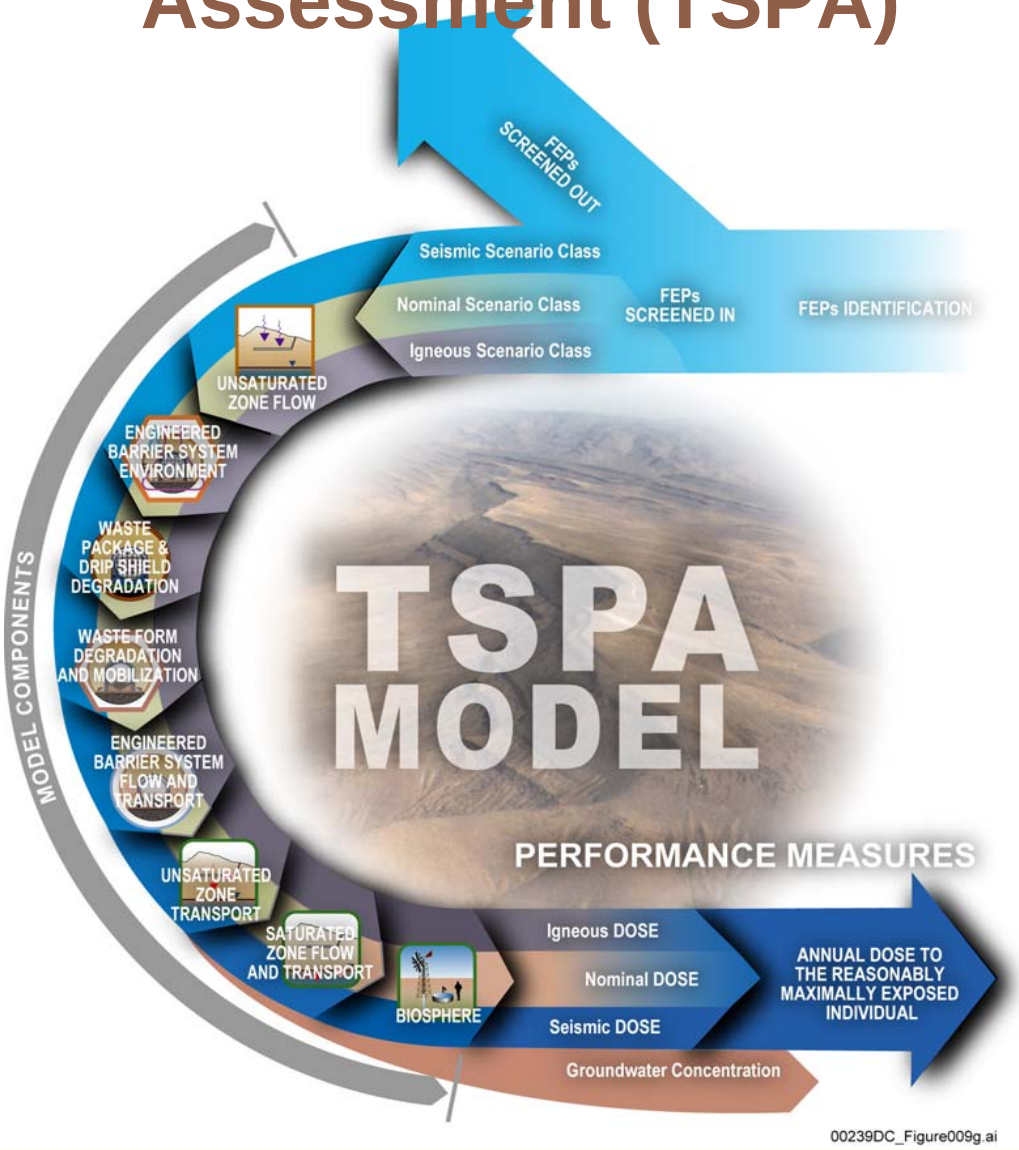
Waste Package (ITWI):
Prevents or substantially reduces water from contacting the waste form

Titanium Drip Shield above the Waste Packages (ITWI):
Prevents or substantially reduces water from contacting the waste package

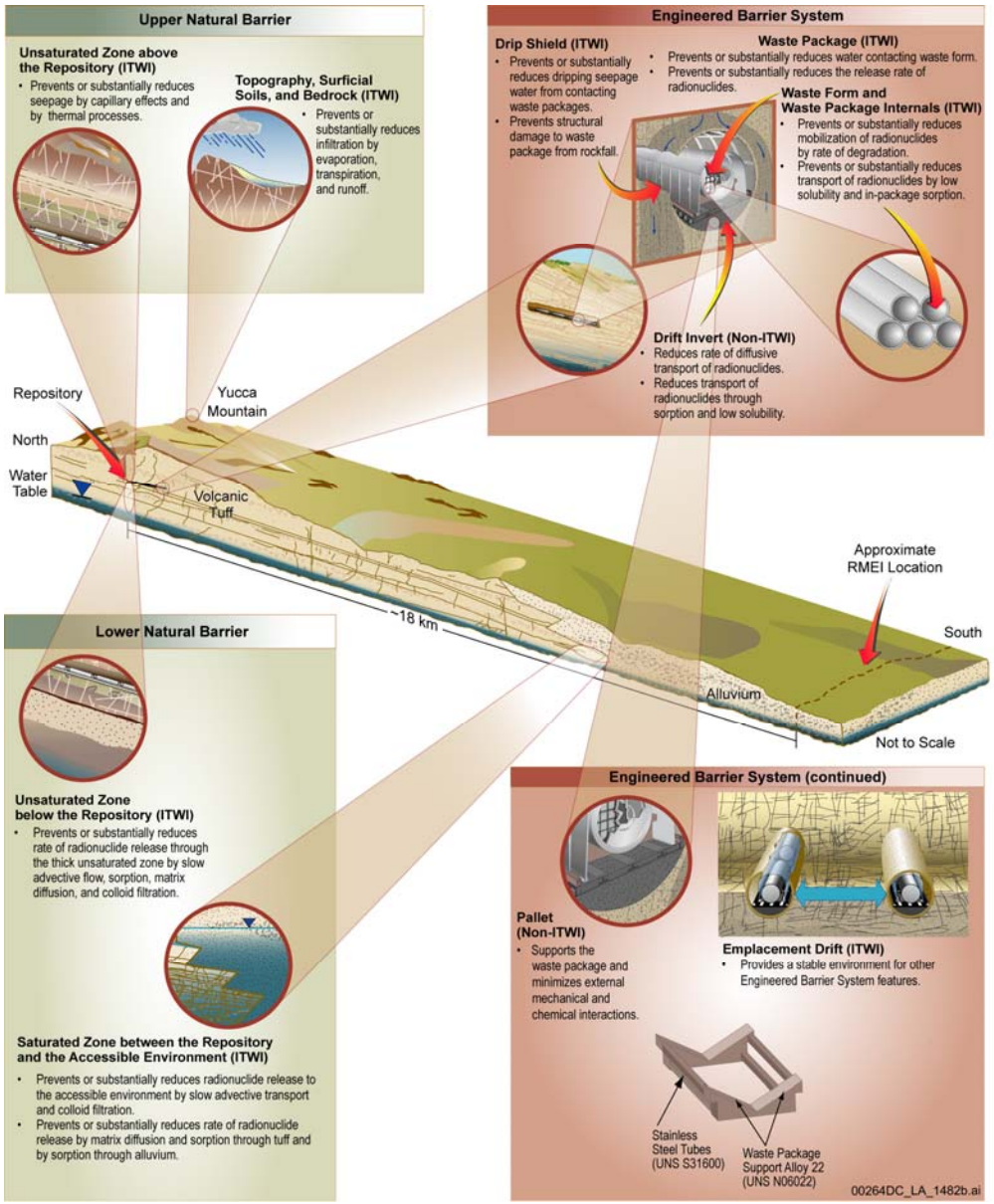
Emplacement Drift



Estimating how the repository will perform in the future using Total System Performance Assessment (TSPA)



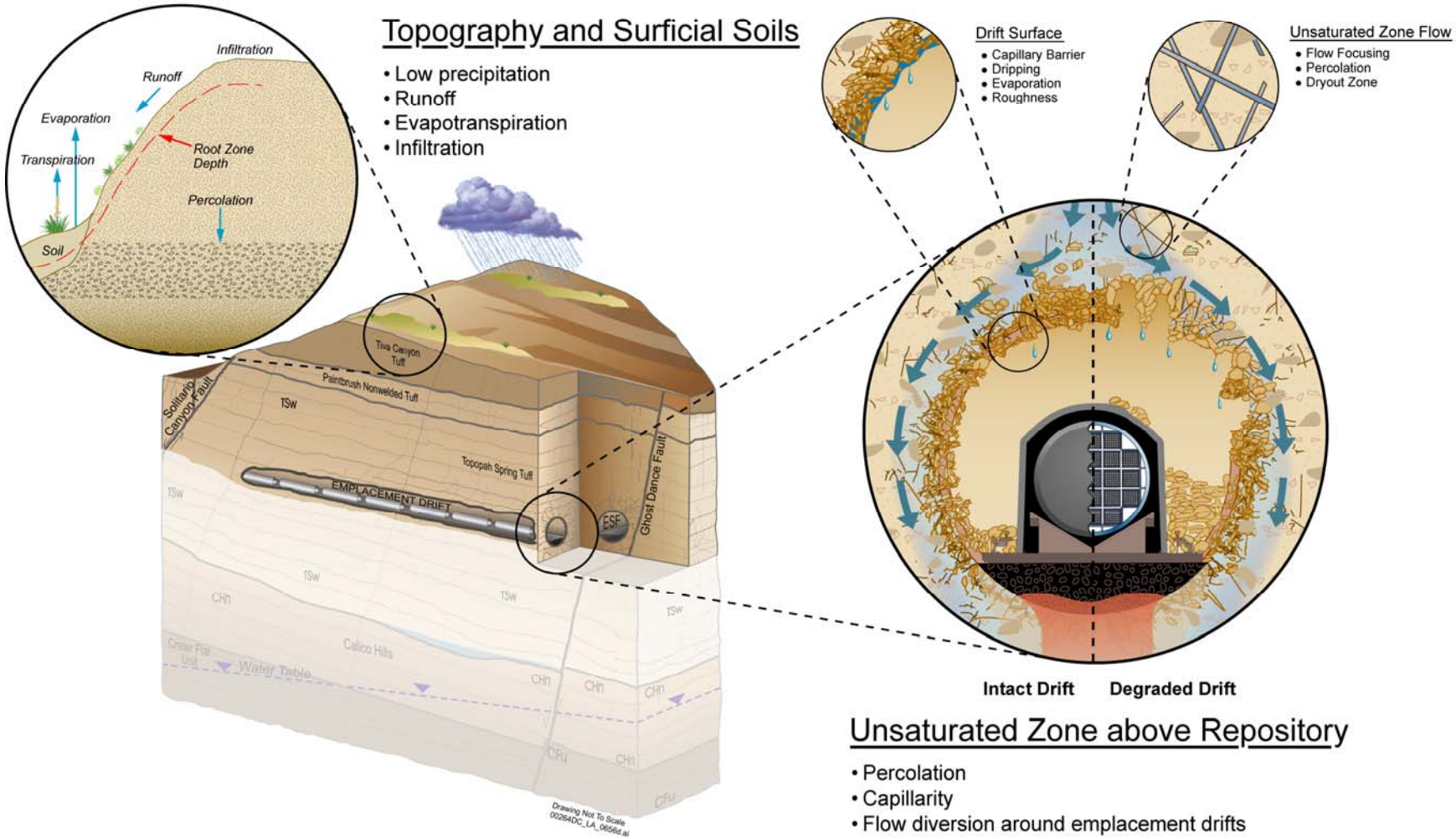
Key barriers work together



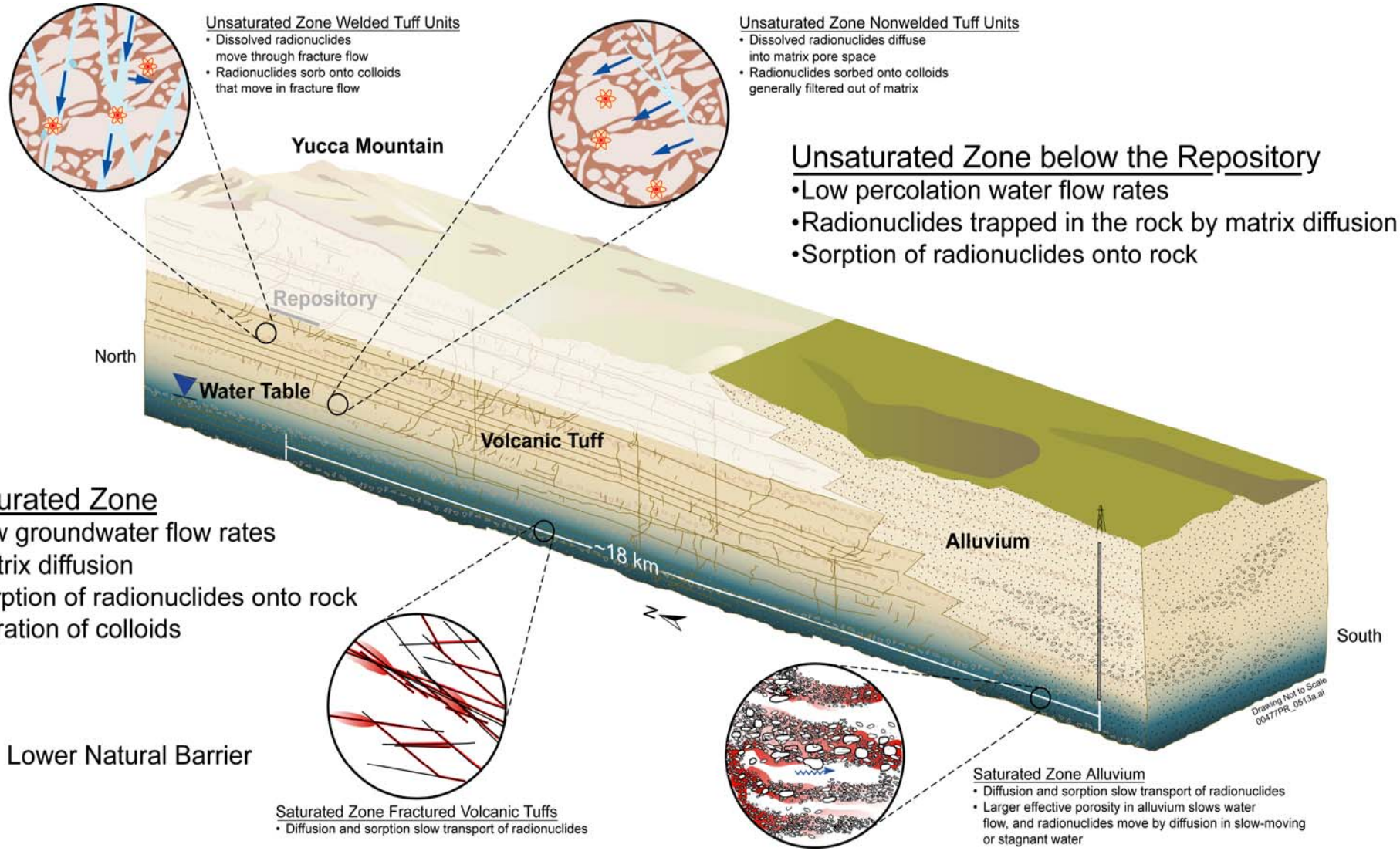
Features and Components

- Surface soils and topography
- Unsaturated zone above the repository
- Emplacement drift
- Drip shield
- Waste package
- Pallet
- Waste form and waste package internals
- Drift invert
- Unsaturated Zone below the repository
- Saturated zone

Upper natural barrier



Lower natural barrier



Total System Performance Assessment Process

- Screen features, events, and processes to determine those to be evaluated in performance assessment
- Develop models, along with their scientific basis, for each feature, event and process included in TSPA
- Evaluate uncertainty in models and parameters
- Construct integrated TSPA model using all retained features, events and processes in scenario classes
  - Nominal scenario class contain all features, events, and processes expected to occur (including climate change)
  - Disruptive event scenario classes contains unexpected events (e.g., early failure, igneous, and seismic)
- Evaluate total-system performance in terms of individual protection and groundwater protection standards; incorporating uncertainty through Monte Carlo simulation

TSPA model architecture

- **TSPA Model consists of four scenario classes**
  - **Nominal Scenario Class**
  - **Igneous Scenario Class**
  - **Seismic Scenario Class**
  - **Early Failure Scenario Class**
- **Each model component has an integrated set of inputs and outputs**
- **Each model abstraction has a conceptual basis**

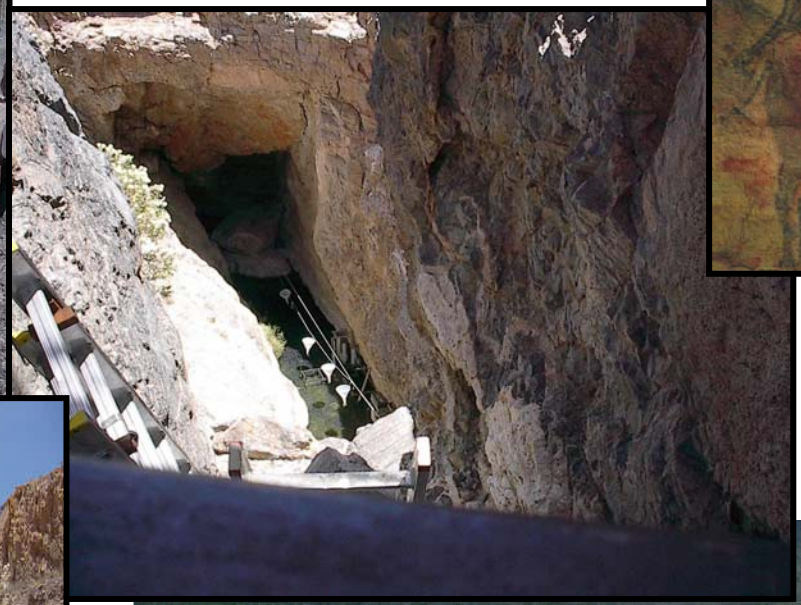
Performance results- individual protection standard

Time Period After Closure (yrs)	Projected Maximum Mean Annual Dose (mrem)	Time of Maximum Mean Annual Dose (yr)	Projected Maximum Median Annual Dose (mrem)	Time of Maximum Median Annual Dose (yr)	Limit for Annual Dose (mrem)
10,000	0.24	10,000	NA	NA	15 (mean)
1,000,000	NA	NA	0.96	~ 720,000	350 (median)
NOTE: Numerical Limits from proposed 10 CFR 63.311(a). Source: SNL 2008a, Table 8.1-1[a].					

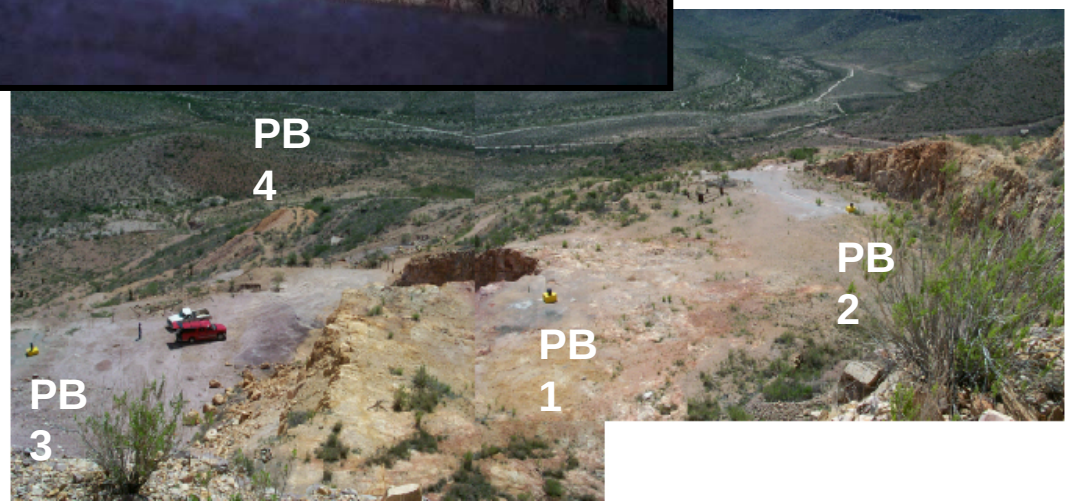
SAR Table 2.4-2. Performance Results for Individual Protection Standard

Adding confidence: natural and man-made analogues

Devils Hole, CA

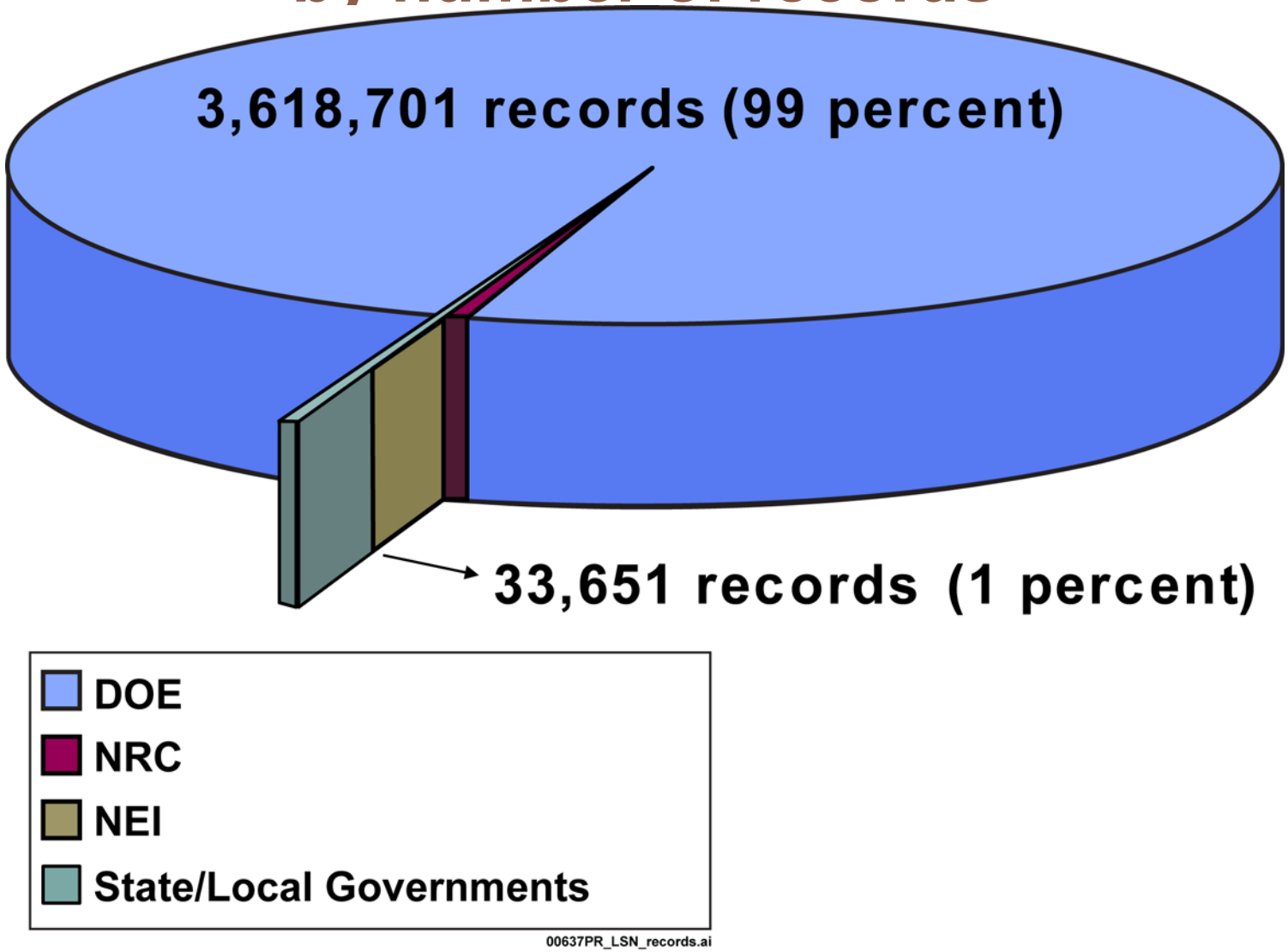


Cave paintings, France

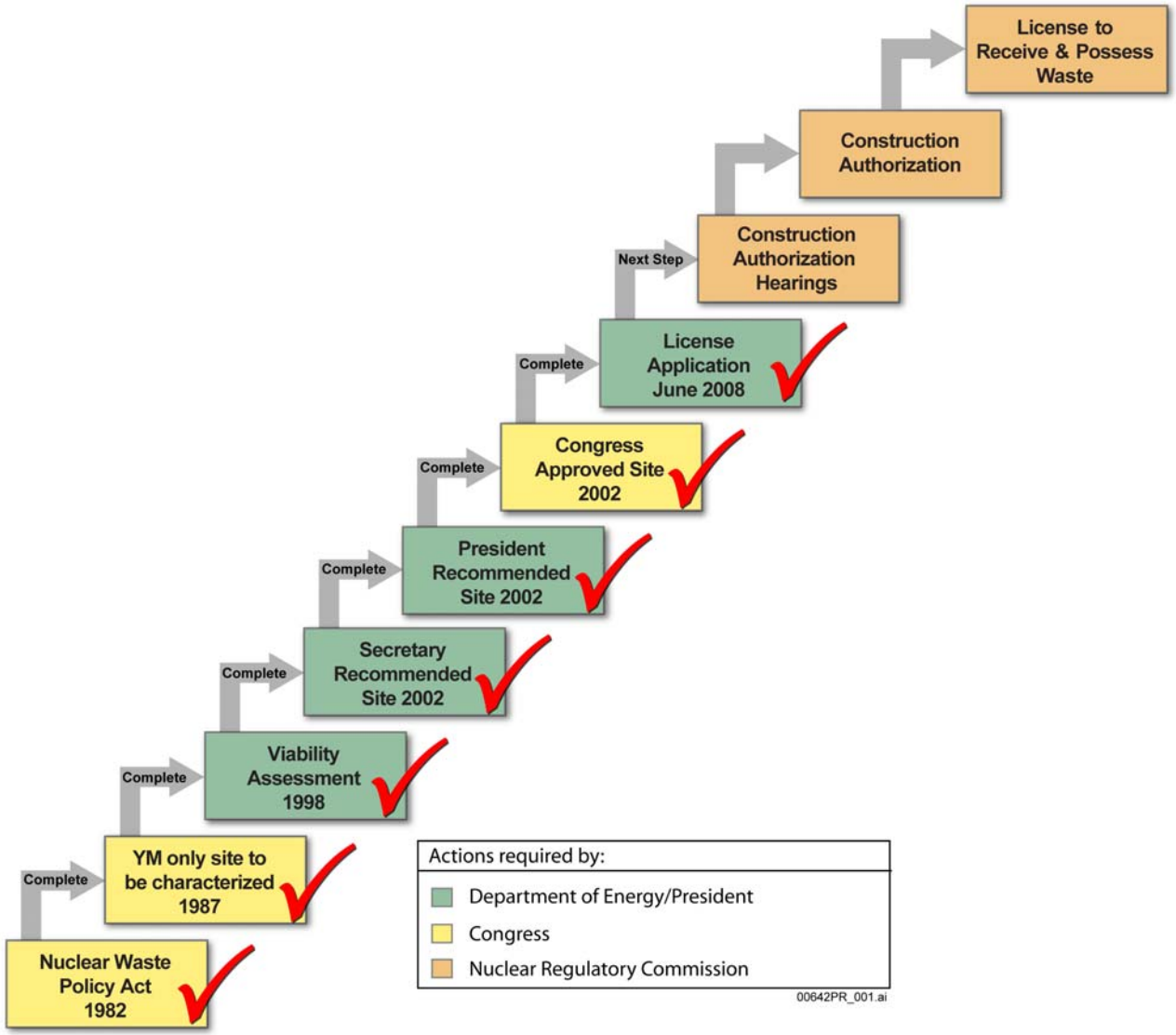


Peña Blanca, Mexico

Licensing Support Network (LSN) contributors by number of records

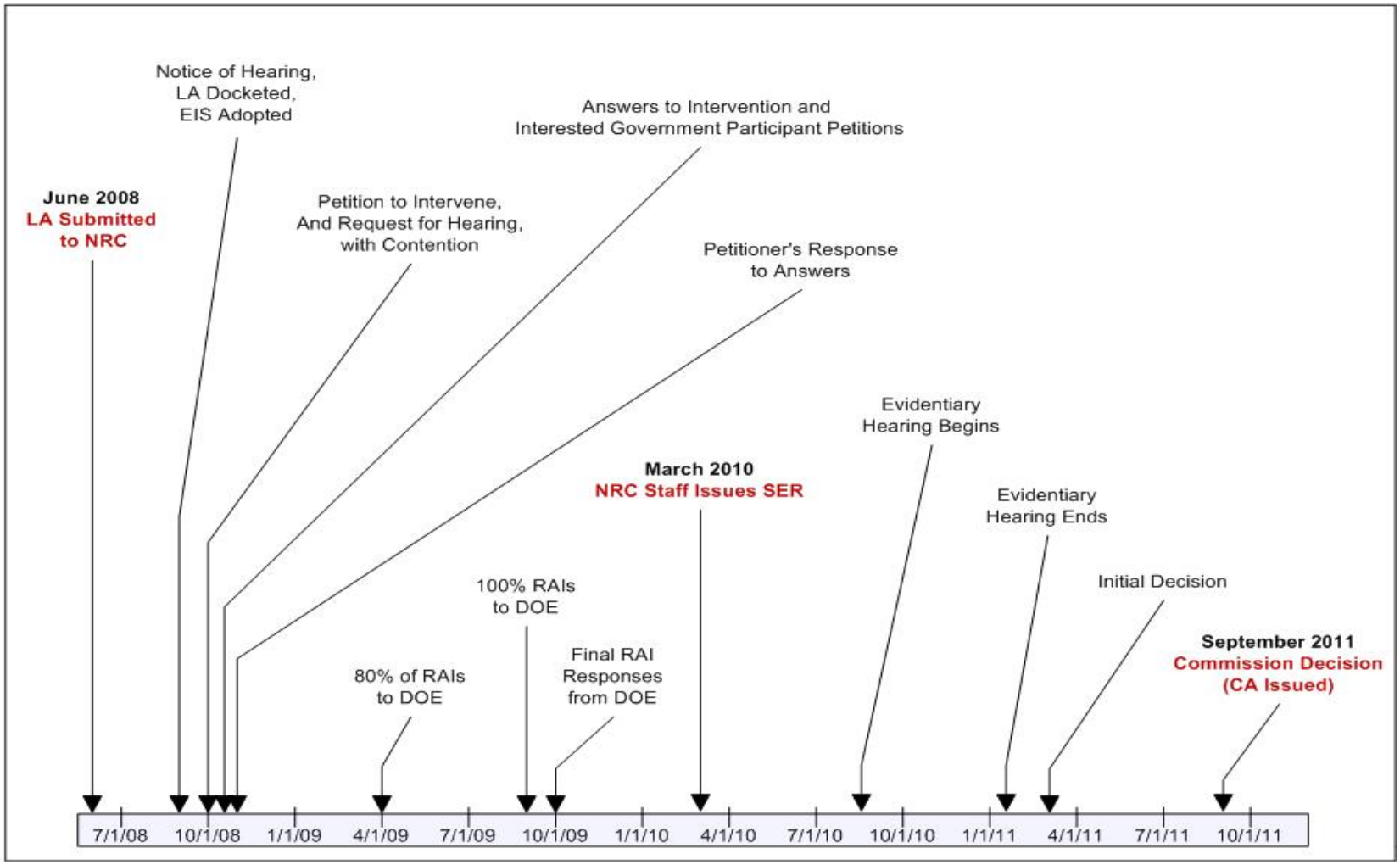


Repository program steps



What's next

Yucca Mountain License Application Review Timeline (anticipated)



Upcoming key milestones

- **Start Nevada Rail Construction - October 2009**
  - **Delayed - Inadequate funding to proceed with design**
- **YM Construction Authorization - September 2011**
  - **Depends on NRC decision**
- **Operating License Submittal - March 2013**
  - **Predicated on funding and construction schedule**
- **Rail Line Operational - June 2014**
  - **2016 is achievable only if adequate funding is provided**
- **Begin Receipt**
  - **Currently under evaluation due to FY 07 and 08 actual funding shortfalls and expected near term funding limitations**
  - **Firm date cannot be set until funding issue resolved**

For more information

www.ocrwm.doe.gov