SAND2018-1411PE

Topic Area V: Waste Management and Subsurface Science

Background

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U.S. DEPARTMENT OF ENERGY | Nuclear Energy

NNSA IAEC Advance Meeting

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Topic Area V: Science of Waste Management

1. Damage Induced by Excavation and Heat Release of a Radioactive Waste Repository (SNL, GSI, NRCN, LLNL)

2. Colloid-facilitated radionuclide transport in fractured carbonate rock: an integrated laboratory, field & numerical modeling study (LLNL, BGU, NRCN, LANL,)

3. Mechanisms of subsurface flow and radionuclide transport (LANL, NRCN, GSI, SNL)

4. Nuclear Wasteform and Barrier Matrixes Interactions with Geologic Strata in the Subsurface (VU, NRCN, SNL)

5. Deep Borehole Disposal (NRCN, GSI, LANL, LLNL, SNL)

Outline

- Background
- Status of Research Activities
- Deep Borehole Disposal
- Summary

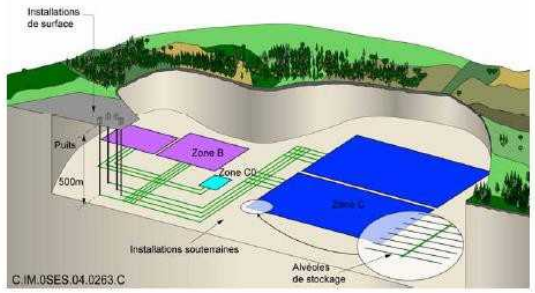
Background

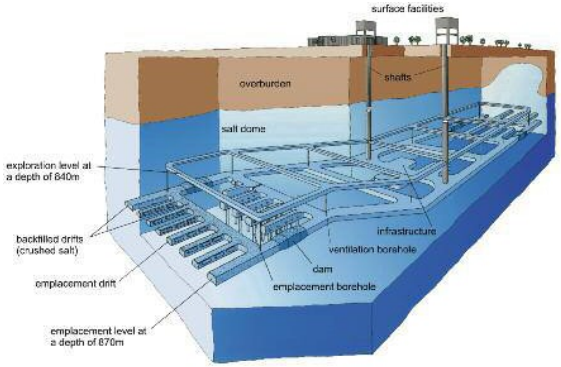
- Low-level, intermediate level, and high level radioactive wastes
- Low-level and intermediate level wastes can be safely disposed in near surface facilities
- High-level wastes (including SNF) must be safely disposed in deep geologic facilities
- Israel's national near-surface low-level radioactive waste disposal site is located in the Yamin Plateau (YP)
- IAEC is evaluating options for deep geologic disposal of HLW and SNF

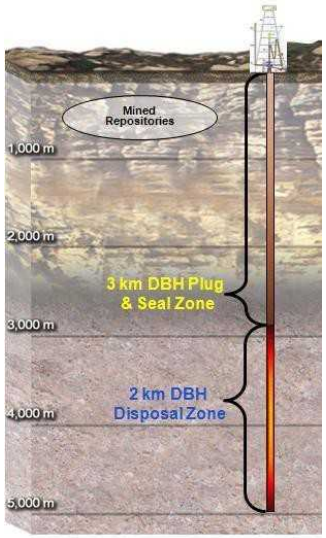
Deep Geologic Disposal Remains the Preferred Approach for Long-Term Isolation of Nuclear Waste

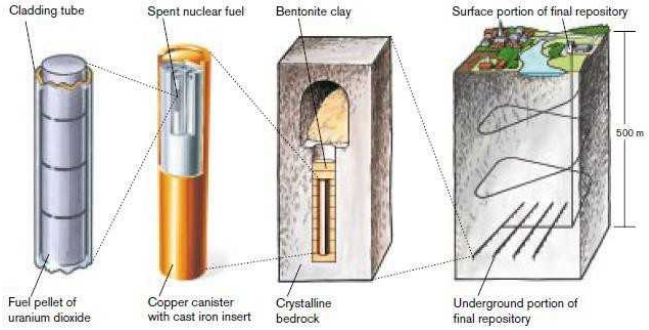
"The conclusion that disposal is needed and that deep geologic disposal is the scientifically preferred approach has been reached by every expert panel that has looked at the issue and by every other country that is pursuing a nuclear waste management program."

Blue Ribbon Commission on America's Nuclear Future, 2012





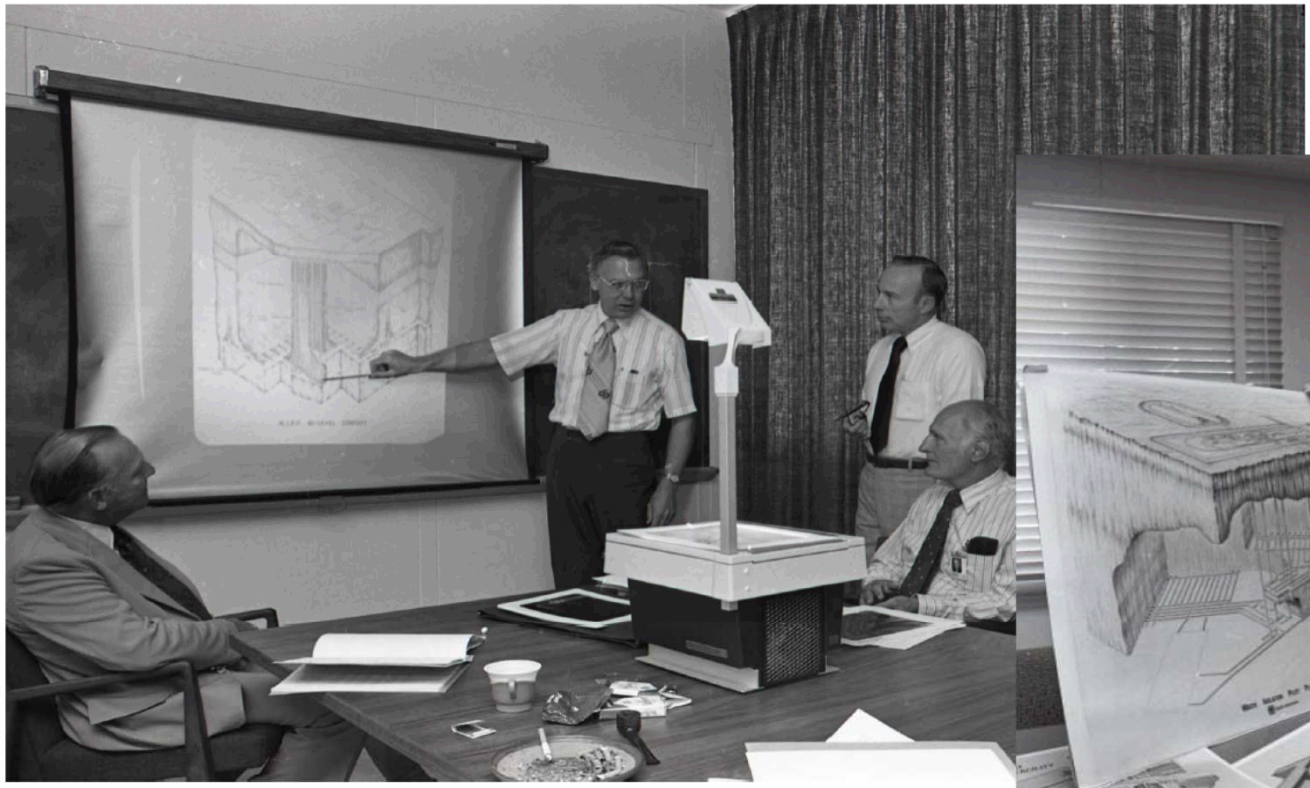




Background

The WIPP Scientific Advisor Role since mid-70's

Background

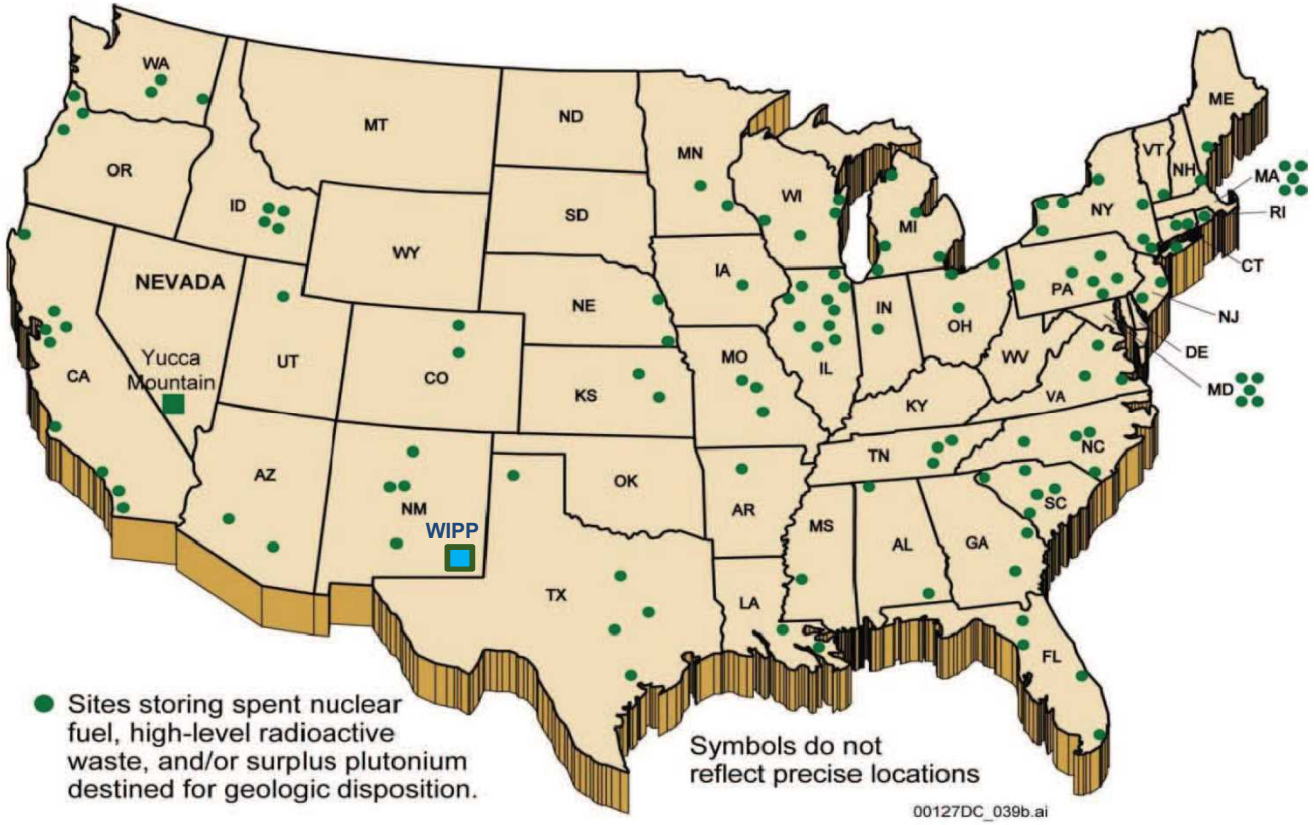


Sandia's contributions date back to 1974, when the Atomic Energy Commission (AEC, one of DOE's predecessor agencies) asked Sandia to study whether the nation's defense nuclear waste could be buried safely in the 250-million-year-old salt beds near Carlsbad, N.M.

LANL has also made significant contributions to WIPP

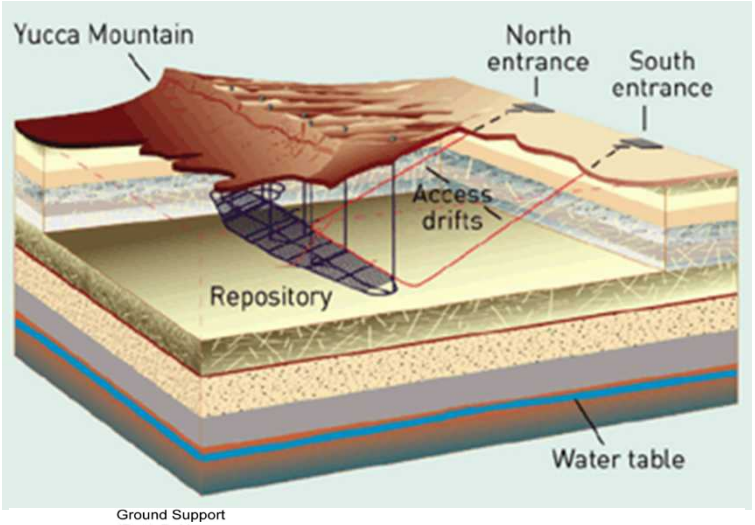
SNL, LANL, and LLNL made major contributions over > 30 years to the proposed Yucca Mountain Repository

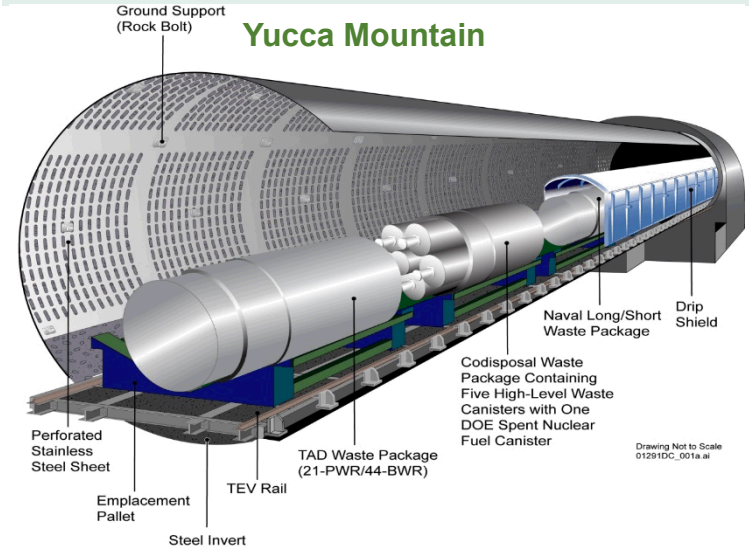
Map of the contiguous United States showing the locations of Yucca Mountain, WIPP, and 126 sites where radioactive waste is currently stored



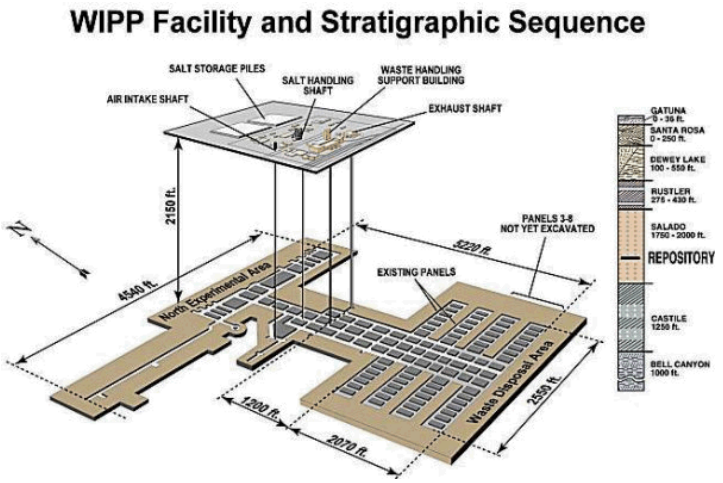
Background

Yucca Mountain and Waste Isolation Pilot Plant





Yucca Mountain



WIPP

Background

Spent Fuel and Waste Science and Technology R&D Campaign Mission

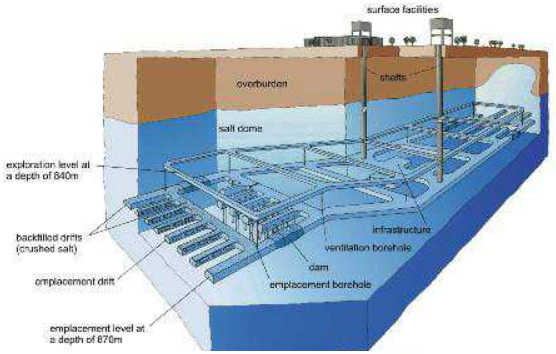
The DOE Office of Spent Fuel and Waste Science and Technology and nine national laboratories participate in the DOE Office of Nuclear Energy's "Spent Fuel and Waste Science and Technology R&D Campaign"

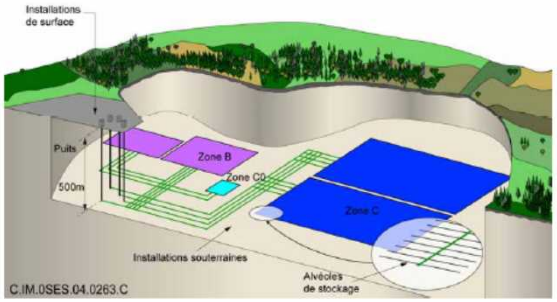
Campaign Mission: to identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles

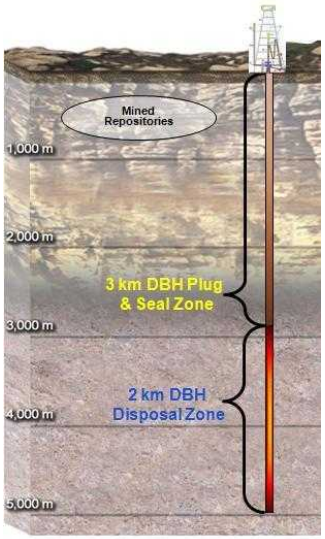
Background

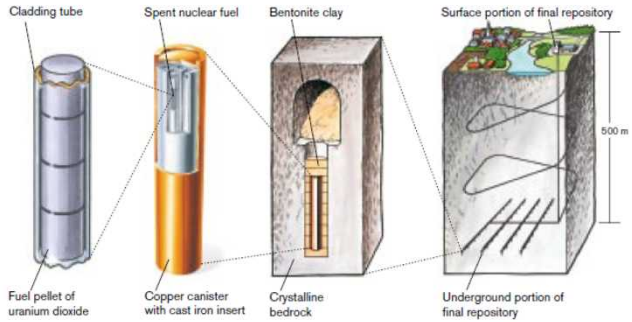
Spent Fuel and Waste Science and Technology R&D Campaign Disposal R&D Objectives

- Provide a sound technical basis for multiple viable disposal options in the US
- Increase confidence in the robustness of generic disposal concepts
- Develop the science and engineering tools needed to support disposal concept implementation



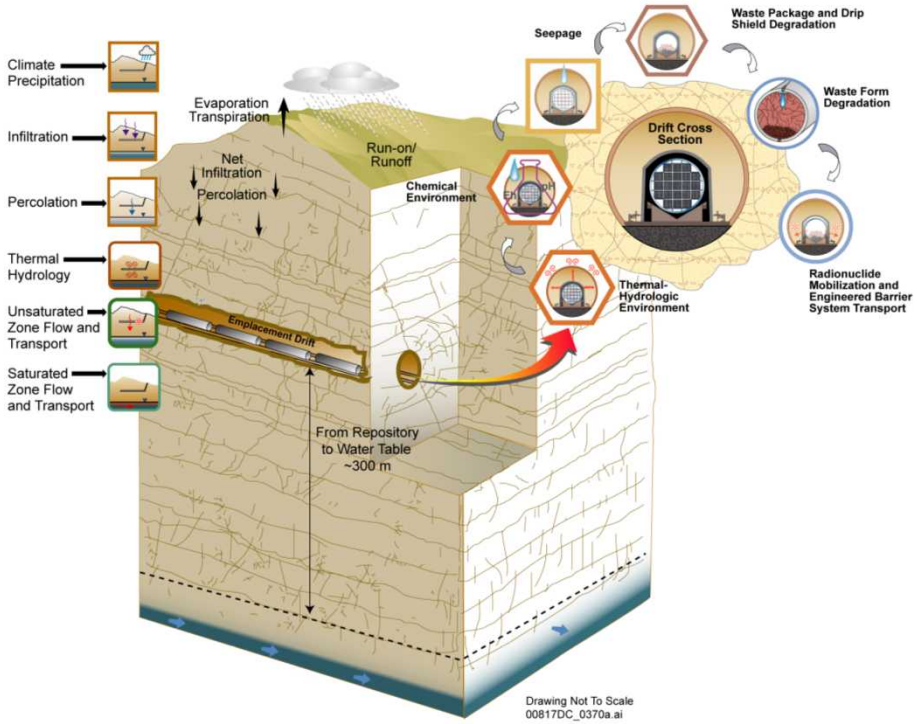


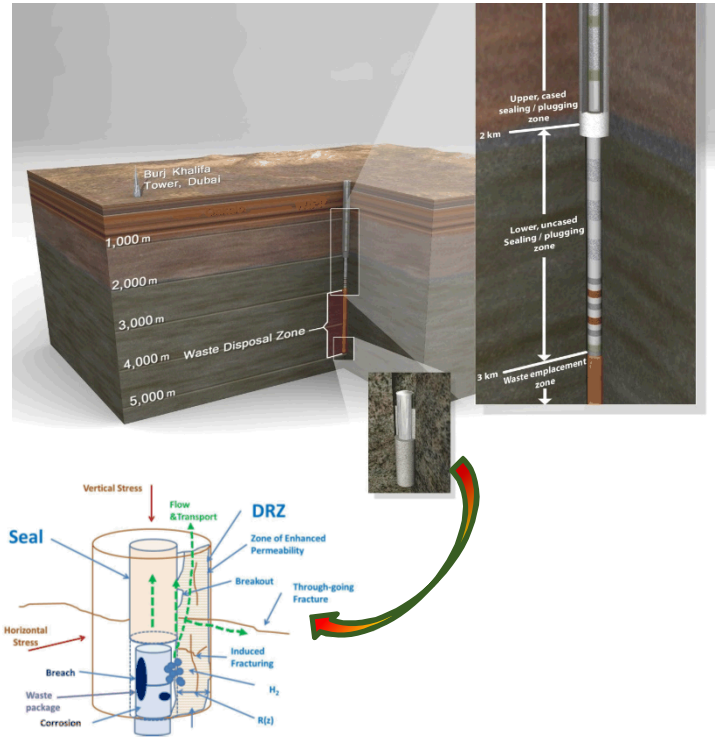




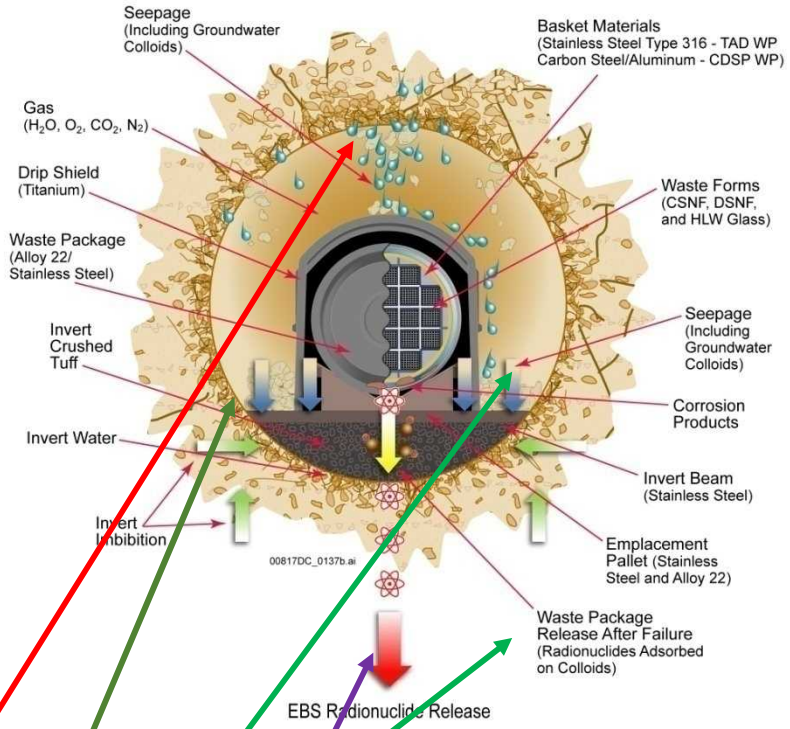
Area V collaborative research projects will leverage IAEC and NNSA expertise to help meet US and Israel Waste Management Objectives

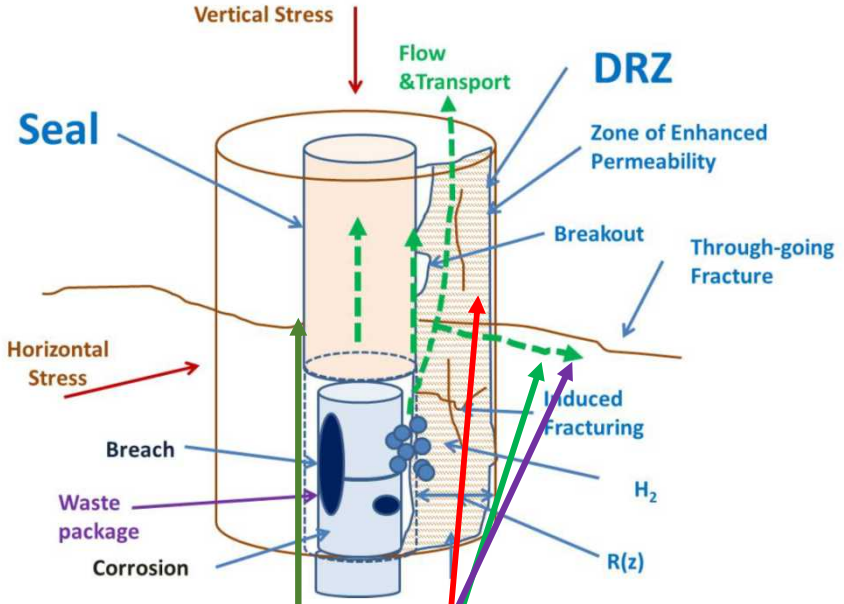
Coupled Processes Determine Disposal Facility Long-Term Performance





Area V Research Projects





Damage Induced by Excavation and Heat Release of a Radioactive Waste Repository

Nuclear Wasteform and Barrier Matrixes Interactions With Geologic Strata

Colloid-Facilitated Radionuclide Transport in Fractured Carbonate Rock

Mechanisms of subsurface flow and radionuclide transport

Deep Borehole Disposal

Elements of Performance Assessment

Biosphere
- Dilution
- Irrigation
- Water Consumption
- Dose Conversion Factors

Repository Design
- Location and layout
- No. and type of WPs
- EBS and Seals
- Thermal Loading and Ventilation

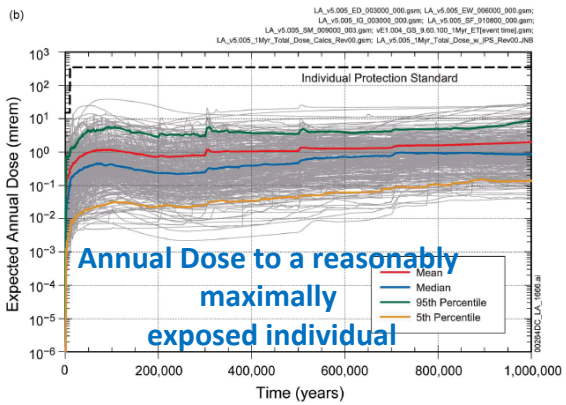
Near Field (EBS + DRZ)
- EBS Evolution
- DRZ Evolution
- Chemical Interactions
- Thermal Effects
- Mechanical Effects
- Flow and Transport

Source Term
- RN Inventory
- WF Degradation
- WP Degradation
- Gas Generation
- RN Release

Far Field
- Flow and Transport
- Sorption
- RN Decay and Ingrowth

Natural System
- Climate
- Stratigraphy
- Hydrogeology
- Geochemistry
- Material properties
- Disruptive events

Performance Goal



Annual Dose to a reasonably maximally exposed individual

Engineered Barrier System (EBS)
Radionuclide (RN)
Waste Form (WF)
Waste Package (WP)
Disturbed Rock Zone (DRZ)