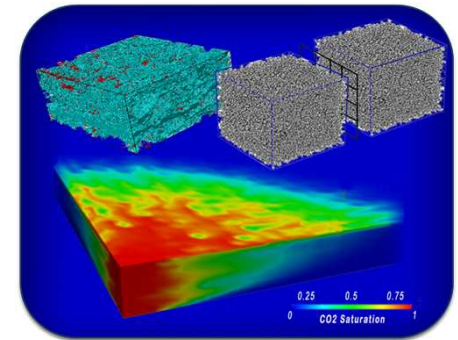
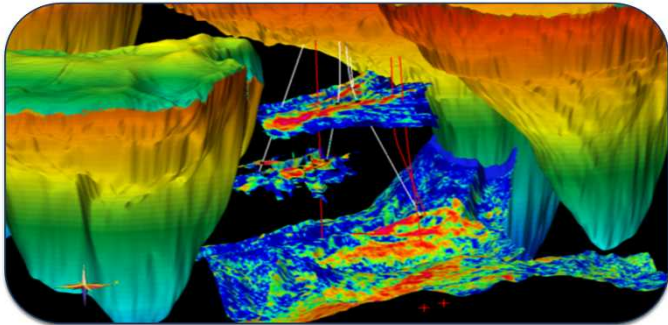


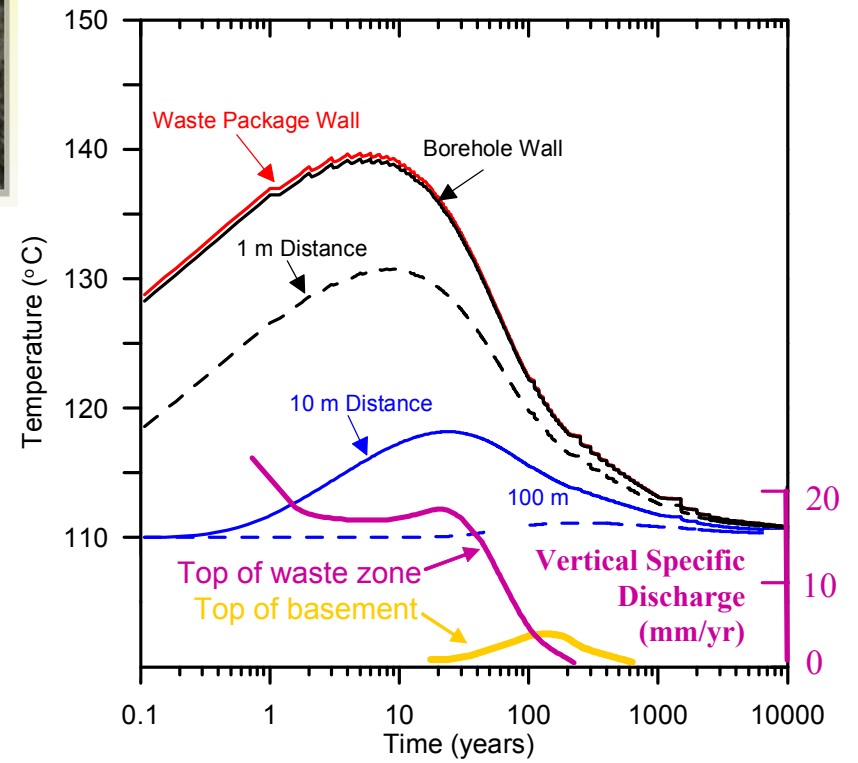
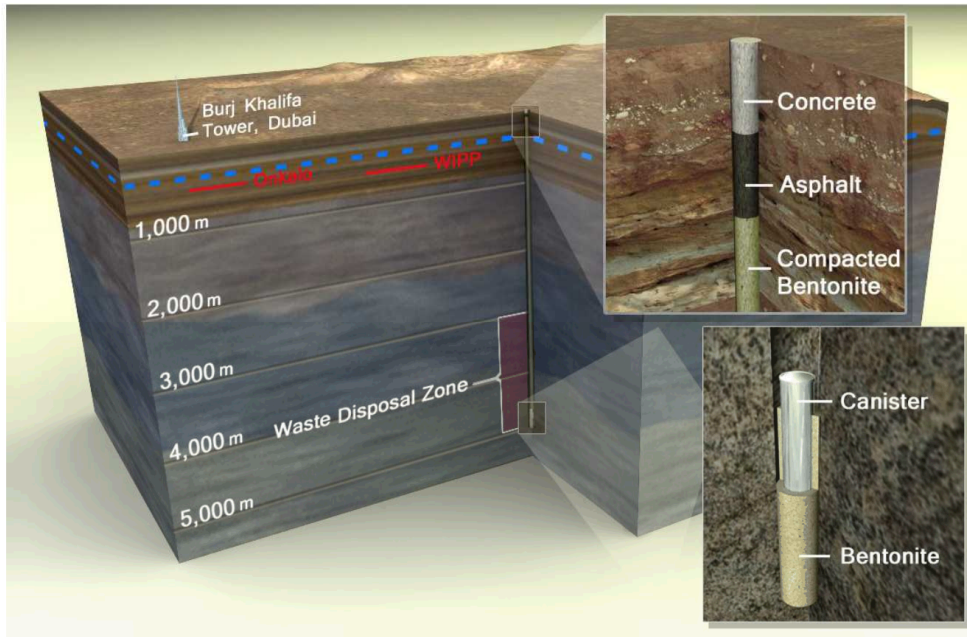
Exceptional service in the national interest



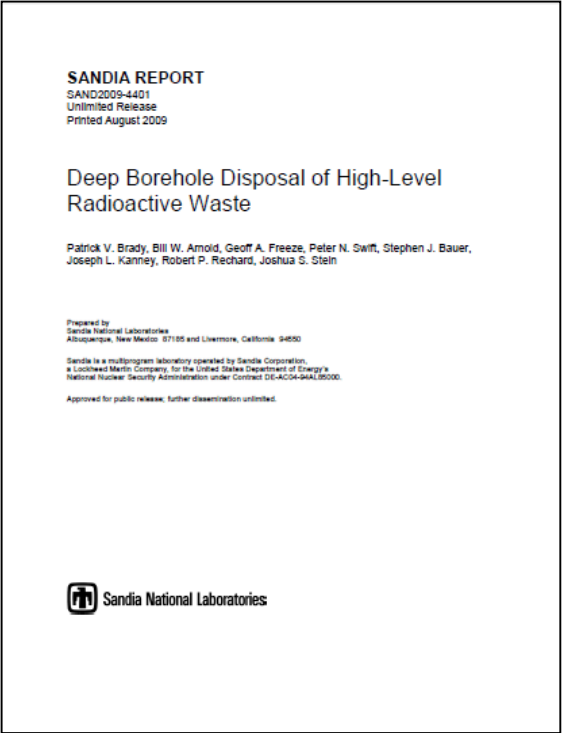
“DOE should develop an RD&D plan and roadmap for taking the borehole disposal concept to the point of a licensed demonstration.”

Deep Borehole Demonstration

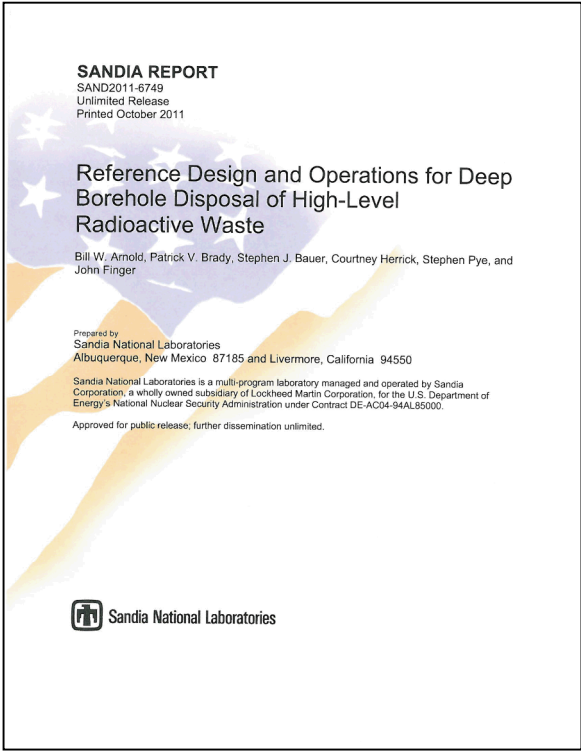
Patrick V. Brady, Robert J. MacKinnon, and
Bill Arnold



From the Blue Ribbon Commission on America's Nuclear Future Draft Report to the Secretary of Energy ***“DOE should develop an RD&D plan and roadmap for taking the borehole disposal concept to the point of a licensed demonstration.”*** January 26, 2012.



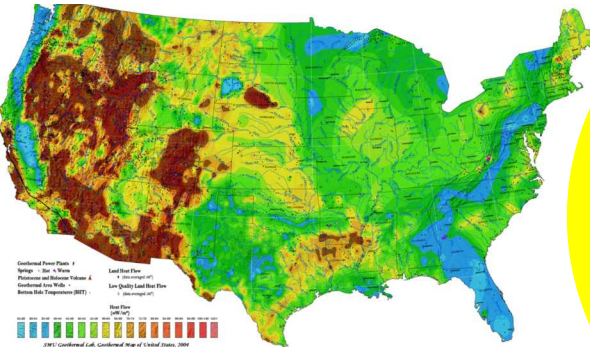
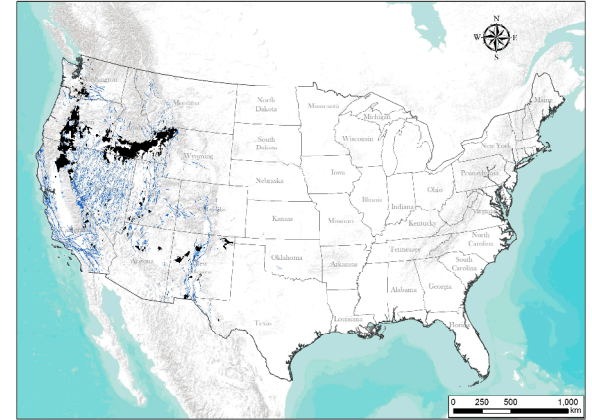
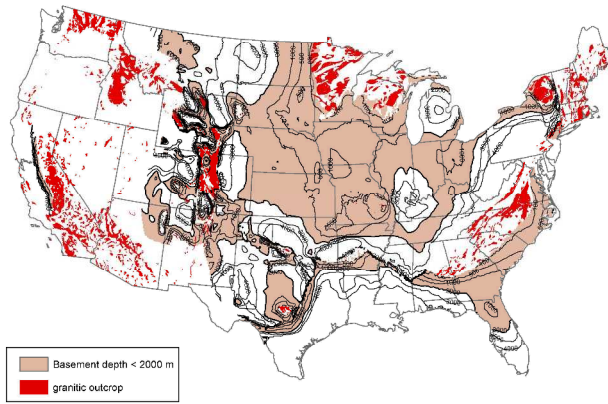
2009



2011

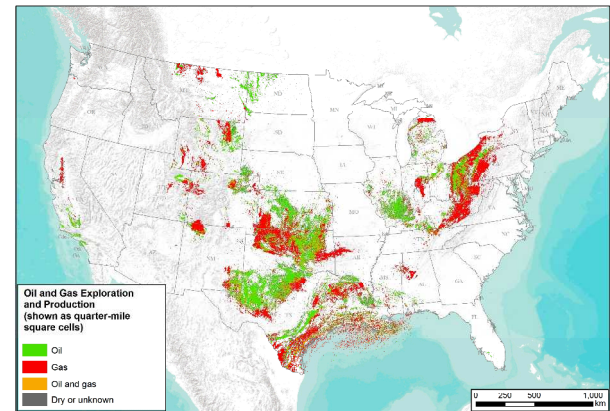
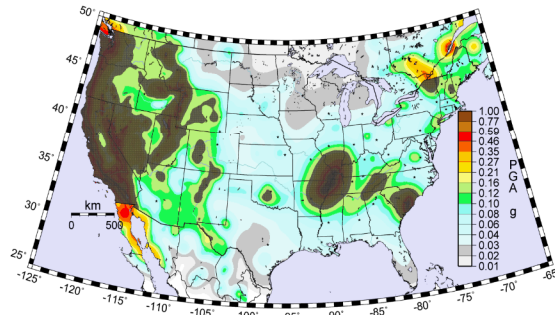


2012



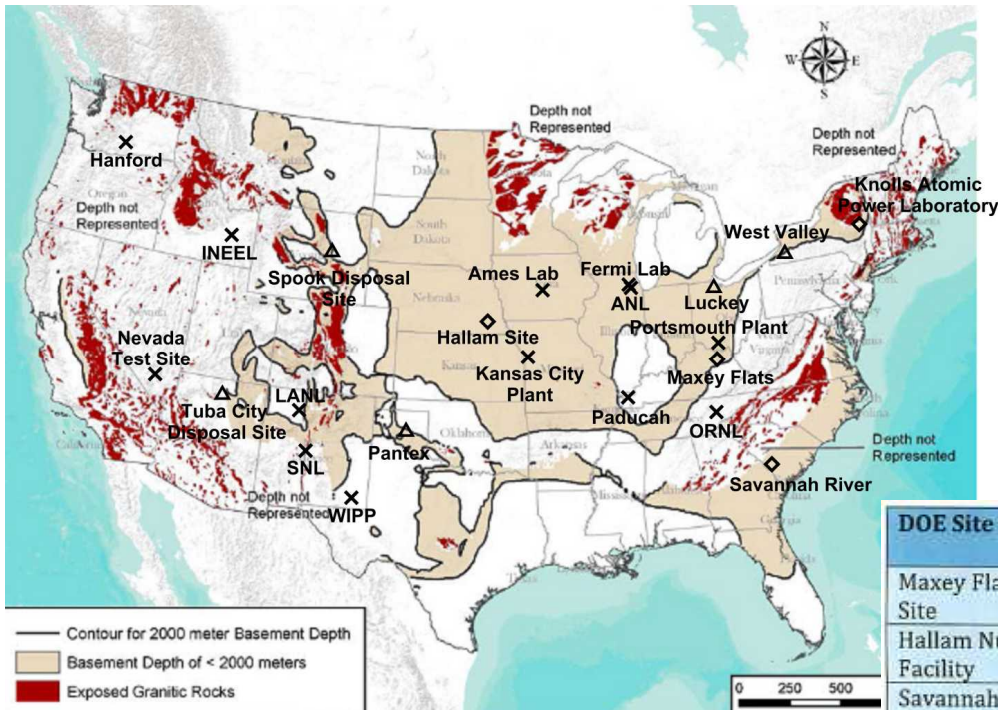
**Crystalline
basement < 2 km,
Absence of recent
volcanics,
Absence of oil
and gas activity,
Low seismicity,
Low heat flow**

PGA with 2% in 50 year PE. BC rock. 2008 USGS



DOE Site Screening Criteria

- Depth to crystalline basement – less than 2 km to basement effectively required
- Strategic petroleum reserve site – these sites were effectively eliminated
- Distance to urban area – sites within 10 km of an urban area were effectively eliminated
- Site area greater than 1 km² – sites with ample area for drilling operations preferred
- Distance to large topographic relief – distance of greater than 100 km to topographic slope of greater than 1° preferred to avoid deep groundwater circulation
- Geothermal heat flux – less than 75 mW/m² preferred
- Seismic hazard – less than 2% probability within 50 years of peak ground acceleration greater than 0.16 g preferred. Also generally indicative of tectonic stability
- Distance to Quaternary age volcanism – greater than 10 km distance preferred
- Distance to Quaternary age faulting – greater than 10 km distance preferred
- Crystalline basement structural complexity – lack of major shear zones or major tectonic features preferred
- Density of petroleum drilling – low density of deep drilling preferred
- Existing deep subsurface radioactive contamination – lack of existing radioactive contamination preferred



High Ranking DOE Sites

DOE Site Name	State	Ranking Class	Notes
Maxey Flats Disposal Site	Kentucky	Primary	Some uncertainty in depth to crystalline basement
Hallam Nuclear Power Facility	Nebraska	Primary	Crystalline basement may be structurally complex.
Savannah River Site	South Carolina	Primary	Crystalline basement rocks at this site are geologically younger than the Precambrian age rocks at most other sites. Hydrogeological isolation of these rocks is less well established.
Knolls Atomic Power Laboratory	New York	Primary	Relatively near urban area
Luckey Site	Ohio	Secondary	Relatively small site area
Spook UMTRA Site	Wyoming	Secondary	Significant uncertainty exists concerning the depth to crystalline basement. Additional information might eliminate this site on that basis.
Pantex Plant	Texas	Secondary	Significant uncertainty exists concerning the depth to crystalline basement. Additional information might eliminate this site on that basis.
Tuba City UMTRA Site	Arizona	Secondary	Significant uncertainty exists concerning the depth to crystalline basement. Additional information might eliminate this site on that basis.
West Valley Demonstration Project	New York	Secondary	Significant uncertainty exists concerning the depth to crystalline basement. Additional information might eliminate this site on that basis.

Table 5.1-1 Overlapping enhanced geothermal technology and deep borehole needs

Wellbore integrity and drilling technology

- Novel materials for well completions
- Real-time, in situ data acquisition and transmission systems
- Diagnostics and remediation tools and techniques
- Quantification of seal material and failure
- Advanced drilling and completion tools
- Well abandonment analysis

Subsurface Stress

- Sensing stress state beyond the borehole

Fracture & Fluid Flow Control

- Physicochemical controls and responses
- Manipulating (enhancing, reducing and eliminating) fluid flow

New Subsurface Signals

- New Sensors and Monitoring Approaches
- Next Generation Integration Approaches
- Diagnostic signatures of critical transitions
- Autonomous acquisition, processing and assimilation

After: Hubbard S. and Walck, M. C. Adaptive Control of Fractures and Fluids. Subsurface Crosscut National Lab Team. Presented to USEA (2014).