Used Fuel Disposition Campaign

Deep Borehole Disposal Work Package: Overview

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Sandia National Laboratories

UFDC Annual Working Group Meeting
Las Vegas, NV
June 9-11, 2015
Objectives

- Five-year project, planned for FY15 through FY19, to design and implement a Deep Borehole Field Test (DBFT)

Scope (FY15 Activities)

- Task 1: Site Selection (D. Sassani)
- Task 2: Site Characterization (K. Kuhlman)
- Task 3: Field Test Design and Analysis (E. Hardin)
- Task 4: Project Management and Regulatory (G. Freeze)
Deep Borehole Field Test (DBFT) Participants

- **DOE**
  - (DOE-LV): Tim Gunter, Lam Xuan
  - (DOE-ID): Gordon McLellan, Brad Heath, Eliot Dye

- **SNL**
  - Bob MacKinnon, Geoff Freeze, David Sassani, Kris Kuhlman, Ernie Hardin, Pat Brady, (Bill Arnold), Jack Tillman, Gordon Appel, Mark Rigali

- **LANL**
  - Frank Perry, Rick Kelley

- **LBNL**
  - Jim Houseworth, Pat Dobson

- **PNNL**
  - Paul Eslinger, Brady Hanson

- **INL**
  - Dan Jensen

- **ORNL**
  - Randy Belles
Wed. 06/10 (Room 1242) – 08:00 to 09:50
- DBFT Overview (Freeze)
- Site Selection and Evaluation (Sassani, Perry, Belles)
  • Presentations and discussion
- Site Characterization (Kuhlman)
  • Presentations and discussion

Wed. 06/10 (Room 1242) – 10:10 to 12:00
- Test Design (Hardin, Cochran, Sevougian)
  • Presentations and discussion
- International Deep Borehole Experience (Faybishenko, Tsang)
- Borehole Design Options (Rigali)
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Deep Borehole Field Test (DBFT): Overview
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Deep Borehole Disposal History

- Hess et al. (1957) NAS Publication 519
  - The Disposal of Radioactive Waste on Land. Appendix C: Committee on Deep Disposal

- Obrien et al. (1979) LBL-7089
  - The Very Deep Hole Concept: Evaluation of an Alternative for Nuclear Waste disposal

- Woodward-Clyde (1983) ONWI-226
  - Very Deep Hole Systems Engineering Studies

- Juhlin and Sandstedt (1989) SKB 89-39
  - Storage of Nuclear Waste in Very Deep Boreholes

- Ferguson (1994) SRNL WSRC-TR-94-0266
  - Excess Plutonium Disposition: The Deep Borehole Option

- Heiken et al. (1996) LANL LA-13168-MS
  - Disposition of Excess Weapon Plutonium in Deep Borehole: Site Selection Handbook

- Harrison (2000) SKB-R-00-35
  - Very Deep Borehole – Deutag’s Opinion on Boring, Canister Emplacement and Retrievability

  - A Review of the Deep Borehole Disposal Concept

- Beswick (2008)
  - Status of Technology for Deep Borehole Disposal

- Brady et al. (2009) SNL SAND2009-4401
  - Deep Borehole Disposal of High-Level Radioactive Waste

- DOE UFD R&D (2011 - Present)

Deep Borehole Field Test DBFT

## Used Fuel Disposition

### Deep Borehole Drilling History

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Years</th>
<th>Depth [km]</th>
<th>Diam. [in]</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenton Hill (3)</td>
<td>New Mexico</td>
<td>1975-1987</td>
<td>3, 4.2, 4.6</td>
<td>8¾, 9⅛</td>
<td>Enhanced Geothermal</td>
</tr>
<tr>
<td>Cajon Pass</td>
<td>California</td>
<td>1987-1988</td>
<td>3.5</td>
<td>6¼</td>
<td>Geomechanics near San Andreas Fault</td>
</tr>
<tr>
<td>KTB (2)</td>
<td>SE Germany</td>
<td>1987-1994</td>
<td>4, 9.1</td>
<td>6, 6½</td>
<td>Geologic Exploration + Technology Development</td>
</tr>
<tr>
<td>Soultz-sous-Forêts GPK (3)</td>
<td>NE France</td>
<td>1995-2003</td>
<td>5.1, 5.1, 5.3</td>
<td>9¾</td>
<td>Enhanced Geothermal</td>
</tr>
</tbody>
</table>

### Timeline

Crystalline basement rocks are common in many stable continental regions. Existing drilling technology should permit dependable construction at acceptable cost. Low permeability, density stratification, and long residence time of deep saline groundwater opposes upward flow. Geochemically reducing conditions at depth limit the solubility and enhance the sorption of many radionuclides. Borehole seals can be engineered to maintain a low-permeability barrier over the period of thermally-induced upward flow. Waste canisters can be engineered to maintain structural integrity during transportation, handling, and emplacement.
The DBFT includes:

- Characterization Borehole (CBH) - smaller-diameter (8.5 in.) to 5,000 m
  - Drilling and completing
  - Downhole characterization testing
- Field Test Borehole (FTBH) - larger-diameter (17 in.) to 5,000 m
  - Drilling and completing
- Canister Handling and Emplacement Testing
  - Canister design and fabrication
    - Surrogate canisters without radioactive waste
  - Canister surface handling demonstration
  - Downhole emplacement and retrieval demonstration
- Seals Research
- Assessment and Analysis
  - System Modeling
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DBFT Project Organization Chart

Fuel Cycle Technologies
John Herczeg, DOE/NE-5

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William Boyle, DOE/NE-53
Tim Gunter, DOE
Peter Swift, NTD

Deep Borehole Field Test
Project Technical Lead, SNL
Supporting National Labs and University Partners

Procurement Support
DOE-ID

Contracts

Technical Advisor/Execution Support

Site Management and Drilling Integration Services for Characterization Borehole

Engineering Services

Drilling Integration Services for Field Test Borehole

Canister and Emplacement System Engineering

Characterization Borehole Design and Testing

Project Management

Site Selection and Site Characterization

Emplacement System Demonstration
DBFT FY15 Timeline

- 09/30/14 – Final Project Plan Rev. 0 Submitted
- 10/24/14 – Siting RFI Issued
- 12/08/14 – Siting RFI Responses Received
- 04/07/15 – Draft RFP Issued for Site Management and Drilling CBH
- 05/05/15 – Draft RFP Responses Received
- Summer 2015 – Award IDIQ Contract for Engineering Services
- Summer 2015 – Issue Final RFP for Site Management & Drilling CBH
- Fall 2015 – Final RFP Responses Due
- Early 2016 – Award Contract for Site Management & Drilling CBH
- Summer/Fall 2016 – Start Drilling CBH
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DBFT Estimated Project Budget

- ~ $80M over 5-year duration (FY15-FY19)
  
  - FY15: $6.5M planning and procurements
  
  - FY16-FY18: >$20M per year, significant drilling and engineering costs
  
  - FY19: closeout
DBFT FY15 Milestones

- **06/04/15 - Site Evaluation for Deep Borehole Field Test**
  - SNL, LANL, LBNL, ORNL [M2FT-15SN0817061]

- **07/01/15 - Site Acquisition Activities Initiated**
  - DOE-HQ [M2FT-15HQ0817072]

- **09/15/15 - Deep Borehole Field Test Specifications**
  - SNL, LBNL [M2FT-15SN0817091]

- **09/29/15 - Conceptual Design and Requirements for Characterization and Field Test Boreholes**
  - SNL, LANL, INL [M2FT-15SN0817081]

- **12/31/15 - Site Selection Recommendation**
  - DOE-HQ [M2FT-15HQ0817071]
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Deep Borehole Field Test (DBFT): Site Selection
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Deep Borehole Field Test (DBFT): Site Characterization
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Deep Borehole Field Test (DBFT): Test Design
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Deep Borehole Field Test (DBFT): Open Discussion
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