Used Fuel Disposition Campaign

Deep Borehole Disposal Work Package: Overview

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Sandia National Laboratories

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Deep Borehole Disposal Work Package (1.02.08.17)

- **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

Session Outlines

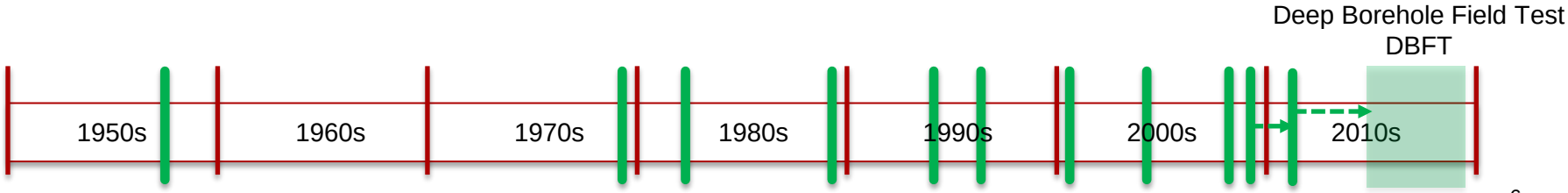
- **Wed. 06/10 (Room 1242) – 08:00 to 09:50**
  - DBFT Overview (Freeze)
  - Site Selection and Evaluation (Sassani, Perry, Belles)
    - *Presentations and discussion*
  - Site Characterization (Kuhlman)
    - *Presentations and discussion*

- **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)

Deep Borehole Field Test (DBFT): Overview

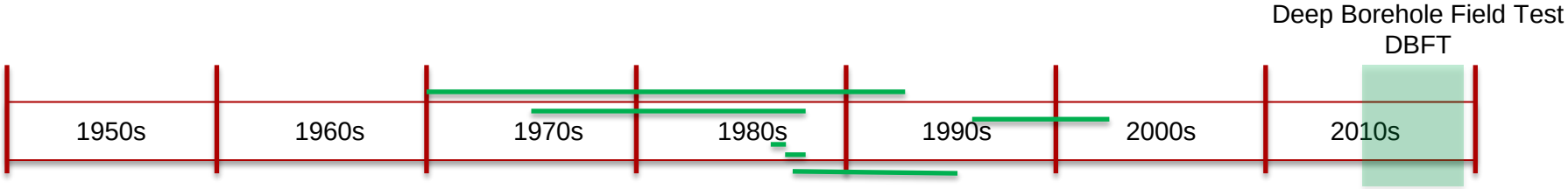
Deep Borehole Disposal History

- **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*
- **Nirex (2004) N/108**
  - *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 Drilling History

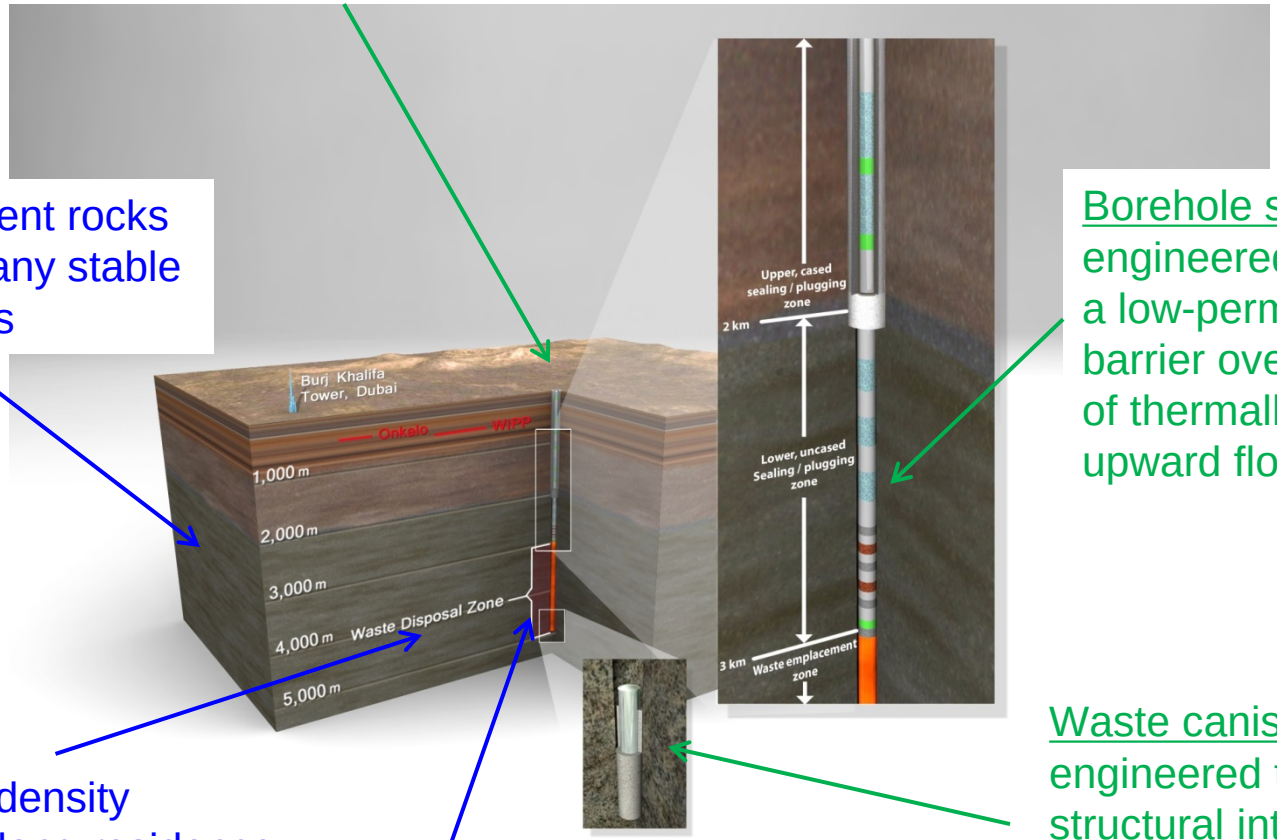
Name	Location	Years	Depth [km]	Diam. [in]	Purpose
Kola SG-3	NW USSR	1970-1992	12.2	8½	Geologic Exploration + Technology Development
Fenton Hill (3)	New Mexico	1975-1987	3, 4.2, 4.6	8¾, 9⅞	Enhanced Geothermal
Gravberg	Central Sweden	1986-1987	6.6	6½	Gas Wildcat in Siljan Impact Structure
Cajon Pass	California	1987-1988	3.5	6¼	Geomechanics near San Andreas Fault
KTB (2)	SE Germany	1987-1994	4, 9.1	6, 6½	Geologic Exploration + Technology Development
Soultz-sous-Forêts GPK (3)	NE France	1995-2003	5.1, 5.1, 5.3	9⅝	Enhanced Geothermal



Deep Borehole Disposal Concept
Engineering and Hydrogeochemical Feasibility

Existing drilling technology should permit dependable construction at acceptable cost

Crystalline basement rocks are common in many stable continental regions



Borehole seals can be engineered to maintain a low-permeability barrier over the period of thermally-induced upward flow

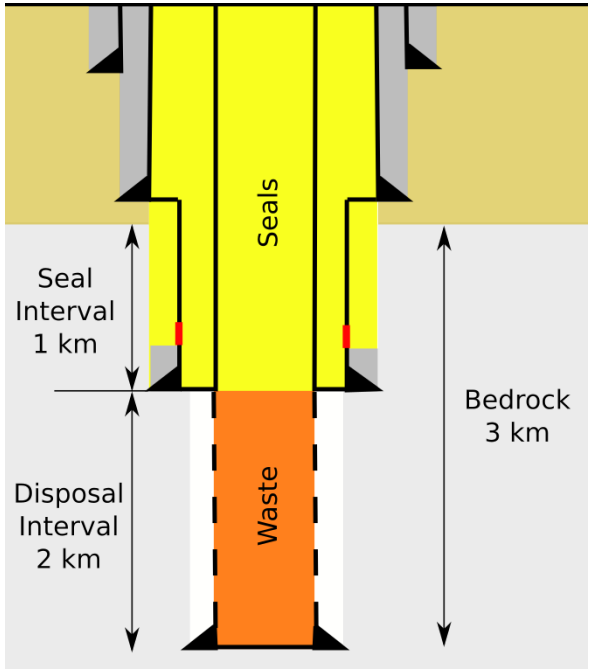
Low permeability, density stratification, and long residence time of deep saline groundwater opposes upward flow

Geochemically reducing conditions at depth limit the solubility and enhance the sorption of many radionuclides

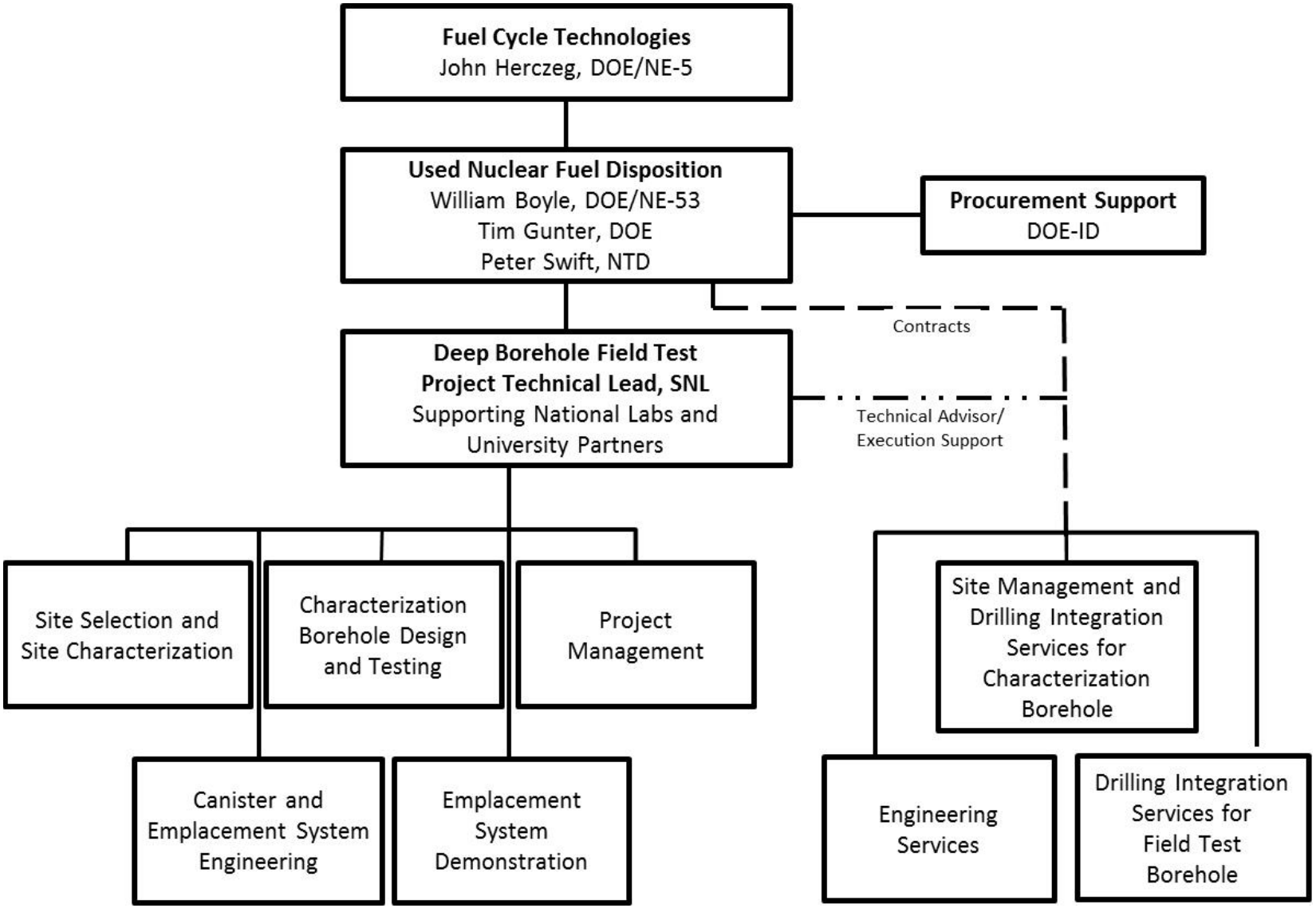
Waste canisters can be engineered to maintain structural integrity during transportation, handling, and emplacement

DBFT Overview

- **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*



DBFT Project Organization Chart



DBFT FY15 Timeline

- **09/30/14 – Final Project Plan Rev. 0 Submitted**
  - FCRD-UFD-2014-000592, SAND2014-18559R
- **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**

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]

Deep Borehole Field Test (DBFT): Site Selection

Deep Borehole Field Test (DBFT): Site Characterization

Deep Borehole Field Test (DBFT): Test Design

Deep Borehole Field Test (DBFT): Open Discussion

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