Used Fuel Disposition R&D Campaign

Introduction to the *DOE-Managed Spent Nuclear Fuel and High Level Waste Research* (aka Defense Repository)

David Sevougian, Kevin McMahon

Sandia National Laboratories

Used Fuel Disposition Working Group Meeting

Las Vegas, Nevada

June 7-9, 2016

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND2016-5110-PE

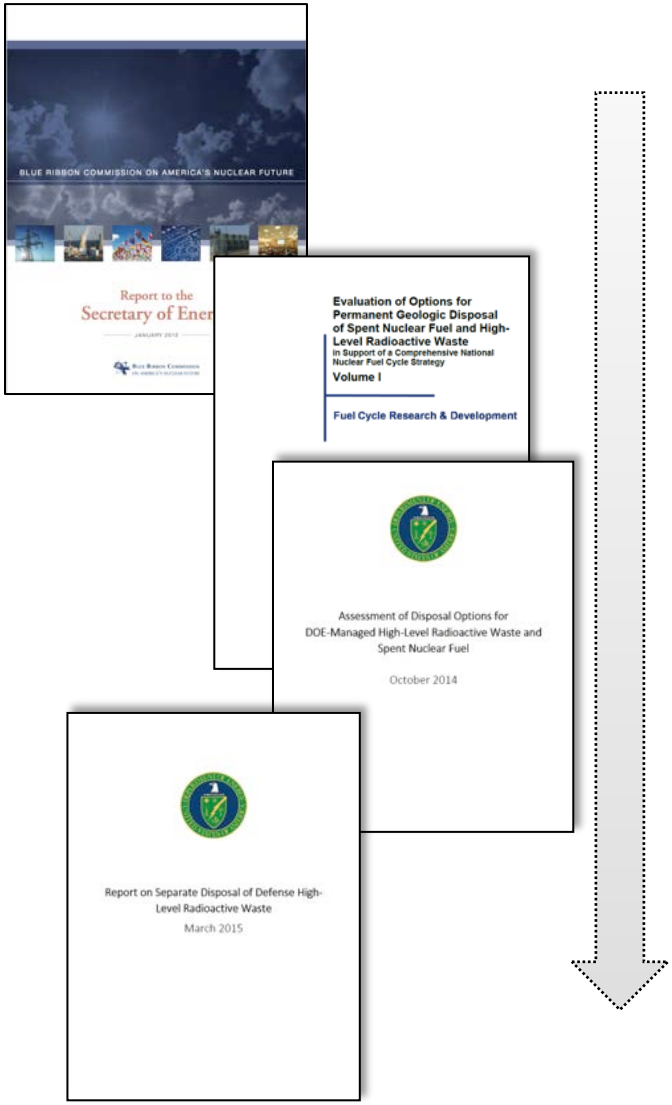
Outline for this Introduction

- **Overview and background**
  - Timeline leading up to March 2015 decision
  - Separate repository
- **Structure of the DOE-managed SNF/HLW R&D program**
  - Major technical components
- **What is DOE Managed HLW & SNF?**
  - Volumes and thermal characteristics
  - Options for disposal
- **UFD WG Agenda for DOE Managed HLW & SNF discussions and presentations**

Used Fuel Disposition

Recent Timeline for Separate Repository

- **January 2012 Blue Ribbon Commission (BRC) on America's Nuclear Future report to the Secretary of Energy**
  - Recommends review of "single repository" policy, whereby defense-related and commercial wastes are commingled
- **April 2014 UFD report "Evaluation of Options for Disposal…"**
  - Concludes that both commingled and separate repositories are technically feasible
- **October 2014 DOE report "Assessment of Disposal Options…"**
  - Recommends that the DOE begin implementation of a phased, adaptive, and consent-based strategy with development of a separate repository for some DOE-managed HLW and SNF
  - Also recommends the DOE retain flexibility to consider deep borehole disposal of some DOE-managed waste forms
- **March 2015 DOE report "…Separate Disposal of Defense High-Level Radioactive Waste"**
  - Presents the basis for a decision in the context of the Nuclear Waste Policy Act



The March 24, 2015 Decision

The White House

Office of the Press Secretary

E-Mail Tweet Share +

For Immediate Release March 24, 2015

Presidential Memorandum -- Disposal of Defense High-Level Radioactive Waste in a Separate Repository

MEMORANDUM FOR THE SECRETARY OF ENERGY

SUBJECT: Disposal of Defense High-Level Radioactive Waste in a Separate Repository

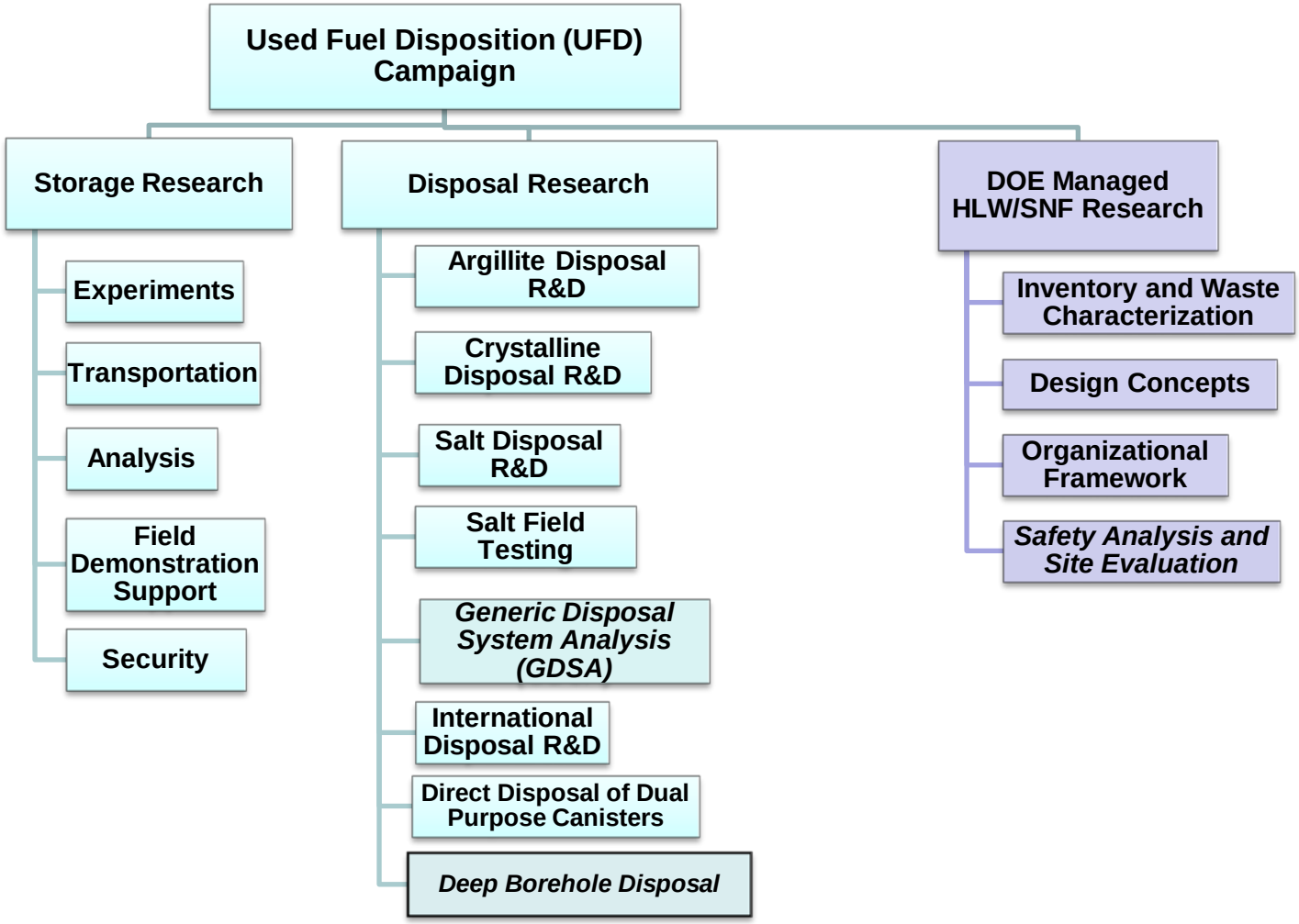
Your memorandum and accompanying report of January 9, 2015, analyze the factors enumerated in section 8 of the Nuclear Waste Policy Act of 1982 (the "Act") concerning disposal of high-level radioactive waste resulting from atomic energy defense activities, conclude that a strong basis exists to find a separate repository is required pursuant to section 8 of the Act, and recommend that I make this finding.

In accordance with the Act, I find the development of a repository for the disposal of high-level radioactive waste resulting from atomic energy defense activities only is required.

BARACK OBAMA

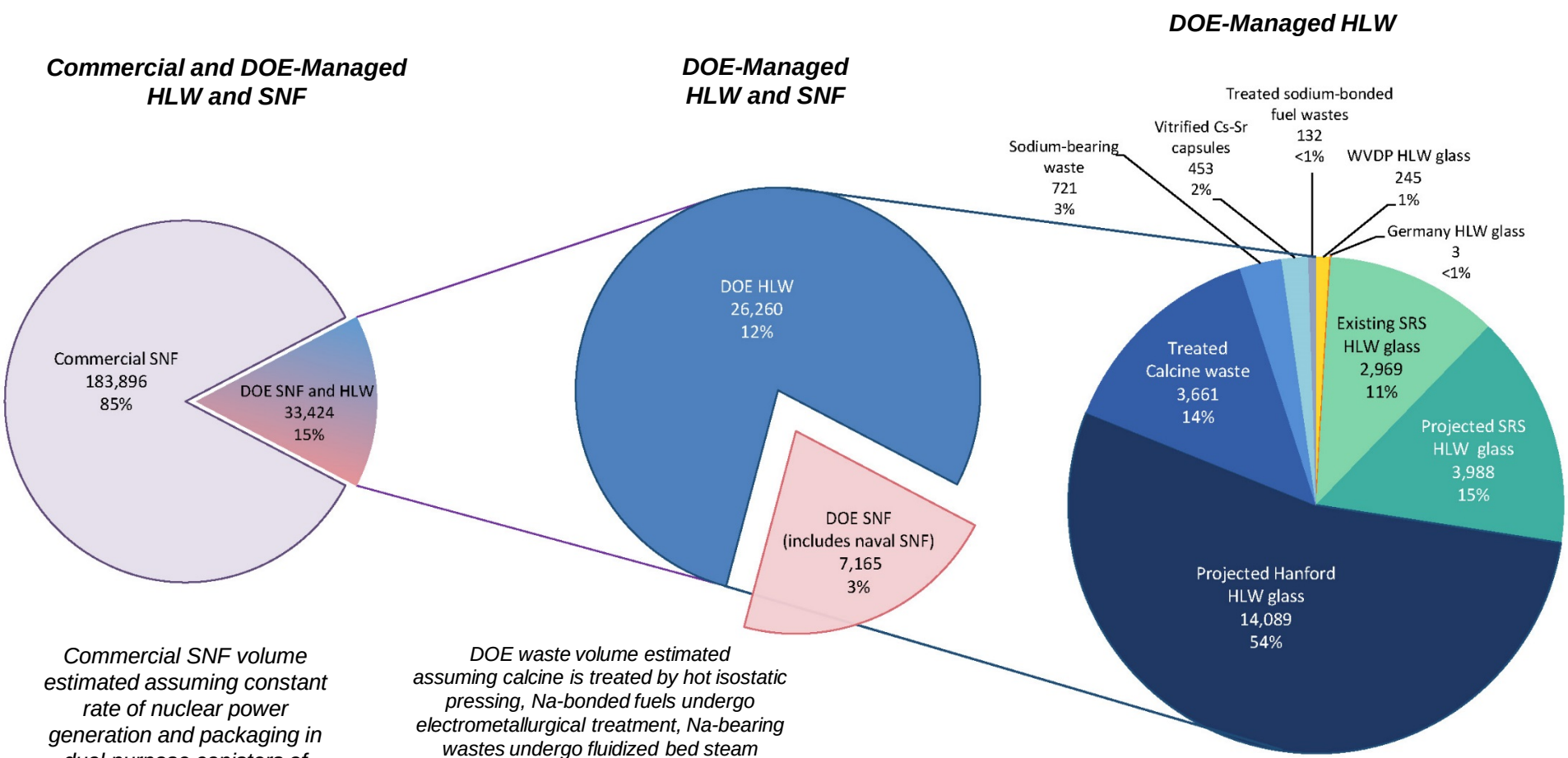
Used Fuel Disposition

Work Structure for the R&D Program



Projected Volumes of DOE-managed HLW and SNF in 2048

Projected volumes in m^3

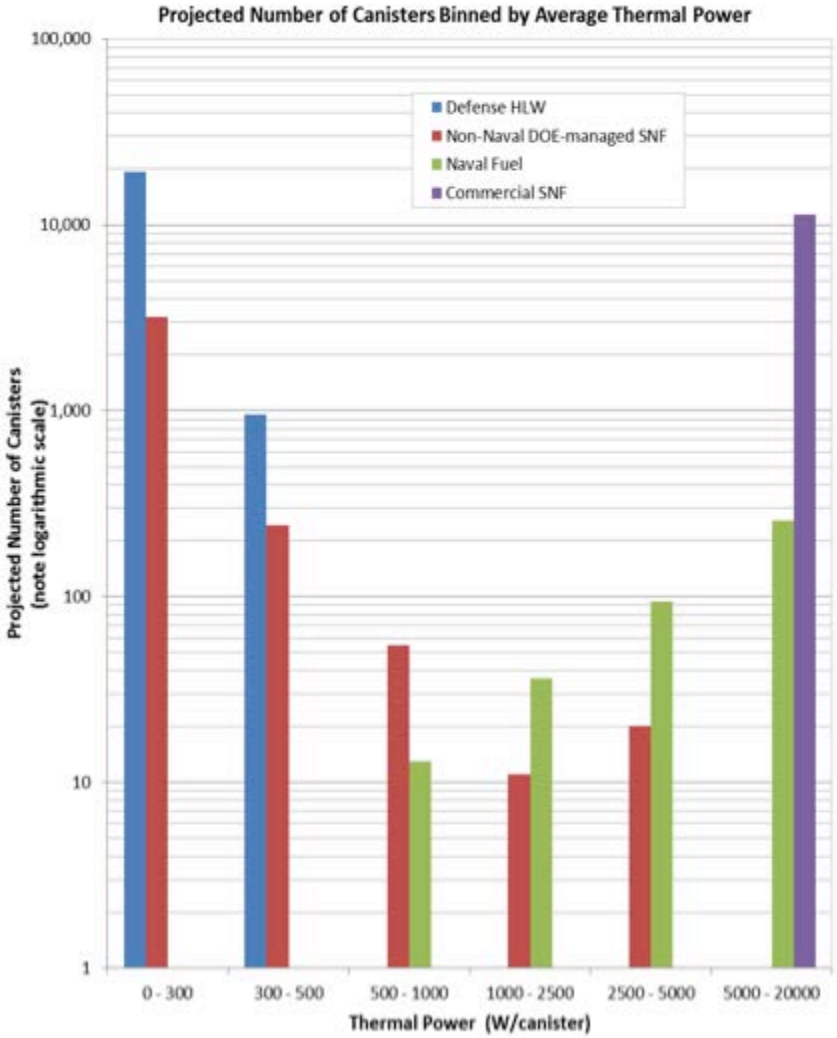


Commercial SNF volume estimated assuming constant rate of nuclear power generation and packaging in dual purpose canisters of existing design

DOE waste volume estimated assuming calcine is treated by hot isostatic pressing, Na-bonded fuels undergo electrometallurgical treatment, Na-bearing wastes undergo fluidized bed steam reforming, and all other HLW wastes are vitrified. Naval SNF estimated as of 2035

Thermal Characteristics of HLW and SNF Affect Disposal Strategies

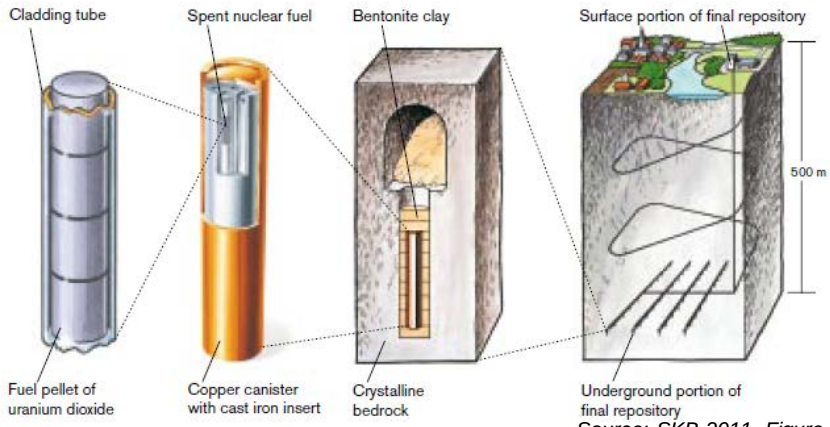
- **Repository designs and operational concepts can be engineered to address waste-form thermal characteristics:**
  - All Defense HLW is relatively cold: less than 500 W per canister
  - Most DOE-managed SNF is relatively cold: less than 1000 W per canister
  - All commercial SNF has comparatively high thermal output
  - Some naval SNF is comparable in thermal power to commercial SNF
- **Initial R&D will limit EBS/repository designs to canisters of approximately less than 1000 W**



Used Fuel Disposition

Potential Disposal Concepts

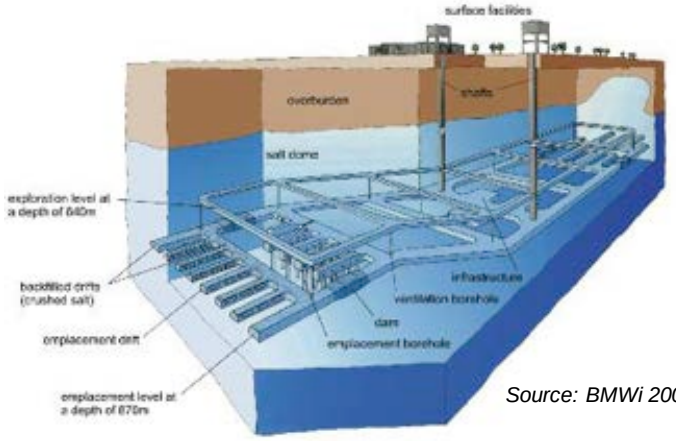
Mined repository in granite or other hard rock



Source: SKB 2011, Figure S-1.

(primary focus of FY16, in conjunction with GDSA work)

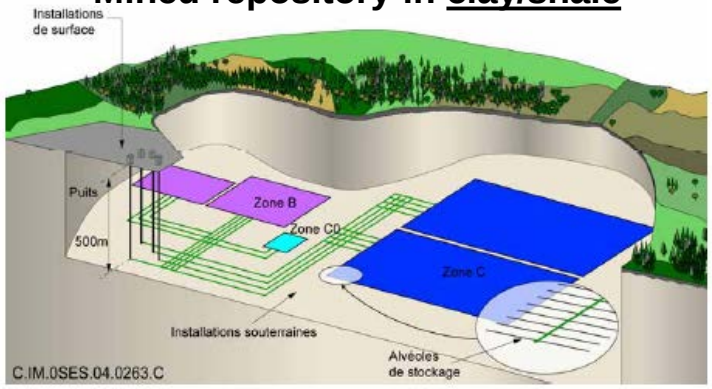
Mined repository in bedded salt



Source: BMWi 2008, Figure 15.

(some work in FY15; hope to update for FY16)

Mined repository in clay/shale

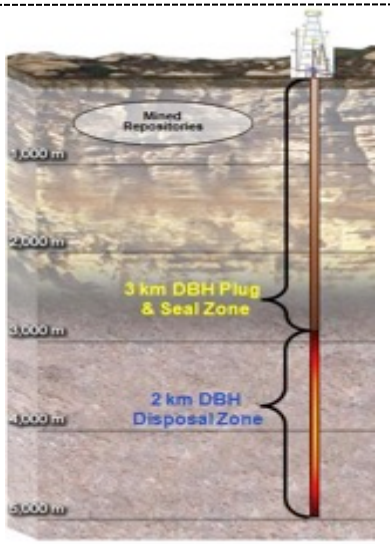


(deferred due to funding cut)

Source: ANDRA 2005b.

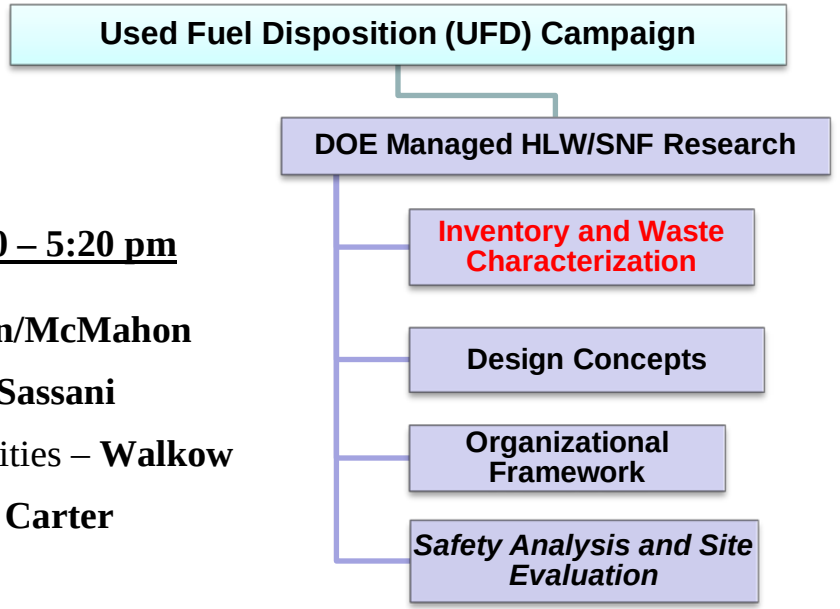
Deep borehole in crystalline basement rock

(R&D conducted under DBFT WPs)



Agenda

Session 1: Tuesday, 3:30 – 5:20 pm, June 7 – Rm. 1243



Session 1: Defense Inventory and Waste Characterization, 3:30 – 5:20 pm

3:30 – 3:40: Introduction to Defense Repository R&D – **Sevougian/McMahon**

3:40 – 4:00: Overview of Inventory and Waste Characterization – **Sassani**

4:00 – 4:25: On-Line Waste Library (OWL) Database and Capabilities – **Walkow**

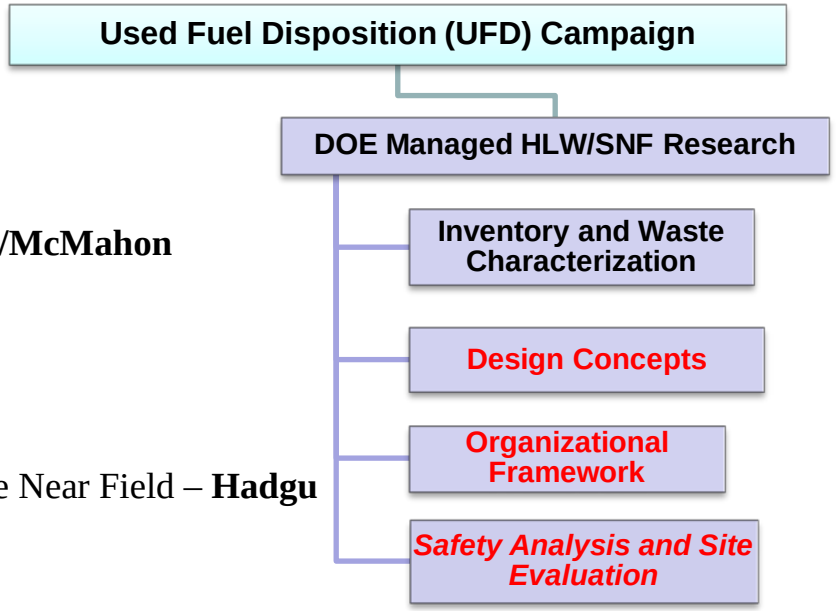
4:25 – 5:00: Decay Heat and Inventory of DOE-Managed Waste – **Carter**

5:00 – 5:20: OWL Hands-on Database Demo – **Walkow**

Agenda (continued)

Session 2: Thursday, 8:00 – 9:50 am, June 9 – Rm. 1243

Session 3: Thursday, 10:10 am – 12:00, June 9 – Rm. 1243



Session 2: Preliminary EBS Design Concepts, 8:00 – 9:50 am

8:00 – 8:10: Introduction to Defense Repository R&D – **Sevougian/McMahon**

8:10 – 8:30: Overview of EBS Design Concepts – **Matteo**

8:30 – 8:45: Waste Package Considerations – **Rigali**

8:45 – 9:15: EBS Design Alternatives – **Hardin**

9:15 – 9:30: Preliminary Analysis of the Effect of Decay Heat in the Near Field – **Hadgu**

9:30 – 9:45: Brainstorming on Design Alternatives – **All**

9:45 – 10:10 *Break*

Session 3: Safety Analysis and Organization/Procedural Frameworks, 10:10 am – 12:00 n

10:10 – 10:30: Overview of D-Repo Safety Analysis R&D – **Sevougian**

10:30 – 10:50: Regional Geology Investigations – **Perry**

10:50 – 11:20: D-Repo Repository Reference Case and Preliminary PA Simulations – **Stein**

11:20 – 11:35: Draft Program Plan: Organizational and Procedural Frameworks – **Swift**

11:35 – 11:50: Wrap-up and Brainstorming on Future Directions – **All**

Back-Up Slides

Six Factors Analyzed for the Separate Repository Decision

- **From March 2015 DOE report "…Separate Disposal of Defense High-Level Radioactive Waste"**
  - Cost Efficiency: "…*on balance, cost efficiency favors development of a Defense HLW Repository.*"
  - Health and Safety: "…*would advance long-term health and safety by eliminating the need for active human control and maintenance of waste at various DOE sites.*"
  - Regulation: "…*could simplify the licensing of a subsequent repository by providing important lessons learned…*"
  - Transportation: "…*an earlier opportunity to develop the institutional processes for the transportation of waste prior to the development of a subsequent repository.*"
  - Public Acceptability: "*would provide useful experience in siting future facilities*" (by using the more publically acceptable "*phased, adaptive, consent-based siting approach*")
  - National Security: "…*the likely earlier availability of a Defense HLW Repository could provide additional support to national security objectives…*"

