SAND2014-4347P

Used Fuel Disposition R&D Campaign

Used Fuel Disposition R&D Campaign Working Group Meeting

Introduction

Peter Swift

National Technical Director

Used Fuel Disposition R&D Campaign

Las Vegas, Nevada

June 4, 2014

Sandia National Laboratories is a multiprogram 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. SAND2013-xxxxP

Used Fuel Disposition

Outline of Presentation

- **Meeting Objectives and Approach**
- **Where we fit in the DOE Office of Nuclear Energy**
  - Mission and Objectives
- **Current Status of the UFD campaign**
  - FY14 organization
  - FY15 planning
- **Program management topics**
  - Review of the PICSNE reporting process, and thank you to the Work Package Managers
  - A comment on the importance of process

Meeting Objectives

- **Objectives**
  - Address communication challenges
    - *Geographically dispersed team*
    - *Broadly focused mission*
    - *Diverse R&D topics*
  - Communication between campaign management and researchers
    - *Provide clear information about strategic plans, budget possibilities, R&D needs*
  - Communication between lab and federal staff
    - *Accomplishments for FY14, plans for FY15, expectations regarding multiyear planning*
  - Communication among multiple campaigns and crosscutting activities
    - *Used Fuel Disposition, Nuclear Fuel Storage and Transportation Planning Project, Material Recovery/Waste Form, Fuel Cycle Options, QA*
  - Communication among researchers with common interests
    - *Researchers from the NE University Programs are here for the first time*

Used Fuel Disposition

Meeting Approach

- **Comments on previous meetings**
  - What we've been doing in the past has worked
  - Limit plenary sessions to information needed by all
  - Provide opportunities for focused technical discussions
- **The plan**
  - Full-group presentations on the first and last days only
    - *Opportunity for campaign management to provide basic information and strategy*
    - *Opportunity for questions and discussion; all topics are welcome*
    - *Updates from other campaigns: NFST, Fuel Cycle Options, Material Recovery/Waste Forms*
    - *Programmatic Updates: documentation and quality assurance*
  - Topical break-out sessions Wednesday afternoon and Thursday
    - *In-depth discussions*
    - *Space is available for impromptu meetings: contact campaign management for help*
  - Reconvene as a full group for Friday morning session
    - *Updates on programmatic topics*
    - *Update from Material Recovery/Waste Form Campaign*
    - *Updates from the Storage/Transportation and Disposal Leads*
    - *Closing comments*

Welcome to the NEUP Researchers

- **UFD R&D is affiliated with 19 active NEUP research projects, plus the Integrated Research Project**
  - 11 projects in Storage R&D
  - 2 projects in Transportation R&D
  - 6 projects in Disposal R&D
  - 1 Integrated Research Project in Storage R&D
- **Breakout sessions this afternoon (room B174) will include presentations from 8 NEUP projects**
  - "Structural Performance of Spent Nuclear Fuel Casks for Long-Term Exposure," Luis Ibarra, University of Utah
  - "Multifunctional Concrete Materials with Ultra-High Damage Tolerance and Self-Sensing Capacity for Extended SNF Storage Systems," Mo Li, University of Houston
  - "Development of a Probabilistic Model for Dry Storage Canister Life Prediction: An Update" PI-Professor Ronald Ballinger, Ms. Sara Ferry (Grad Student), Dr. Sebastien Teysseyre, MIT
  - "Doubling the Life of Concrete Structures," B. Pesci (PI), K.S.Raja (Co-PI), Y.Xi (Co-PI), G-L, Song (Co-PI), University of Idaho
  - Development and Experimental Benchmark of Computational Methods to Predict Used-Fuel Cladding Temperatures under Vacuum Drying Conditions," Miles Greiner, University of Nevada, Reno
  - "The Impacts of Pore-Scale Physical and Chemical Heterogeneities on the Transport of Radionuclide-Carrying Colloids," Wu Ning, Colorado School of Mines
  - "Improving the Understanding of the Coupled Thermal-Mechanical-Hydrologic Behavior of Consolidating Granular Salt," John Stormont, University of New Mexico
  - "Quantification of Actinide Sorption to Engineered Barrier Materials Under Extreme Conditions," Brian Powell, Clemson

Active NEUP Projects Affiliated with UFD R&D: Storage

Project FY-ID	R&D Area	Title	Organization	PI	Collaborators	Award Date
12-3374	Storage	Validation Experiments for Spent-Fuel Dry-Cask In-Basket Convection	Utah State University	Barton Smith	Glen Hansen (Sandia National Laboratory)	5/8/12
12-3545	Storage	Concrete Materials with Ultra-High Damage Resistance and Self-Sensing Capacity For Extended Nuclear Fuel Storage Systems	University of Houston	Mo Li	Kalyana Nakshatrala (University of Houston) Kaspar Willam (University of Houston) Yunping Xi (University of Colorado-Boulder) Dan Naus (Oak Ridge National Laboratory)	5/8/12
12-3660	Storage	Development and Experimental Benchmark of Simulations to Predict Used Nuclear Fuel Cladding Temperatures during Drying and Transfer Operations	University of Nevada, Reno	Miles Greiner		5/8/12
12-3730	Storage	Probabilistic Multi-Hazard Assessment of Dry Cask Structures	University of Houston	Bora Bencturk	Jamie Padgett (Rice University) Rizwan Uddin (University of Illinois-Urbana Champaign) Kaspar Willam (University of Houston)	5/8/12
12-3736	Storage	Nonlinear Ultrasonic Diagnosis and Prognosis of ASR Damage in Dry Cask Storage	Northwestern University	Jianmin Qu	Laurence J. Jacobs (Georgia Institute of Technology) Maria Guimaraes (Utility/Industry:EPRI) Zdenek Bazant (Northwestern University)	5/8/12
12-3756	Storage	Seismic Performance of Dry Casks Storage for Long-Term Exposure	University of Utah	Luis Ibarra	David Sanders (University of Nevada-Reno) Chris Pantelides (University of Utah) Haori Yang (University of Utah)	9/27/12

Active NEUP Projects Affiliated with UFD R&D: Storage (cont.)

Project FY-ID	R&D Area	Title		PI	Collaborators	Award Date
11-2987	Storage	Anisotropic azimuthal power and temperature distribution on fuel rod: impact on hydride distribution	Pennsylvania State University	Arthur Motta	Kostadin Ivanov (University:Pennsylvania State University) Maria Avramova (University:Pennsylvania State University)	8/9/11
11-3117	Storage	Life Prediction of Spent Fuel Storage Canister Material	Massachusetts Institute of Technology	Ronald Ballinger	Sebastien Teysseyre (National Laboratory:Idaho National Laboratory)	8/9/11
13-4840	Storage	Development of a nano-modified concrete for next generation of storage systems	Vanderbilt University	Florence Sanchez	Caglar Oskay (University:Vanderbilt University) David Kosson (University:Vanderbilt University) Allen Croff (University:Vanderbilt University) Anick Delagrave (Utility/Industry:Lafarge North America)	9/20/13
13-5178	Storage	Structural Health Monitoring of Nuclear Spent Fuel Storage Facilities	University of South Carolina	Lingyu (L**Organization**ucy)	Victor Giurgiutiu (University:University of South Carolina) Travis Knight (University:University of South Carolina) Matthieu Gresil (University:University of South Carolina) Bin Lin (University:University of South Carolina) Adrian Mendez-Torres (National Laboratory:Savannah River National Laboratory)	9/20/13
13-5365	Storage	Doubling the Life of Concrete Structures	University of Idaho	Batric Pesic	Krishnan Raja (University:University of Idaho) Guang-Ling Song (National Laboratory:Oak Ridge National Laboratory) Yunping Xi (University:University of Colorado, Boulder)	9/20/13

Active NEUP Projects Affiliated with UFD R&D: Transportation

Project FY-ID	R&D Area	Title	Organization	PI	Collaborators	Award Date
13-5106	Transportation	Risk Assessment of Structural Integrity of Transportation Casks	University of Utah	Luis Ibarra	Haori Yang (University:University of Utah) Ricardo Medina (University:University of New Hampshire)	9/20/13
13-5427	Transportation	Enhanced Shielding Performance of HLW Storage Packages via Multi-Component Coatings	Virginia Polytechnic Institute and State University	Leigh Winfrey	Mohamed Bourham (University:North Carolina State University)	9/20/13

Active NEUP Projects Affiliated with UFD R&D: Disposal

Project FY-ID	R&D Area	Title	Organization	PI	Collaborators	Award Date
12-3298	Disposal	Optimization of Deep Borehole Systems for HLW Disposal	Massachusetts Institute of Technology	Michael Driscoll	Richard St. Clair (MIT) stclair@mit.edu Patrick V. Brady (Sandia National Laboratory)	5/8/12
12-3361	Disposal	Coupling of nuclear waste form corrosion and radionuclide transport in presence of relevant repository sediments	Washington State University	Nathalie Wall	James J. Neeway (Pacific Northwest National Laboratory) Nikolla P. Qafoku (Pacific Northwest National Laboratory) Joseph V. Ryan (Pacific Northwest National Laboratory)	5/8/12
12-3528	Disposal	Radiation and Thermal Effects on Used Nuclear Fuel and Nuclear Waste Forms	University of Tennessee at Knoxville	William Weber	Yanwen Zhang (University of Tennessee) Kurt E. Sickafus (University of Tennessee)	5/8/12
11-3180	Disposal	Quantification of cation sorption to engineered barrier materials under extreme conditions	Clemson University	Brian Powell	Mark Schlautman (University:Clemson University) Linfeng Rao (National Laboratory:Lawrence Berkeley National Laboratory) Heino Nitche (University:University of California-Berkeley)	8/9/11
13-4834	Disposal	Improving the understanding of the coupled thermal-mechanical-hydrologic behavior of consolidating granular salt	University of New Mexico	John Stormont	Stephen Bauer (National Laboratory:Sandia National Laboratory)	9/20/13
13-5008	Disposal	The impacts of pore-scale physical and chemical heterogeneities on the transport of radionuclide-carrying colloids	Colorado School of Mines	Ning Wu	Xiaolong Yin (University:Colorado School of Mines) Keith Neeves (University:Colorado School of Mines) Jaehun Chun (National Laboratory:Pacific Northwest National Laboratory) Wooyong Um (National Laboratory:Pacific Northwest National Laboratory)	9/20/13

Used Fuel Disposition R&D Campaign

Mission and Organization of the Campaign

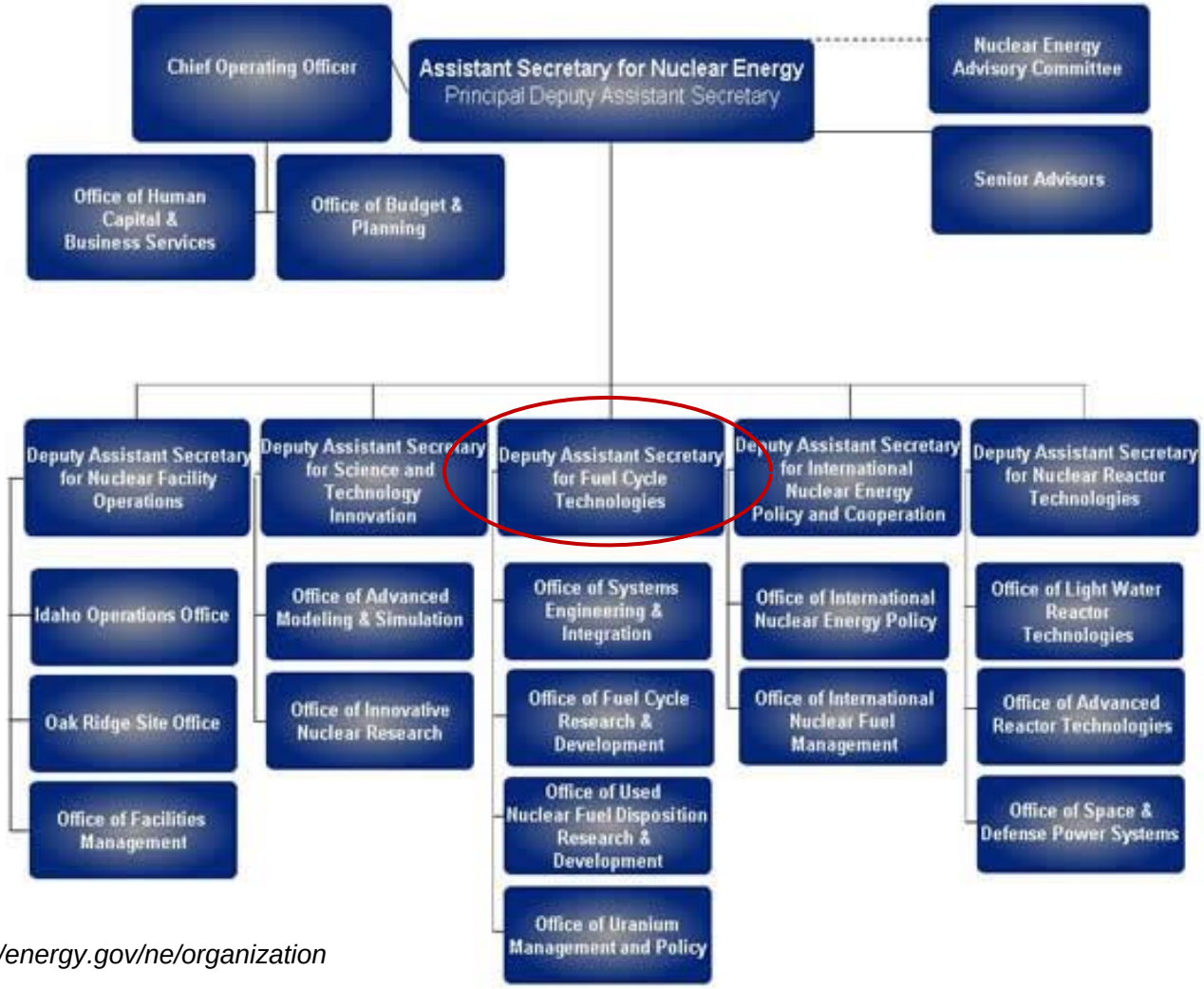
DOE Office of Nuclear Energy Mission Statement

- **The primary mission of the Office of Nuclear Energy is to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate.**

- **NE's program is guided by the four research objectives detailed in its Nuclear Energy Research and Development Roadmap:**
  - Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
  - Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
  - Develop sustainable fuel cycles.
  - Understand and minimize the risks of nuclear proliferation and terrorism.

Source: http://energy.gov/ne/mission

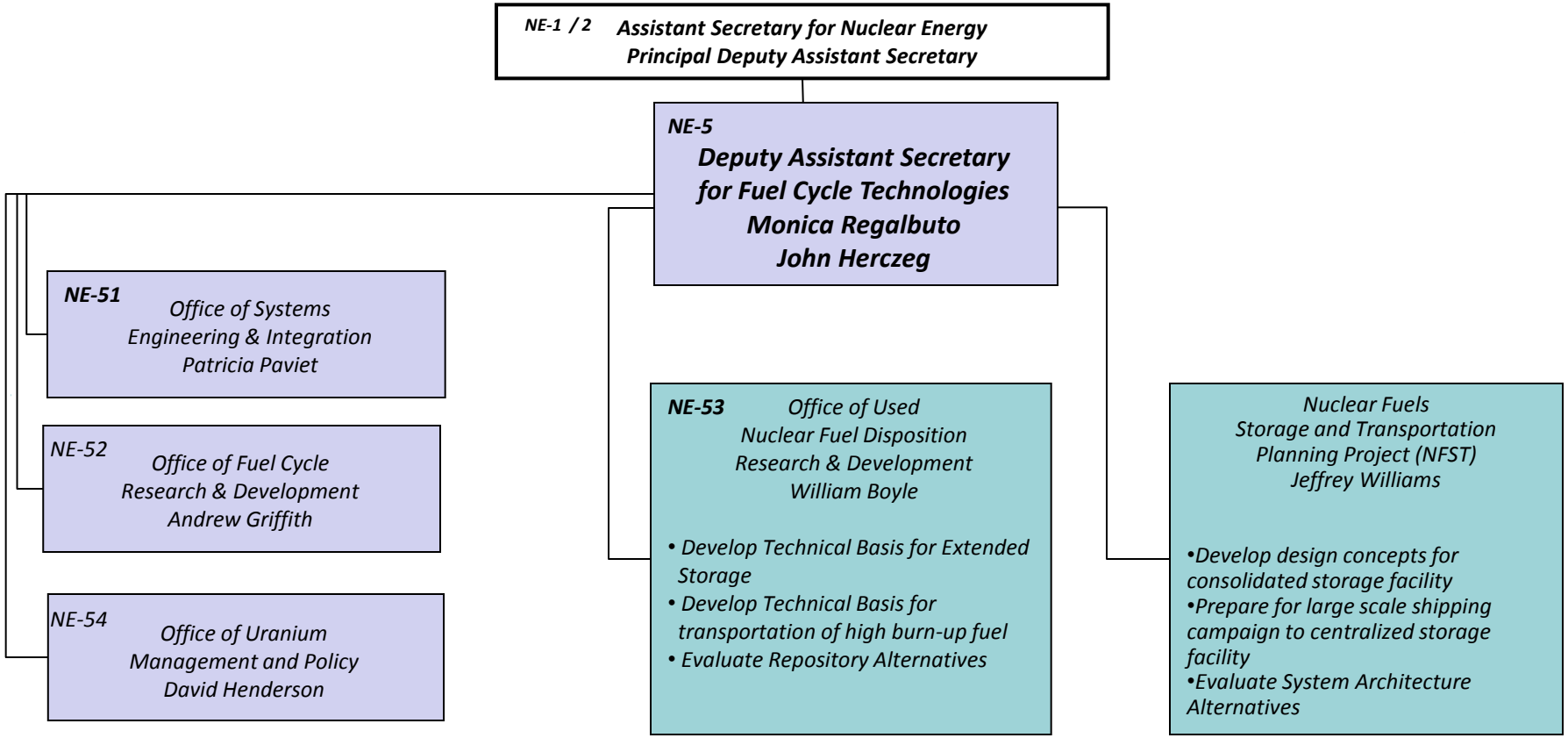
DOE-NE Organization Chart



Source: http://energy.gov/ne/organization

Used Fuel Disposition

DOE Office of Nuclear Energy
Office of Fuel Cycle Technologies (NE-5)



Used Fuel Disposition R&D Campaign Mission

The DOE Office of Used Nuclear Fuel Disposition Research and Development and nine national laboratories participate in the DOE Office of Nuclear Energy's "Used Fuel Disposition Campaign"

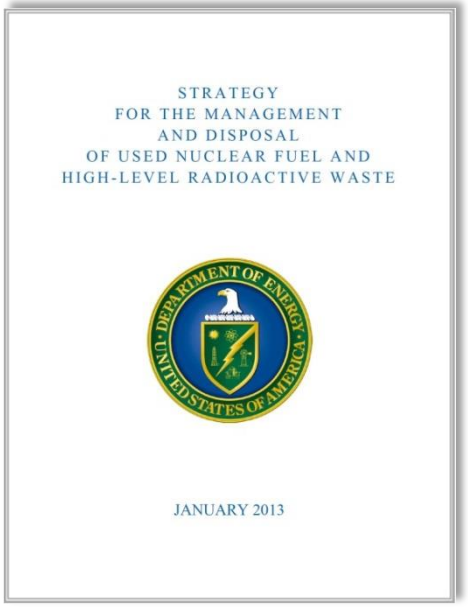
Campaign Mission: to identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles

Summary of the Administration's UNF and HLW Strategy

Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste **issued January 2013**

The Strategy is:

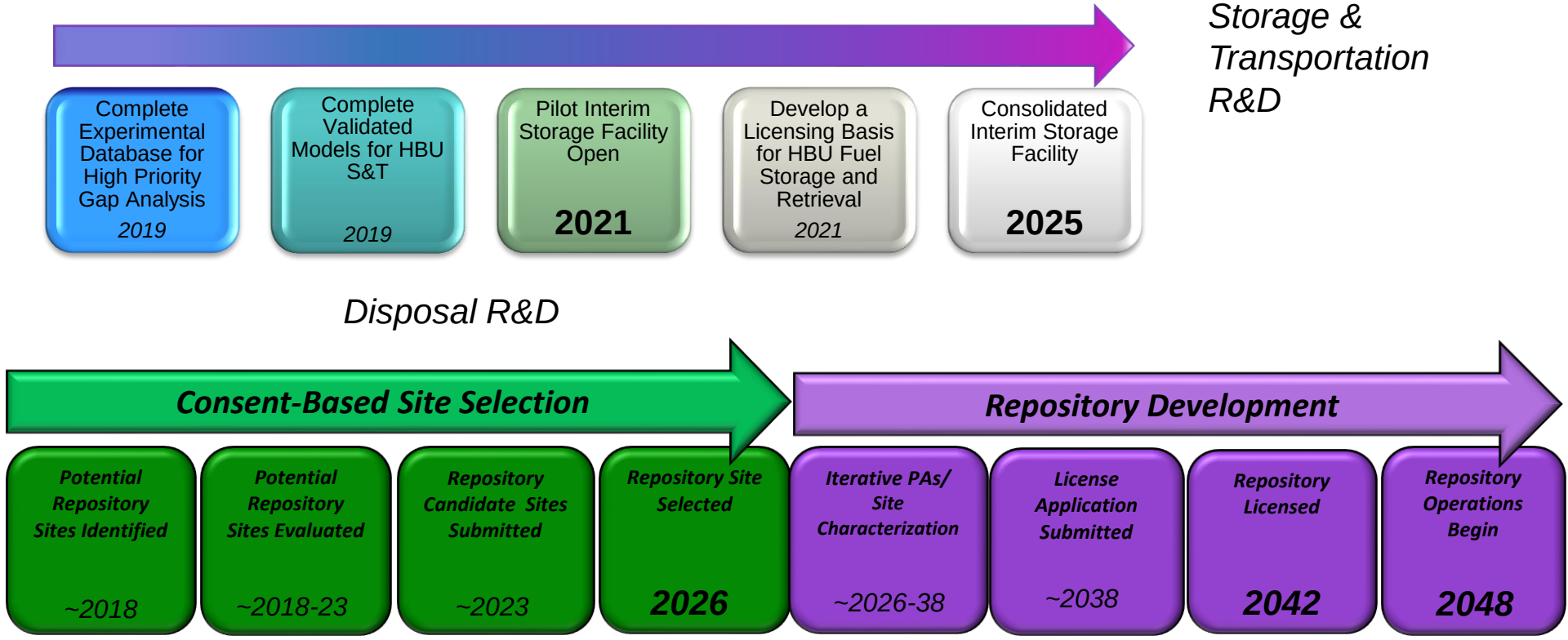
- **A statement of Administration policy regarding the importance of addressing the disposition of used nuclear fuel and high-level radioactive waste**
- **The Response to the final report and recommendations made by the *Blue Ribbon Commission on America's Nuclear Future***
- **The initial basis for discussions among the Administration, Congress and other stakeholders**



The Strategy outlines a 10-year program of work that:

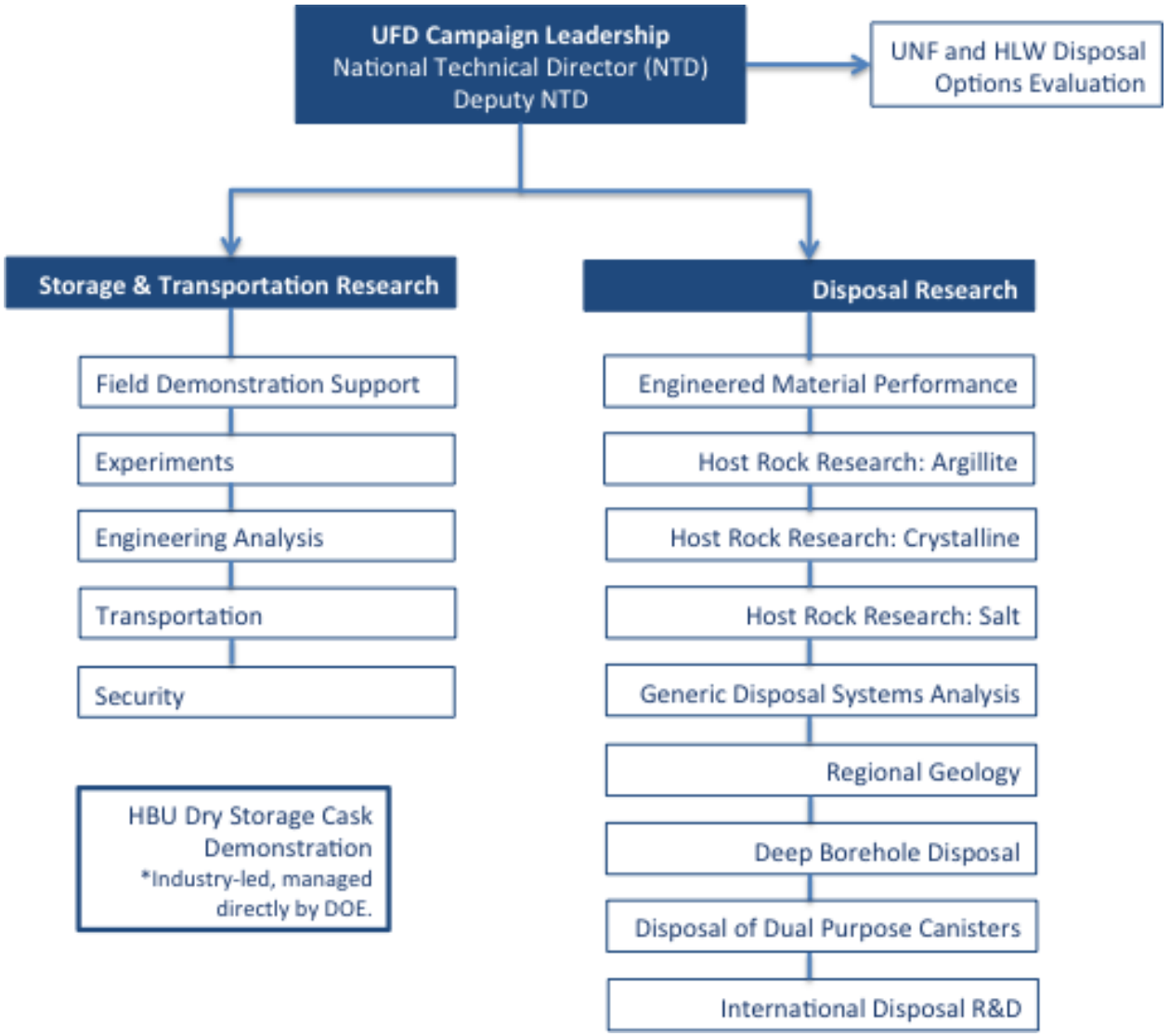
- Sites, designs, licenses, constructs and begins operations of a pilot interim storage facility (operating 2021)
- Advances toward the siting and licensing of a larger interim storage facility (operating 2025)
- Makes demonstrable progress on the siting and characterization of repository sites (repository sited 2026, licensed 2042, operating 2048)

R&D Path to Support DOE Waste Management Strategy



*Approximate target dates (in italics) needed to meet deadlines (in **bold**) set out in the 2013 DOE Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*

Campaign Structure



UFD R&D Campaign 2009-Present

- FY09 Planning meeting at Argonne National Laboratory, June 2009
- FY10 R&D funding at $7.1 M
  - Disposal R&D, modest level of effort on Storage R&D, no Transportation R&D
- FY11 R&D funding at $23.8 M
  - Nine national laboratories participating in UFD
  - Significant R&D program in Storage, including Transportation
  - Disposal R&D not site specific
- FY12 R&D budget baseline at $22.8 M, end-of-year actual ~$37 M
  - Some elements of FY12 work scope not established until fourth quarter
- FY13 R&D $23.5 M
  - Nuclear Fuel Storage and Transportation Planning Project initiated
  - Storage demonstration R&D initiated external to UFD R&D campaign
- FY14 R&D planning baseline at $20.4 M
  - Significant redirection of scope within campaign (next slide)
  - Work through February limited to annual total of $15.4 M

NE-53 Guidance (June 10, 2013)

Priorities

- Campaign Management
- High Burnup Cask Demonstration
  - *EPRI contract*
  - *Supporting work at national labs*
- Direct Disposal of Dual Purpose Canisters R&D
- International Disposal Activities
- Transportation R&D
- Remaining Work
  - *"generally consistent with the FY14 Integrated Priority List"*

Budget Areas	Percentage	Approximate Dollars in thousands
Campaign Management	8.0%	$1,600
Storage	43.9%	$8,780
Disposal	31.5%	$6,300
International	6.8%	$1,360
Transportation	9.8%	$1,960
Total	100.0%	$20,000

Implementing UFD R&D Priorities from FY13 to FY14

Overall Campaign Funding at National Laboratories down ~15 %

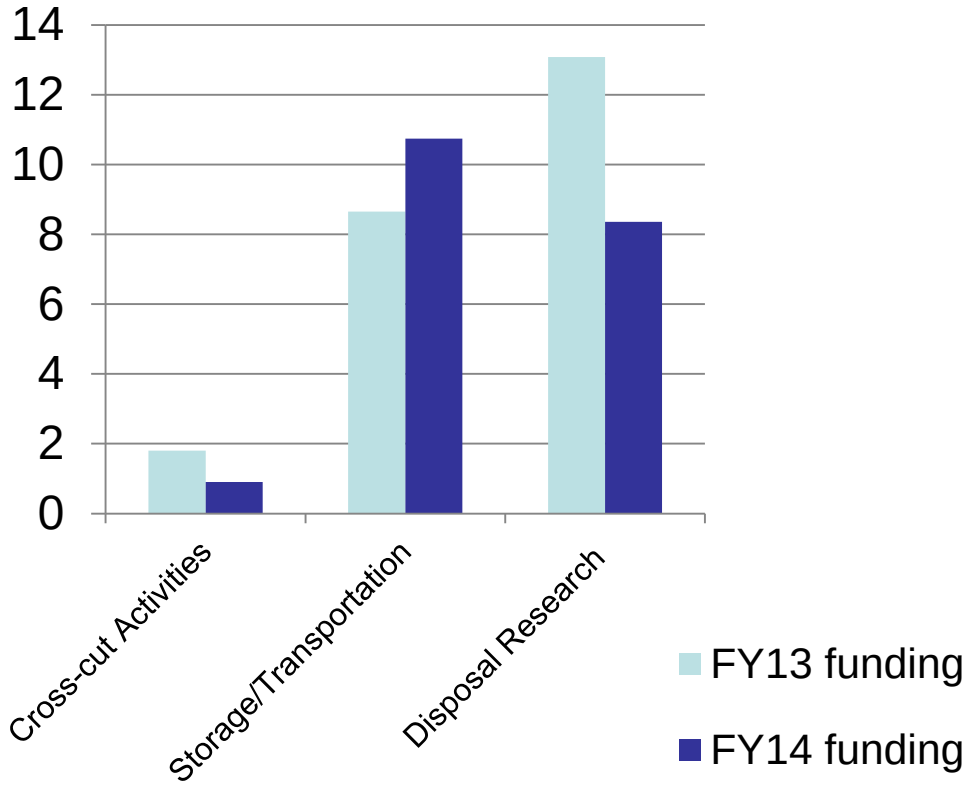
$23.5 M → $20 M

Cross-cut Activities now only include Management and Integration costs

Storage and Transportation R&D increases ~ 24%

International Disposal Research Activities remain roughly level

Overall Disposal R&D (including international) decreases ~ 40%



Specific UFD Campaign Objectives Near Term (2015-2020)

Storage and Transportation

- Develop understanding of how hydrides affect cladding integrity in high-burnup UNF
  - *Predictive modeling*
  - *Experimentation*
- Develop understanding of how corrosion and stress corrosion cracking affect performance of stainless steel storage canisters
  - *Material and environmental data*
- Characterize external loadings on UNF during normal conditions of transport
- Support the full-scale storage demonstration project

Specific UFD Campaign Objectives Near Term (2015-2020)

Disposal Research

- Update the Disposal R&D Roadmap
- Complete evaluation of the direct disposal of dual-purpose canisters
- Complete a Geographical Information System database to support site screening and selection
- Develop experimental and modeling basis for understanding long-term performance of engineered materials in repository environments
- Develop experimental and modeling basis for understanding long-term performance of disposal systems in argillaceous rock, salt, crystalline rock, and deep boreholes
- Develop system analysis tools to support site selection and evaluation
- Develop reference cases for generic disposal concepts
- Leverage international disposal R&D
- Field a deep borehole disposal demonstration

UFD Strategic Objectives
Long Term (2015-2025)

- Collaborate with industry to field a full-scale NRC-licensed storage demonstration facility with monitoring and inspection capabilities to assess long-term performance
- Conduct high priority separate effects tests on storage system safety components that align with the confirmatory demonstration (e.g., full-assembly material property data, closure system degradation behavior, concrete performance)
- Collaborate with industry and NFST to support the transport of UNF from orphaned independent spent fuel storage installations (ISFSIs) to a consolidated storage facility
- Collaborate with industry and NFST to develop and implement integrated storage, transportation, and disposal concepts that ensure safe, secure, and timely storage, transportation and disposal of waste

Used Fuel Disposition R&D Campaign

FY15 Planning

Used Fuel Disposition

From the FY15 President's Budget Request (Volume 3, p. 435-437)

In FY 2015 in the UNF Disposition subprogram the Department is allocating $30 million to support preliminary generic process development and other non-R&D activities related to storage, transportation, disposal, and consent-based siting, including $24 million from the Nuclear Waste Fund. In addition, the Department requests $49 million for related research and development.

Fuel Cycle Research and Development
Funding ($K)

	FY 2013 Current[1]	FY 2014 Enacted[2]	FY 2014 Current	FY 2015 Request	FY 2015 vs FY 2014 Enacted
Fuel Cycle Research and Development					
Material Recovery and Waste Form Development	37,450	34,300	34,300	35,300	+1,000
Advanced Fuels	39,146	60,100	60,100	43,100	-17,000
Systems Analysis and Integration	21,993	19,605	19,605	18,500	-1,105
Materials Protection, Accounting, & Control Technology	6,983	7,600	7,600	7,600	0
Used Nuclear Fuel Disposition	57,848	60,000	60,000	79,000	+19,000
Fuel Resources	6,476	4,600	4,600	5,600	+1,000
Total, Fuel Cycle Research and Development	169,896	186,205	186,205	189,100	+2,895

Includes both UFD R&D and NFST

Used Nuclear Fuel R&D: The increase from $60,000,000 to $79,000,000 supports research and development activities required to develop the technical knowledge to support long-term storage of high-burnup fuels. Of this increase, $9M will be used to implement the adaptions that are determined to be necessary to use existing Idaho National Laboratory (INL) facilities to handle large transportation casks. Funding increases to $6M for the high-burnup, dry storage demonstration effort. It is expected that this will be the peak funding year for this effort. Other increases include progress on deep borehole demonstration activities and implementing the field tests to advance salt repository science for disposal of heat generating waste.

From the FY15 President's Budget Request (Volume 3, p. 449)

- *Research and Development activities [for FY15]*
  - Develop the technical knowledge and the capability to examine high-burnup UNF to support NRC licensing for long-term storage. This activity involves the following:
    - *Initiate activities to develop capabilities to examine fuel and evaluate high-burnup fuel in long-term storage through adapting existing facilities at the Idaho National Laboratory. The adapted facilities will have the capability to examine the entire dry cask storage system (DCSS) after storage, including the fuel, cladding, assembly hardware, baskets, neutron poisons, and canister/cask and reseal the cask after examination.*
    - *Support for industry testing of canister material performance in situ at three additional independent Spent Fuel Storage installation sites in collaboration with the Electric Power Research Institute to obtain environmental samples and canister performance data.*
    - *Develop advanced instrumentation: Explore the development of nondestructive evaluation/examination and long-term online monitoring technologies for DCSS integrity assessments including crucial physical parameters such as temperature, pressure, leakage and structural integrity in general.*
    - *Conduct tests: Conduct additional shaker table tests on industry-supplied dummy fuel assemblies. Test high-burnup cladding and stainless steel canisters for corrosion. Test measurement of loads on fuel assemblies during transportation.*
  - Continue long-term R&D and international collaborations on alternative disposal environments, including field tests.
  - Continue R&D work to explore the possibility of direct disposing existing loaded dual purpose canisters in a repository.
  - Evaluate alternative design concepts for deep borehole

What does this mean for FY15 Planning?

- **Actual budgets will be determined by Congressional appropriation**
- **The $49M target in the President's Budget for "related research and development"**
  1. Is "pretax"
     - *Roughly 30% of NE's R&D appropriations in the past have gone to NE University Programs (20%), Small Business Innovation Research/Technology Transfer (SBIR/STTR), and other activities*
  2. Must include specified "non-campaign" activities
     - *"$9M will be used to implement the adaptions that are determined to be necessary to use existing Idaho National Laboratory (INL) facilities to handle large transportation casks."*
     - *"Funding increases to $6M for the high-burnup, dry storage demonstration effort."*
- **Formal guidance has not been provided from DOE for FY15 planning, but total UFD R&D funding at National Laboratories is likely to decrease in FY15 relative to FY14**
- **Shifting priorities will impact some areas more than others**

Used Fuel Disposition

Schedule for FY15 Planning

- June 2014: Guidance from NE to the Campaigns with targets and priorities
- July 2014: Campaign management works with NE-53 to prepare FY15 plan at the control account level
- July 23, 2015: NE-5 Budget Planning Review
- August-September 2015: Preparation of final FY15 planning packages

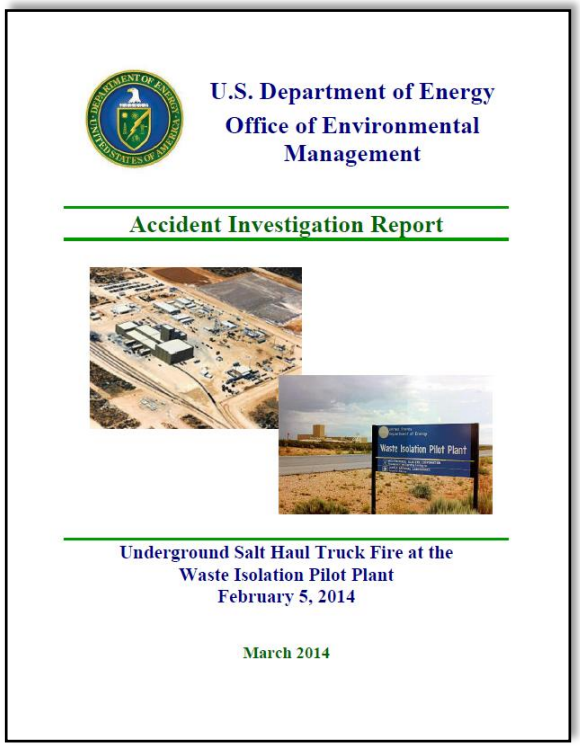
Used Fuel Disposition R&D Campaign

Project Management Topics

Work Package Management and Reporting Expectations

- **Enter information in PICS NE with the assumption that it will be read**
  - Put entries in the correct field
  - Proofread
  - With respect to “Milestone Variance Explanation”
    - *Enter the real explanation, please*
    - *Work with your Control Account Manager*
  - With respect to “Accomplishments”
    - *Focus on significant new developments*
    - *If the text starts with “continued ongoing work…”, it’s not a significant new development, and a short entry is appropriate. The quality of work is not judged by the length of the entry.*
    - *If the activity was dormant for the month, say so (and if appropriate, enter a short variance explanation)*
  - With respect to “Identified Carryover”
    - *Be realistic as early as possible*
- **Pay attention when you plan next year’s packages**
  - Work with your Control Account Manager and DOE technical point of contact to define the work scope
  - Spend plans matter--you will be held accountable for under- and over-spending
  - Plan deliverables that are achievable, and complete them on time
- **Enter all foreign travel in PICS-NE**

What Process Matters

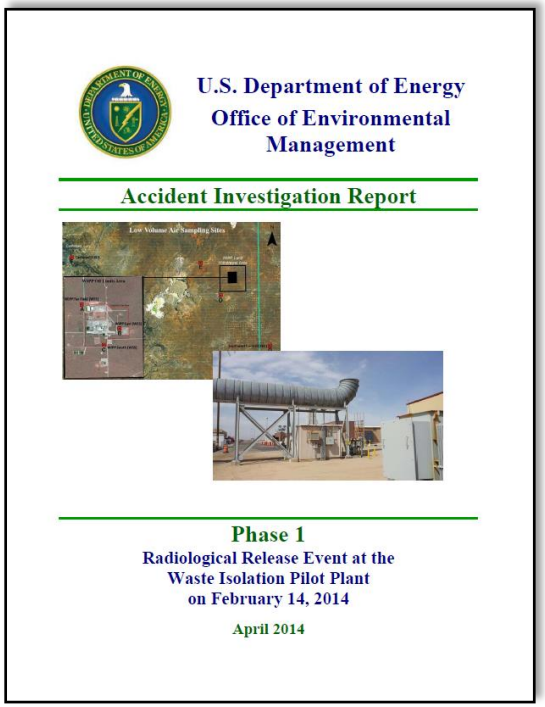


U.S. Department of Energy
Office of Environmental Management

Accident Investigation Report

Underground Salt Haul Truck Fire at the
Waste Isolation Pilot Plant
February 5, 2014

March 2014



U.S. Department of Energy
Office of Environmental Management

Accident Investigation Report

Phase 1
Radiological Release Event at the
Waste Isolation Pilot Plant
on February 14, 2014

April 2014

http://www.wipp.energy.gov/wipprecovery/accident_desc.html

Questions and Discussion?