FINAL SCHEDULE: May 18, 2018
SFWST Annual Working Group Meeting

DISPOSAL RESEARCH (DR) SCHEDULE

TUESDAY, MAY 22, 2018

8:00-8:30am	**Obtain nametag, sign in**	SEB Foyer
8:30-9:30 am	**Welcome & SFWST Campaign Updates** • DR & ST High Level Updates • Ram Murthy: QA Update	Auditorium
9:30-9:50 am	**Break**	SEB Foyer
9:50 – 10:20 am	**DR NEUP Topical Session** (Ruth Tinnacher, California State University East Bay).	Classroom #1242
10:20-12:00	**DPC Session** (Hardin, Banerjee)	Classroom #1242
Noon-1:30 pm	**Lunch** (on your own)	
1:30-2:15 pm	**International Session** (Birkholzer)	Classroom #1242
2:15-2:45 pm	**DR Integration Intro – Objectives, Goals** (MacKinnon/McMahon)	Classroom #1242
2:45-3:05 pm	**Break**	SEB Foyer
3:05-5:00 pm	**DR Integration** (Sevougian) **DR Roadmap** (Sassani) **GDSA Status** (Mariner)	Classroom #1242
5:00-5:30 pm	**Online Waste Library** (OWL) demo (Sassani)	Classroom #1242

WEDNESDAY, MAY 23, 2018

8:00-10:00 am	**Argillite Disposal R&D** (Includes EBS R&D) Jove-Colon/Matteo • Carlos F. Jove Colon – (SNL) Disposal in Argillite R&D WP Overview • Jonny Rutqvist – Summary of LBNL FY18 Coupled THM Process Model Developments and Validations • Yves Guglielmi – LBNL Argillite expanded work-scope on fault slip and in situ THM monitoring using new multi-physics borehole tool • Ed Matteo – (SNL) EBS Crosscuts and Integration in the FY18 Workscope • Florie Caporuscio – (LANL) Disposal in Argillite R&D: Accomplishments & Path Forward (Argillite & EBS) • Mavrik Zavarin – (LLNL) Update on corrosion studies • Carlos F. Jove Colon – (SNL) Disposal in Argillite International Collaborations WP Overview • Mavrik Zavarin – (LLNL) TDB Development: Surface Complexation Modeling	Classroom #1242
10:00-10:20 am	**Break**	SEB Foyer
10:20-12:20 pm	**Crystalline Disposal R&D** (includes EBS R&D) Wang/Matteo • Yifeng Wang (SNL) Disposal in crystalline – overview • Hari S. Viswanathan (LANL) Discrete fracture network modeling in crystalline rock • Teklu Hadgu (SNL) Flow & transport modeling for Mizunami site	Classroom #1242

Additional Available Breakout Rooms: #1240 (holds 40), #1245 (holds 30), #2251 (holds 24)

	• Elena Kalinina (SNL) Field data synthesis and upscaling for fractured rocks • Hakim Boukhalfa (LANL) Update on colloid-facilitated radionuclide transport • Pat Dobson (LBNL) FY18 LBNL Crystalline R&D updates • Hao Xu (LBNL) Coupled THMC models for bentonite under high temperature • Liange Zheng (LBNL) Studying bentonite: FEBEX-DP and HotBENT • Melissa M. Mills (SNL) Update on smectite-to-illite transformation • Patricia Fox (LBNL) Effect of Long-Term Bentonite Heating on U(VI) Adsorption • Cindy Atkins-Duffin (LLNL) Update on NEA-TDB activities • Yifeng Wang (SNL) Update on Decovalex 2019 Tasks A & F	
12:20-1:50 pm	**Lunch** (on your own)	
1:50-3:50 pm	**Salt Disposal R&D** (Includes EBS R&D) Kuhlman/Matteo • Kris Kuhlman (SNL): WIPP Heater Test Overview • Doug Weaver (LANL): WIPP Support and Logistics • Phil Stauffer (LANL): Update on Salt Disposal R&D • Jonny Rutqvist (LBL): Update on Salt Disposal R&D • Melissa Mills (SNL): Laboratory Brine Evap. Studies • Peter Johnson (LANL): Coupled THC Processes in Salt • Yuxin Wu (LBL): Geophysics in Heater Test • Ed Matteo (SNL): International / EBS / Sealing	Classroom #1242
3:50-4:10 pm	**Break**	SEB Foyer
4:10-5:40 pm	**Prioritize & Scope FY19 DR Activities:** • Crystalline Breakout Session (Mariner) • Salt Breakout Session (Kuhlman) • DPC Breakout Session (Hardin) • Argillite Breakout Session (Sassani)	Classroom #1242 Classroom #1245 Conf. room #2251 Classroom #1240

THURSDAY, MAY 24, 2018

8-9:15 am 9:15-10 am	**Prioritize & Scope FY19 DR Activities (cont'd):** • Crystalline Breakout Session (Mariner) • Salt Breakout Session (Kuhlman) • DPC Breakout Session (Hardin) • Argillite Breakout Session (Sassani) **Cross-cutting Activities** • International (Birkholzer) • EBS (Matteo)	Classroom #1242 Classroom #1245 Conf. room #2251 Classroom #1240 Classroom # 1242
10-10:20 am	**Break**	SEB Foyer
10:20-11:30 am	**DR Summary Integration & Planning Session** – overall prioritization and review of cross-cutting R&D issues; review FY19 and out-year scope (Sevougian, Mariner, Sassani, Kuhlman, Hardin)	Classroom #1242
11:30-Noon	**Working Group Debrief and Closing**	Auditorium

Additional Available Breakout Rooms: #1240 (holds 40), #1245 (holds 30), #2251 (holds 24)

Disposal Research (DR) NEUP Abstracts

1. **NEUP: Ruth M. Tinnacher**

Title: Effects of Mineral Impurities and Heat on Uranium(VI) Sorption onto Bentonite

PICSNE Work package #: NU-17-CA-CSEB-020403-01

Dates: 10/01/2017 - 9/30/2020

Institution: California State University East Bay, Hayward, California

PI Name: Ruth M. Tinnacher

Presenter: Ruth M. Tinnacher

Title of Presentation: Effects of Mineral Impurities and Heat on Uranium(VI) Sorption onto Bentonite

Abstract:

Most nuclear waste disposal options include compacted bentonite, consisting of montmorillonite clay, as part of a barrier system to minimize contaminant mobility. Uranium (U) is the primary element in spent nuclear fuel, and from an environmental perspective, a potential contaminant of water resources. Furthermore, uranium may control nuclear fuel degradation rates and the consequent release of other radioactive contaminants based on its diffusive transport away from waste canisters. Uranium sorption onto clay and other mineral surfaces is expected to limit U(VI) mobility in these systems. However, at this point a prediction of U(VI) sorption and transport behavior in performance assessment (PA) models is complicated by a series of factors, such as: (1) the presence of various U(VI) solution species with different charges and sorption characteristics; (2) the complex microstructure of montmorillonite clay resulting in two types of clay porosities and multiple sorption sites; (3) the largely unknown effects of bentonite mineral impurities on pore water chemistry, U(VI) sorption and diffusion behavior; and (4) the potential impacts of heat, generated by the decay of spent fuel, on mineralogical and microstructural transformations, and any subsequent effects on radionuclide sorption and mobility.

In this project, we investigate the effects of calcite impurities on U(VI) sorption and diffusion onto montmorillonite before and after mineral exposure to heat. Based on a combination of data from U(VI) batch sorption experiments and extended X-ray absorption fine structure (EXAFS) spectroscopy, we will develop a new U(VI)-montmorillonite surface complexation model to determine under which conditions impurity effects are relevant for U(VI) sorption processes, and how they can be incorporated into PA models. In diffusion experiments, we will further test the relevance of changes in U(VI) sorption behavior for the diffusive transport of U(VI). Molecular dynamics (MD) calculations will support the simulation of diffusion results by evaluating steric effects associated with the size of U(VI) solution complexes (relative to the sub-nanometer width of montmorillonite nanopores).

In this presentation, we will discuss the motivation for this research, provide an overview of project tasks, and present first, preliminary results after about seven months into this project.

FINAL SCHEDULE: May 18, 2018
SFWST Annual Working Group Meeting

STORAGE AND TRANSPORTATION (ST) SCHEDULE

TUESDAY, MAY 22, 2018

8:00-8:30am	**Obtain nametag, sign in**	SEB Foyer
8:30-9:30 am	**Welcome & SFWST Campaign Updates** • DR & ST High Level Updates • Ram Murthy: QA Update	Auditorium
9:30-9:50am	**Break**	SEB Foyer
9:50-10:40am	**ST NEUP Topical Sessions** (2 @ 25 min each) (Zeev Shayer, Colorado School of Mines / Travis Knight, University of South Carolina)	Classroom #1243
10:40-Noon	**ST SBIR Topical Sessions** (2 @ 25 min each) (Max Wiedmann, Intelligent Optical Systems / Dan Xiang, X-Wave Innovations). (25 minutes left for discussion and networking)	Classroom #1243
Noon-1:30 pm	**Lunch** (on your own)	
1:30-2:45 pm	**ST SBIR Topical Sessions** (2 @ 25 min each) (James Christian, Radiation Monitoring Devices / Peter Jardine, Shape Change) (25 minutes left for discussion and networking)	Classroom #1243
2:45-3 pm	Break	SEB Foyer
3-5:30 pm	**Stress Corrosion Cracking (Bryan)** • Remi Dingreville (SNL): Probabilistic Stress Corrosion Cracking Model • Zhenzhen Yu (CSM): Effect of Residual Stress and Microstructure on Pitting Behavior in 304 Stainless Steel • Robert Sindelar (SRNL): Testing of Canister Weldments for SCC Growth Rate • Nick Klymyshyn (PNNL): Friction Stir Welding as a Solution to Canister SCC	Classroom #1243

WEDNESDAY, MAY 23, 2018

8:00-10:00 am	**Stress Corrosion Cracking (Bryan)** • Stylianos Chatzidakis (ORNL): Overview of SNF Dry Storage Canister Repair Activities at Oak Ridge National Lab • Eric Schindelholz/Charles Bryan (SNL): Status Report on Interim Storage Canister SCC Studies at Sandia National Laboratories **Discussion of Research Direction and Collaboration**	Classroom #1243
10:00-10:20 am	**Break**	SEB Foyer
10:20-12:20 pm	**Thermal Analysis (Hanson)** • Introduction (Brady Hanson, 10 min) • Phase 1 discussion (Eric Lindgren, 20 min) • Demo results (Brady Hanson, 15 min) • Phase 2 discussion (Jim Fort/David Richmond, 40 min) • Phase 3 discussion (Eric Lindgren, 20 min) • Group discussion/path forward (Brady Hanson, 15 min)	Classroom #1243
12:20-1:50 pm	**Lunch** (on your own)	
1:50-3:50 pm	**Transportation Session I (Kalinina)** • 1:50-2:10 Elena Kalinina, Preliminary Results of Rail Data Analysis • 2:10-2:30, Nick Klymyshyn, ENSA/DOE Transportation Test Campaign Modeling Update • 2:30-3:00, Pavlo Ivanusa, Filtering Procedure Discussion	Classroom #1243

Additional Available Breakout Rooms: #1240 (holds 40), #1245 (holds 30), #2251 (holds 24)

	• 3:00-3:20, Kevin Kadooka, Railcar Dynamics Modeling • 3:20-3:50, Casey Spitz, Cask Dynamics Modeling	
3:50-4:10 pm	**Break**	SEB Foyer
4:10-5:30 pm	**Transportation Session II (Kalinina)** • 4:10-4:30, All, Summary Discussion of Data Analysis and Modeling • 4:30-4:45, All, Shaker Table Test Discussion • 4:45-5:30, All, 30cm Drop Test Discussion	Classroom #1243

THURSDAY, MAY 24, 2018

	ST: THURSDAY, MAY 24, 2018	
8:00-10:00 am	**Sister Rods (Saltzstein)** • Finalized test plan visual. (Saltzstein, 10 minutes) • Summary of Sister Rod NDE Results (Montgomery) • Sister Rod NDE, puncture, and gas communication results to date. (Montgomery, 30 min) • CIRFT tests: When, Where and How? (Bevard, 15 min) • Particle release test plan development (Bevard, 15 min) • Hydride cooling rate progress (Hanson, 10 min) • Shipping rods from ORNL to PNNL Logistical Discussion (Hanson and Scaglione, 20 min) • ANL results, logistics, and topics. (Billone, 10 min) • Puncture Tests (Saltzstein, 10 min)	Classroom #1243
10:00-10:20 am	**Break**	SEB Foyer
10:20-11:30 am	**Sister Rods** (Saltzstein) • Radiochemical Assays at ORNL from Waste Management (Scaglione, 10 min) • F-35 Rod Puncture discussion (Scaglione and Hanson, 10 min) • Revise and Finalize the Sister Rod Test Plan Document (Saltzstein, 30 min)	Classroom #1243
11:30-Noon	**Working Group Debrief and Closing**	Auditorium

Additional Available Breakout Rooms: #1240 (holds 40), #1245 (holds 30), #2251 (holds 24)

Storage and Transportation (ST) NEUP and SBIR Abstracts

1. **NEUP: Travis W. Knight**

Title: Experimental Determination and Modeling of Used Fuel Drying by Vacuum and Gas Circulation for Dry Cask Storage

PICSNE Work package #: Project14-7730

Dates: 10/01/14-9/30/18

Institution: University of South Carolina, Columbia, SC, Nuclear Engineering Program, Department of Mechanical Engineering

PI Name: Travis W. Knight

Presenter: Travis W. Knight

Title of Presentation: Experimental Determination of Used Fuel Vacuum Drying Using a Mock Fuel Assembly

Abstract:

An experimental facility has been designed and constructed to investigate vacuum drying of used nuclear fuel for placement in dry cask storage. The motivation for this study was to demonstrate the drying of used nuclear fuel using industry practice and provide the experimental data for development of drying models. A full size BWR fuel assembly (Areva Atrium 10A) with depleted uranium rods and 12 heater rods to simulate decay heat of used fuel is utilized in experiments. The fuel assembly with an interchangeable rod and chamber are designed to examine drying of key features of concern such as a simulated failed rod, a BWR water rod, a PWR guide thimble, porous neutron absorber materials, spacer disks, etc. The vacuum chamber simulating the storage cask contains structure similar to baskets for the fuel assembly and surrounding rails to center in the chamber. A test plan is currently being executed and involving separate effects of individual features test and combined tests with selected features to provide data for the development of drying models to describe drying as a function of cask variables such as temperature, pressure, and relative humidity. The experimental plan follows typical industry practice of vacuum drying in stages stepping down in pressure and separated by hold times to provide indication of excess water retained by observation of pressure rise due to boiling of water.

Continuous measurement and recording of data is conducted to capture temperature using more than 60 thermocouples, relative humidity, pressure, etc. Two thermal cameras are trained on viewports aligned at key features such as weep holes in the simulated PWR guide tube or BWR water rod. In addition to following criteria for determination of drying, direct observation is made to confirm drying. Flow meters and desiccators, not part of typical drying equipment, are utilized to quantify water removal to further confirm the amount of water removed and also as a function of time to assist in validation of mechanistic models of drying. Optical emission spectroscopy is further utilized to quantify the amount of water in the gas stream during vacuum drying.

Storage and Transportation (ST) NEUP and SBIR Abstracts (Cont'd)

2. **SBIR: James Christian, Radiation Monitoring Devices, Inc.**

SBIR award number: DE SC0015934

Institution: Radiation Monitoring Devices, Inc.

PI Name: James Christian, PhD

Project Name: Wireless Sensor Platform for Dry Spent Fuel Cask Monitoring

Presenter: James Christian

Title of Presentation: Update on the Wireless Sensor Platform for Dry Spent Fuel Cask Monitoring

Abstract:

RMD, in collaboration with Areva Transnuclear and Dr. Steve Skutnik at the University of Tennessee Knoxville, is designing, constructing and testing a prototype sensor system for dry spent fuel cask monitoring. The system is meant to be permanently sealed in a spent fuel cask, monitoring radiation, temperature, and pressure, while being powered from the thermal gradient between the fuel assemblies and the interior surface of the cask wall. The gathered data will be transmitted wirelessly through the cask wall. Mechanical design is based on actual dimensions of an Areva Transnuclear NUHOMS 32PTH. Preliminary designs for the radiation detector, acoustic transmission subsystem and expected thermoelectric generator layout and power capacity will be presented.

3. **SBIR: Peter Jardine, Shape Change**

SBIR Award:DE-SC0017713, Shape Change Technologies LLC, Dr. A. Peter Jardine

Title: Progress on a Precise Remote Sealing Technique for Dry Nuclear Storage Casks

Abstract:

Identification and repair of Stress-Corrosion Cracking (SCC) in nuclear waste casks has two primary challenges; one is a way to reliably identify a likely SCC site, given the high radiation and thermal conditions imposed on any electronics, and secondly, how to effect a patch weld that does not affect either the underlying steel microstructure, is non-contact, and can be easily applied within the tight space constraints imposed by the concrete over-cask Our Phase 1 work effort consisted in demonstrating a novel means to identify likely

crack sites as well developing a quantifying a patch weld technique that has been shown to be effective at rapid bonding to the stainless steel, with minimal impact on the underlying stainless steel microstructure. This effort will be discussed, with emphasis on the patch-weld technique.

Storage and Transportation (ST) NEUP and SBIR Abstracts (Cont'd)

4. **SBIR: Max Wiedmann, Optech Ventures & Intelligent Optical Systems**

SBIR award number: DE-SC0015769

Institution: Intelligent Optical Systems, Inc.

PI: Marvin Klein, Ph.D.

Project name: Diagnostics of Chlorine Induced Stress Corrosion Cracking Using Laser Ultrasonics

Presenter: Max Wiedmann

Title: Nondestructive Evaluation of Stress Corrosion Cracking in DCSSs Using Laser Ultrasonics

Abstract:

The stainless steel canister inside a dry cask storage system used to store spent nuclear fuel is at risk for chlorine-induced stress corrosion cracking, especially near welds and at storage sites exposed to high humidity. It is highly desirable to have a viable technique for *in-situ* nondestructive evaluation of SCC, specifically to measure the depth of the crack along its length. Intelligent Optical Systems has applied laser ultrasonic testing (LUT) to meet the demanding needs of canister inspection. LUT is a noncontact method for performing ultrasonic testing. It can measure crack depth with high accuracy. The components are resistant to the high-radiation, high-temperature environment inside the cask. The measurement head is fiber-delivered and can be miniaturized to fit into the tight spaces inside the cask.

5. **SBIR: Dan Xiang, X-Wave Innovations**

DE-SC0013745, X-wave Innovations, Inc., Dr. Dan Xiang (PI), Project Title: "A Self-Powered, Wireless Sensor System for Remote and Long-Term Monitoring of Internal Conditions of Nuclear Waste Casks".

Presenter: Dan Xiang

"A Self-Powered, Wireless Sensor System for Remote and Long-Term Monitoring of Internal Conditions of Nuclear Waste Casks"

Abstract:

A major concern with nuclear energy is the safe storage of the spent nuclear fuel before final disposal. A monitoring sensor located inside a storage cask to provide direct measurements of internal conditions is of particular interest to DOE. Conventional wireless sensors have inherent limitations because the stainless steel canister shields the RF signals from wireless sensors inside the canister to communicate with outside devices. In this SBIR effort, X-wave Innovations, Inc., is developing a self-powered, wireless sensor system (SPWSS) capable of monitoring the internal conditions (e.g., temperature, pressure, gas species (e.g., H2) and moisture (H2O)) of stainless steel nuclear waste storage casks and wirelessly transmitting the signal through the thick steel wall without any cable running through it.

Storage and Transportation (ST) NEUP and SBIR Abstracts (Cont'd)

6. **NEUP: Zeev Shayer, Colorado School of Mines**

DE-NE0008442, IRP-15-9318, 2015-2018

Project Name: "Innovative Approach to SCC Inspection and Evaluation of Canister in Dry Storage"

Lead university: Colorado School of Mines

PI name, and presenter: Zeev Shayer

Abstract:

Lifetime extension of dry storage canisters requires the ability to accurately predict and monitor material degradation so that corrective maintenance actions can be taken at time. Monitoring and inspection of dry storage facilities in combination with material property prediction and environmental conditions are necessary. One of the primary concerns with respect to the long-term performance of the storage casks is the potential for corrosion initiation due to deliquescence of salts deposited on the canister surface as aerosols; in regions of high residual weld stresses, this may lead to localized stress corrosion cracking (SCC). Dust and aerosols in the air being drawn though ventilation openings in the overpacks of passively-ventilated dry canister storage systems may be deposited on the stainless steel canister outer surfaces. Under these conditions, localized corrosion attack can occur. Deterioration by Chloride Initiation SCC at Independent Spent Fuel Storage Installations (ISFSIs) can lead to canister penetration, potentially releasing helium and radioactive gases, and permitting air ingress which could pose a threat to fuel rod integrity. An overview of third year IRP/NEUP awarded project will be presented, including closing gap of our understanding in SCC initiation and propagation rate at marine atmospheric environment. Focusing on the development of probability distribution functions for maximum pits depth propagation rate based on experimental data. The key parameters characterizing the probability distributions of pits at each stage depend on environment, material conditions, and stress intensity.

Two presentations:

1) Project overview – Zeev Shayer

2) An Application of Stochastic Modeling to Pitting of Spent Nuclear Fuel Canisters – Zeev Shayer

Chloride induced stress corrosion cracking (CISCC) is one of the main factors affecting the integrity of used nuclear fuel in dry storage canisters, especially at coastal sites. CISCC has complex interactions associated with environment, stress and materials properties. This presentation will be focused on the development of probability distribution functions for maximum pit depth based on experimental data created at SNL, CSM\NCSU and literature.