Workshop on Engineered Barrier Performance Related to Low-Level Radioactive Waste, Decommissioning, and Uranium Mill Tailings Facilities

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Time: August 3 - 5, 2010, 8:30 am – 6:00 pm (EDT)

Location: NRC Headquarters Auditorium, 11555 Rockville Pike, Rockville, MD 20852.

WebStreaming: http://video.nrc.gov/live/

Instructions:

Hyperlinks to the slides for each presentation are shown in blue and underlined.

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Agenda & Links to Presentations

August 3, 2010 (8:30 am – 12:30 pm EDT) Tuesday

Session 1: **Introductions and Orientation**

8:30 am

Welcome and Introductions
James Lyons, Deputy Director, NRC/RES (5 min.)
Larry Camper, Director, NRC/FSME/DWMEP (5 min.)

8:40 am

Discussion of Workshop Objectives, Goals and Agenda
Hans Arlt, NRC/FSME/DWMEP (10 min.)

***Objectives**:* Facilitate communication of Federal agencies' research and State regulatory experiences on the workshop topics to the technical community, and to discuss degradation processes and changing performance of engineered barriers, monitoring (short-term), model support (long-term), and modeling of processes within the barriers, especially engineered surface covers. Discuss lessons learned and practical examples of performance

failures and successes based on field observations. Share information on research results, existing guidance, and identify potential improvements to guidance.

***Goals**:* Identify lessons learned and recommendations to maintain adequate engineered barrier performance; to include areas for future research, and to identify potential needs for modifying and updating guidance.

8:50 am

Identification and Differentiation of Engineered Barrier Types by Function and Design

Professor Craig Benson, University of Wisconsin/CRESP (20 min.)

- **Surface Covers** – conventional covers with clay or composite (clay-geomembrane) barriers; water balance covers that control percolation by balancing soil water storage and water removal via evapotranspiration.
- **Bottom Liners** – subsurface barriers along the base and sidewalls of disposal facilities constructed with clay barriers, geomembranes, geosynthetic clay liners, and combinations thereof.
- **Cover and Bottom Liner Functions**: control water percolation into waste; control gases and radon release; maintain stabilization/prevent erosion; deter inadvertent intruders; and minimize contaminant transport or a combination thereof.

9:10 am

Overview of Engineered Barrier Performance and Regulatory Compliance Criteria

Jacob Philip, NRC/RES and David Esh, NRC/FSME (15 min.)

- Experiences with different engineered barrier types and their various components (e.g., DOE UMTRA sites to include Title I and II sites; LLRW facilities; WIR multi-layer covers; ACAP examples)
- NRC guidelines on engineered barrier performance, or on monitoring disposal sites of various waste types can be found in NUREG-1757 for complex materials decommissioning, NUREG-1854 for WIR, NUREG-1620 for radioactive mill tailings, and NUREG-1388 for LLW. NUREG-1623 presents methods, guidelines, and procedures for designing erosion protection, for long term stabilization
- NRC experiences and timeline
- Recent research and publications

9:25 am

Experience of the States in Regulating Facilities Involving Engineered Covers and Liners

Session Chairs:

Stephen Salomon, NRC/FSME and Susan Jablonski, TCEQ, State of Texas (80 min.)

Technical Reporter:

Douglas Mandeville, NRC/FSME

- Overview of research activities and findings with emphasis on practical insights on monitoring, modeling and confirming short- and long-term performance of engineered systems

Questions for Presenters:

- What are your State's regulatory activities and findings which confirm short- and long-term performance of engineered systems with emphasis on practical insights on monitoring and modeling?

- What are your siting regulations regarding engineered barriers (1) degradation processes that change performance; (2) monitoring devices and systems; (3) codes and modeling experiences; and (4) model support to gain confidence in long-term performance?

- How do you see these regulations evolving based upon experiences?

Presentations

9:25 – 9:35 am **Modeling and Monitoring of Barrier Performance for the Planned Texas Low-Level Radioactive Waste Disposal Facility**
Susan Jablonski, P.E., Peter Lodde, P.E., and Abel Porras, P.E.
Texas Commission on Environmental Quality (TCEQ), State of Texas

9:35 – 9:45 am **Utah Clive Low-Level Radioactive Waste Facility**
Loren Morton, Utah Division of Radiation Control, State of Utah

9:45 – 9:55 am **Overview of the Performance and Use of Engineered Barriers at the Barnwell LLRW Disposal Site**
Susan E. Jenkins, Division of Waste Management, South Carolina Department of Health and Environmental Control (SC DHEC), State of South Carolina

9:55 – 10:05 am **Washington State's Experience with Decommissioning and Evaluation of Cover Designs for Low-Level Radioactive Waste and Uranium Mill Tailings Facilities**
Gary Robertson, Office of Radiation Protection, Washington State Department of Health, State of Washington

10:05 – 10:15 am **Colorado Experience with Waste Repository Covers and Caps**
Lawrence J. Bruskin, P.E., Senior Engineer, and Steve Tarlton, P.E.,

Radiation Program Manager, Colorado Department of Public Health & Environment, Hazardous Materials and Waste Management Division, State of Colorado

Panel Discussion by Presenters and Panelists (30 min.)

10:15 – 10:45 am **Panelists:**

Steve Austin

Hydrologist for the Navajo Nation UMTRA sites, Navajo Environmental Protection Agency, Navajo Nation

Robert Paneuf

Acting Director, Bureau of Hazardous Waste & Radiation Management, Division of Solid & Hazardous Materials, Department of Environmental Conservation, West Valley LLW Facility in the State of New York

10:45 am **BREAK** (15 min

11:00 am

Federal Agencies and DOE National Laboratories

Session Chairs:

Jacob Philip, NRC/RES and Brian Andraski, U.S. Geological Survey (90 min.)

Technical Reporter:

George Alexander, NRC/FSME

- Overview of research activities and findings with emphasis on practical insights on monitoring, modeling and confirming short- and long-term performance of engineered systems

Questions for Presenters:

- What performance assessment (PA) was done to predict dose due to gaseous and fluid releases from the facility?
- What laboratory and field tests were performed to obtain input parameters for the PA modeling?

- What field and laboratory tests were performed, and what measurements were taken to validate PA model results?
- Is field monitoring continuing and at what intervals, to validate that the facility is continuing to perform to regulatory criteria?
- What maintenance and repair activities are conducted to remediate the facility if regulatory criteria are not being met?
- Are the PA's that were conducted for the sites and the laboratory/field test results publically available?

Presentations

11:00 – 11:02 am **Introduction**
Jacob Philip, NRC/RES and Brian Andraski, USGS

11:02 – 11:12 am **USACE Experience with HTW Containment Systems**
Kevin Pavlik, U.S. Army Corps of Engineers

11:12 – 11:22 am **The Legacy Management UMTRCA Program**
Richard Bush, DOE/Legacy Management (DOE/LM)

11:22 – 11:32 am **EPA's Review of Its Regulatory Requirements for Uranium and Thorium Mill Tailings: 40 CFR Part 192**
Loren Setlow, U.S. EPA

11:32 – 11:42 am **Investigations Supporting Performance Verification of Engineered Barrier Systems**
Joel Hubbell, Idaho National Laboratory

11:42 – 11:52 am **Savannah River Site E-Area Low-Level Waste Facility Subsidence Studies**
Mark Phifer, Savannah River National Laboratory

11:52 am – 12:02 pm **DOE Overview**
Martin Letourneau, DOE/Environmental Management (DOE/EM)
Presented by Roger Seitz, Savannah River National Laboratories

Panel Discussion by Presenters and Panelists (28 min.)

12:02 – 12:30 pm **Panelist:**

David W. Esh

U.S. NRC

12:30 pm **LUNCH** (60 min.)

August 3, 2010 (1:30 – 5:30 pm EDT) Tuesday

Session 2: **Degradation Processes and Performance Evolution of Engineered Barriers**

Session Chairs:

Craig Benson, University of Wisconsin/CRESP and W. Jody Waugh, S.M. Stoller LLC

Technical Reporter:

Brooke Traynham, NRC/FSME

Topics to be Considered:

- Degradation processes affecting barrier components (e.g., geomembranes, GCLs, drainage layers)
- Climatic factors contributing to degradation in the near term and long term
- Environmental equilibrium: plant succession, climatic variability, and geomorphic processes due to changes in local hydrology
- Anthropogenic impacts on engineered barriers in covers
- Impacts of erosion
- Microbial processes that affect barrier materials and drains (biofouling)
- Geochemical processes that affect degradation of barriers and drains (chemical erosion, embrittlement, and clogging of drainage)

Questions for Presenters:

- For all types of covers, what are the most significant short-term and long-term degradation processes causing increases in radon release, water percolation, erosion, and bio-uptake?

- For all types of liners, what are the most significant short-term and long-term degradation processes causing increased water and contaminant flux?

- How will climatological and ecological changes affect degradation processes (e.g., at humid, temperate sites, as well as for dry, cold sites)?

- How can degradation processes be minimized, and radon release, percolation, erosion, and bio-uptake be reduced for various ecologies and climates (e.g., QA/QC, installation, type of cover, material, etc.)?

- Can the desired changes to reduce one process cause the undesired increase of another; for example, activities that reduce erosion inadvertently cause an increase in water percolation? How can such unintended consequences be avoided?

- How can our understanding of degradation processes be used to improve the designs and performance of covers and liners?

Presentations

1:30 – 2:00 pm **UMTRA Experience Monitoring Degradation Processes and Their Effects on the Performance of Covers**
Jody Waugh, SM Stoller Corporation (DOE/LM), Grand Junction, CO

2:00 – 2:30 pm **Soil Development Processes and Their Effects on the Performance of Covers**
Craig Benson, Geological Engineering, University of Wisconsin

2:30 pm **BREAK** (10 min.)

2:40 – 3:10 pm **Geomorphological and Landform Processes and Changes in the Performance of Covers**
Gary Willgoose, Australian Professorial Fellow in Environmental Engineering, University of Newcastle, Callaghan, Australia

3:10 – 3:40 pm **Ecological Processes and Changes in the Performance of Covers**
Steven Link, Department of Science and Engineering, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR

3:40 – 4:10 pm **Degradation Processes and Changes in the Performance of Geosynthetics**
Kerry Rowe, Vice-Principal and Professor of Civil Engineering, Queen's University, Kingston, Ontario

4:10 pm **BREAK** (10 min.)

Panel Discussion by Presenters and Panelists (70 min.)

4:20 – 5:30 pm **Panelists:**

Bill Albright

Desert Research Institute/UNV

Bob Phaneuf

New York State Department of Environmental Conservation (NYS DEC)

Mark Phifer

Savannah River National Laboratory

Kevin Leary

DOE-Hanford

5:30 pm **Opportunity for Public Questions and Comments**

Please call-in to: **1-888-566-6344** Passcode: **15103**

6:00 pm **ADJOURN**

August 4, 2010 (8:30 am – 12:30 pm EDT) Wednesday

Session 3: **Experience with Monitoring Devices and Systems Used to Measure Performance**

Session Chairs:

William Albright, Desert Research Institute/UNV and Craig Benson, University of Wisconsin/CRESP

Technical Reporter:

Robert Johnson, NRC/FSME

Topics to be Considered:

- Monitoring of short-term performance processes and indicators of percolation, leakage, and radon flux
- Monitoring of long-term performance processes and indicators using indirect (time-lapse imagery or geophysical surveys) and direct monitoring (large-scale pan lysimeters)
- Remote sensing and surveillance
- Direct measurement of percolation rates and radon fluxes over specified intervals
- Meteorological monitoring of rainfall, snow cover, temperature, and evapotranspiration
- Leachate collection and analysis for liners
- Sampling of contaminants and soil water chemistry to detect failure modes
- Monitoring of degradation processes on, and within, the barrier that modify the barrier from "*as built*" performance metrics to a longer-term performance level
- Monitoring to verify assumptions in PAs and modeling predictions
- Remote monitoring methods

Questions for Presenters:

- What areas should be monitored for significant degradation/performance (i.e., what are the important process and components)?
- Which barrier systems can be effectively monitored (*in situ* and remotely), and for how long?
- What tools, techniques, and methodologies are available for monitoring, and where/when should they be applied?
- What type and level of monitoring should be done (data sufficiency), and for how long?
- Does monitoring in the short-term provide insights and possible understanding of long-term issues?
- How important are information gaps in monitoring?

Presentations

8:30 – 8:55 am **In Search of the Perfect Cap: 15 Years of Performance Data from the Prototype Hanford Barrier**
Andy Ward, Pacific Northwest National Laboratory

8:55 – 9:20 am **ACAP: Monitoring cover performance and changes in performance with drainage lysimeters, instruments, and exhumations**
Bill Albright (DRI) and Craig Benson (UW)

9:20 – 9:45 am **Monitoring Contaminant Strategies: Tools, Techniques, Methodologies and Modeling Approaches**

Tim Gish, Audrey Gruber, Yakov Pachepsky, U.S. Department of Agriculture/Agricultural Research Service, Beltsville, MD

9:45 am **BREAK** (10 min.)

9:55 – 10:20 am **Aerial remote sensing as a component of closure cap monitoring**
John Gladden, Savannah River National Laboratory

10:20 – 10:45 am **Differential Settlement and its Importance on the Performance of Cover Systems at Radiological Waste Disposal Facilities**
Bob Bachus, Geosyntec Consultants

10:45 am **BREAK** (15 min.)

Panel Discussion by Presenters and Panelists (90 min.)

11:00 – 12:30 pm **Panelists:**

Brian Andraski

US Geological Survey

Bill Kustas

USDA/ARS

12:30 pm **LUNCH** (60 min.)

August 4, 2010 (1:30 – 5:30 pm EDT) Wednesday

Session 4: **Modeling Experiences in Performance Assessment and Evaluation of Performance Monitoring**

Session Chairs:

David Esh, NRC/FSME and Thomas Nicholson, NRC/RES

Technical Reporter:

Christopher Grossman, NRC/FSME

Topics to be Considered:

- Water balance models to evaluate storage capacity, infiltration and deep percolation
- Assess environmental conditions
- Assess failure modes and changes to materials and system components over time
- Small- (point) versus large-scale (average) estimates of flux and perturbations
- Estimate percolation rates through covers at different scales
- Estimate radon flux through various covers (especially clay covers) over time
- Estimate long-term environmental equilibrium conditions related to natural and anthropogenic changes
- Issues of spatial/temporal scale and corresponding field-scale observations
- Time periods for evaluation (i.e., 0 – 5 years, 5 – 10 years, 10 – 50 years, 50 – 100 years, 100 – 500 years, 500 – 1,000 years, and greater than 1,000 years)

Questions for Presenters:

- When should numerical modeling of engineered barriers be performed?
- Over what time periods should performance simulations be considered?
- What are the criteria to determine the detail of modeling needed, e.g., should the actual processes changing a GCL be modeled?
- Which hydrologic, erosion, and mass wasting codes are recommended to better evaluate long-term performance of covers?
- What codes are recommended for simulating ecological evolution?
- What codes are recommended for predicting physical and chemical changes in soil properties and geosynthetic materials?
- How should ecological and climatological changes be incorporated into performance simulations?
- What input data and parameters are required for these codes and is this information available?

Presentations

1:30 – 1:55 pm **Development of an Integrated Probabilistic Model of Radiological Fate and Transport in**

an Engineered Cover
John Tauxe, Neptune and Company

1:55 – 2:20 pm **Practical Considerations for Modeling and Monitoring of Engineered Barriers Performance**
Roger Seitz, Savannah River National Laboratories

2:20 – 2:45 pm **Near-Term Hydrological Performance Modeling of Covers**
Craig Benson, University of Wisconsin/CRESP

2:45 pm **BREAK** (10 min.)

2:55 – 3:20 pm **Prototype Hanford Barrier Modeling with the STOMP Sparse Vegetation Evapotranspiration Model**
Andy Ward, Pacific Northwest National Laboratory

3:20 – 3:45 pm **Effects of Plant Succession on the Functioning of Engineered Covers and Modeling of Long-Term Successional Impacts Using the EDYS Ecological Simulation Model**
Terry McLendon, KS2 Ecological Services Specialists, LLC

3:45 – 4:10 pm **Applications of thermal remote sensing for multi-scale monitoring of evapotranspiration**
Bill Kustas and Martha Anderson, U.S. Department of Agriculture/Agricultural Research Service, Beltsville, MD

4:10 pm **BREAK** (10 min.)

Panel Discussion by Presenters and Panelists (80 min.)

4:20 – 5:30 pm **Panelists:**

Ming Zhu

DOE - Environmental Monitoring

Gary Willgoose

University of Newcastle, Callaghan, Australia

5:30 pm **Opportunity for Public Questions and Comments**

Please call-in to: **1-888-566-6344** Passcode: **15103**

6:00 pm

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August 5, 2010 (8:30 am – 12:30 pm EDT) Thursday

Session 5: **Experience with Model Support and Multiple Lines of Evidence to Gain Confidence in Long-Term Performance**

Session Chairs:

Hans Arlt, NRC/FSME and George Alexander, NRC/FSME

Technical Reporter:

Bret Leslie, NRC/NMSS

Topics to be Considered:

- Types of model support strategies and multiple lines of evidence
- Field evidence and laboratory tests to build confidence in performance
- ACAP exhumation and process audits to identify failure modes
- Lessons Learned from uranium recovery experiences and monitoring programs
- Model support commensurate with the risk significance
- Evaluate plant succession and soil development affecting long-term performance
- Landform stability as analogs to engineered barriers
- Attributes and evolution of stable landforms
- Time periods for evaluation (i.e., 0 – 5 years, 5 – 10 years, 10 – 50 years, 50 – 100 years, 100 – 500 years, 500 – 1,000 years, and greater than 1,000 years)
- Development of a performance confirmation program
- Develop a Screening Framework
- Develop a Catalog of Analogs
- Reality checks and use of success criteria to build confidence in short- and long-term performance

Questions for Presenters:

- What information or “lines-of-evidence” is needed to have confidence that an engineered surface cover or

bottom liner will perform as predicted for 100 years?

- What information or “lines-of-evidence” is needed to have confidence that an engineered surface cover or bottom liner will perform as predicted for 100’s to 1000’s of years as ecologic settings and climates change?

Presentations

8:30 – 8:55 am **Overview of Model Support (for Engineered Barriers)**
Dave W. Esh, NRC/FSME

8:55 – 9:20 am **Activities that Support the Scientific Credibility of Radioactive Waste System Performance Models**
Abraham Van Luik, Carlsbad Field Office, DOE-Environmental Management (DOE-EM)

9:20 – 9:45 am **Geomembrane Performance in Landfill Cover Systems**
George R. Koerner, Geosynthetic Institute (GSI)

9:45 am **BREAK** (10 min.)

9:55 – 10:25 am **A Role for Natural Analogs in the Design and Long-Term Performance Evaluation of Earthen Covers for Uranium Mill Tailings**
William J. Waugh, S.M. Stoller Corporation

10:25 – 10:50 am **Arid Soil Evolution and Pedologic Development: Process Considerations and Applications to Engineered Barrier Design**
Todd G. Caldwell[1], Michael H. Young[2], and Eric V. McDonald[1]
[1]Desert Research Institute, Division of Earth and Ecosystem Sciences
[2]University of Texas, Bureau of Economic Geology

10:50 am **BREAK** (15 min.)

Panel Discussion by Presenters and Panelists (85 min.)

11:05 – 12:30 pm **Panelists:**

Mark Phifer

Savannah River National Laboratory

Kent Bostick

Professional Project Services, Inc. (Pro2Serve)

John Walton

Univ. of Texas – El Paso

Kerry Rowe

Civil Engineering, Queen's University

12:30 pm **LUNCH** (60 min.)

August 5, 2010 (1:30 – 5:30 pm EDT) Thursday

Session 6: **Recommendations on Assessing Engineered Barrier Performance, Identifying Future Research Needs, and Discussing Existing Guidance**

Session Chairs:

Thomas Nicholson, NRC/RES and Hans Arlt, NRC/FSME

Technical Reporters:

Mark Fuhrmann, NRC/RES and Allen Gross, NRC/FSME

Significant Insights and Recommendations from Session Presentations and Panel Discussions

1:30 – 1:42 pm **States Overview**

by Susan Jablonski, Stephen Salomon and Douglas Mandeville

1:42 – 1:54 pm **Federal Overview**

by Jake Philip, Brian Andranski and George Alexander

1:54 – 2:06 pm **Degradation Processes**

by Craig Benson, W. Jody Waugh and Brooke Traynham

2:06 – 2:18 pm **Monitoring**

by Bill Albright, Craig Benson and Robert Johnson

2:18 – 2:30 pm **Modeling**

by Dave Esh, Tom Nicholson and Christopher Grossman

2:30 – 2:42 pm **Model Support**

by Hans Arlt, George Alexander and Bret Leslie

2:42 p.m.

BREAK (18 min.)

3:00 p.m.

Group Discussion and Summary of Recommendations (115 min.)

Formulate recommendations on how to evaluate short- and long-term engineered barrier performance:

- Identify degradation processes affecting performance, e.g., different barrier types for different types of ecologic and climate states
- Identify strategies for monitoring and modeling these degradation processes
- To evaluate overall performance, recommend total system monitoring strategy
- To evaluate overall performance, recommend total system numerical modeling strategy
- To gain confidence in overall performance, recommend strategies to obtain information and evidence needed to support short- and long-term performance model results
- Highlight research opportunities to fill information gaps
- Identify potential improvements to existing guidance
- Recommend follow-up coordination among workshop participants

4:55 p.m.

Opportunity for Public Questions and Comments (30 min.)

Please call-in to: **1-888-566-6344** Passcode: **15103**

5:25 p.m.

Action Items and Follow-Ups and Thanks to the Attendees and Speakers

Tom Nicholson and Hans Arlt, Workshop Co-Chairs

5:30 p.m.

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