U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Office of Science and Technology and International

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OCRWM Science & Technology Program

Corrosion Targeted Thrust

Objectives

The materials used for isolating waste in the proposed repository are an important component of the overall approach to the design of the repository system. Opportunities exist to enhance the understanding of material corrosion performance and to probe technical enhancements. These enhancements may include optimizing the performance of waste packages for increased reliability and cost effectiveness. Determination of the status and future performance of waste packages based upon materials, design and realistic repository conditions are important to guide rational, reliable and cost effective decisions by policy-makers, managers and engineers.

Approach

Materials optimization is realized through a coordinated program of targeted applied research. The program comprises directed technical goals and thrusts. A team of leading scientists/engineers from major universities and national laboratories is working together to meet the program objectives. This group brings specialized expertise and facilities including corrosion science, materials science, electrochemistry and geochemistry. The Corrosion Targeted Thrust is coordinated with the Yucca Mountain Project through cooperative projects, technical exchanges and program reviews.

Targeted Technical Thrusts

Enhancements to the long-term performance assessment are the primary focus of the Corrosion Targeted Thrust. Three technical thrusts have been identified for the program:

- Corrosion in thin films, particulate and deposits
- Evolution of corrosion damage by localized corrosion
- Evolution of environment on metal surfaces.

The first thrust addresses the most realistic condition within the repository. The waste packages are supported in air, and they will never be fully immersed in water. Further understanding of the effects of moisture from the surrounding rock and humidity within the repository tunnels on the corrosion performance of waste packages offers more insight for how the materials will react over long periods of time. The second thrust addresses the most relevant mode of corrosion for the conditions at Yucca Mountain, i.e., localized corrosion processes and particularly crevice corrosion. The third thrust enhances the analysis of corrosion performance, i.e., the amount, distribution and chemical composition of the moisture on waste packages at relevant time periods in the repository.

Major Technical Background and Resources

Several sources provide a basis for the selection of high priority, technical thrusts. Worthy of special note are the Department of Energy (DOE), Nuclear Regulatory Commission, Center for Nuclear Waste Regulatory Analyses and others results and analyses for Yucca Mountain; the DOE Basic Energy Sciences (BES)/OCRWM Corrosion Workshop-July 2003; the DOE Waste Package Peer Review-February 2002; and the Nuclear Waste Technical Review Board (NWTRB) Workshop on Long-Term Passivity-July 2001.

Background

Effective corrosion prevention and control is important to the long-term performance of the proposed Yucca Mountain Repository. Nickel-based Alloy 22 and titanium, the principal construction materials for waste packages and drip shields, have excellent corrosion resistance over a wide range of aqueous solution compositions and temperatures. Intact waste packages fully contain and isolate radionuclides for transportation and emplacement in the repository.

The determination of the long-term corrosion performance of waste packages is uncertain due to the exceptionally long times of interest, i.e. 10,000 years and beyond. The Corrosion Targeted Thrust will enhance the technical materials basis for the repository and will seek to offer improvements in materials costs and reliability.

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Corrosion Thrust Program Team

Leading scientists and engineers from universities form a multi-university Corrosion Cooperative (CorrCoOp) that works closely with scientists and engineers at several national laboratories. The CorrCoOp is based at Case Western Reserve University and other participants include Arizona State, Ohio State, Pennsylvania State, University of California-Berkeley, University of Minnesota, University of Toronto, University of Western Ontario and University of Virginia. National laboratories include Lawrence Livermore (LLNL), Oak Ridge (ORNL), Pacific Northwest (PNNL), Lawrence Berkeley (LBNL) (FY 2005 start planned) and Atomic Energy of Canada Limited (AECL).

The Director of the Corrosion Targeted Thrust is Dr. Joe H. Payer at Case. He is supported by an executive committee, a technology/research committee comprised of all program principal investigators, an external review panel and several international affiliates.

Current Projects within the Corrosion Thrust Program

The current list of projects includes:

- Time Evolution of Corrosion Damage by Localized Corrosion (CorrCoOp team)
- Crevice Corrosion-Coupled crevice and cathode interactions (AECL)
- Localized Corrosion Processes (LLNL FY 2005 start)
- Corrosion in Thin Moisture Films and Layer of Particulate and Deposits (CorrCoOp team)
- Durability of Passive Films-Effects of Sulfur and Thermal Treatment (PNNL)
- Corrosion in high temperature salts (LLNL FY 2005 start)
- Time Evolution of Corrosion Environments (CorrCoOp team)
- High-Temperature, Multi-Species Solution Properties and Behavior (ORNL)
- In-Drift Environment on Waste package/drip shield (LBNL FY 2005 start)
- High Performance Amorphous Metal Coatings (DARPA/DOE project; LLNL led team)

Program Milestones

Multi-University Cooperative - established June 2004
Corrosion CoOp Executive Committee Meeting - August 2004
Multi-year Plan for Corrosion Thrust - August 2004
Corrosion Thrust Principal Investigators Meeting - October 2004
Corrosion Thrust External Review Panel Meeting - October 2004

Related Activities

Presentations to NWTRB - "Corrosion Resistance of Alloy 22"
May 18-19, 2004
DOE BES/OCRWM Corrosion Workshop - July 2003

**For additional information
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Emplacement Drift Perspective