



Nuclear Safety R&D in the Waste Processing Technology Development & Deployment Program

**Presentation to
the DOE High Level Waste Corporate Board**

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Outline

- **Nuclear Safety Research & Development Overview**
- **Summary of EM- NSR&D Presentations from February 2009**
 - Evaluating Performance of Nuclear Grade HEPA Filters under Fire/Smoke Challenge Conditions
 - Structural Integrity Initiative for HLW Tanks
 - Pipeline Plugging and Prevention
 - Advanced Mixing Models
 - Basic Science Opportunities in HLW Storage and Processing Safety
 - Cementitious Barriers Partnership



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Nuclear Safety Research & Development Overview

- **DNFSB 2004-1 identified need for renewed DOE attention to nuclear safety R&D**
- **DOE response to DNFSB 2004-1**
 - Develop process to identify safety R&D needs and determine to what extent the needs are being addressed
 - Develop method to ensure nuclear safety R&D needs are identified and integrated into planning
- **Resulted in establishing Nuclear Safety R&D Coordinating Group (CG)**
 - NNSA has the lead; EM participates on this NSR&D Coordinating Group
 - Responsible for establishing and maintaining an annual process to identify, prioritize and propose resources needed to conduct research supporting safe nuclear operations across DOE & NNSA
 - Coordinates quarterly meetings and annual NSR&D Forum
- **DOE-EM Office of Waste Processing TDD Program prioritizes NSR&D**
 - Nuclear safety is among the criteria used for prioritizing tasks that receive funding



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Summary of: Evaluating Performance of Nuclear Grade HEPA Filters Under Fire/Smoke Challenge Conditions

(originally presented by Charlie Waggoner, ICET February 2009)

- **Issue: Basic maximum operating parameters for temperature, maximum aerosol particle size, maximum particulate matter mass concentration and acceptable differential pressure range data for HEPA filters when challenged by smoke, soot and water conditions are needed.**
- **Project will provide information for decisions regarding desired performance of AG-1 Section FC HEPA filters when challenged by smoke, soot, and water**
 - Project scope was based on review of DOE Standard 1066-99
 - Reduce uncertainty in physical operational limits of Section FC HEPA filters when challenged by smoke, soot and water in the event of fire
 - Develop loading curve data due to smoke, soot and water for inclusion in design of DOE Standard 1066-99 compliant ventilation systems
- **Accomplishments and Plans**
 - Data has been generated and presented to show the impact of media velocities on differential pressure, filter efficiency, and filter life with correlations of these effects on two different particle size distributions
 - A new filter test stand is planned for testing under highly controlled conditions (smoke, soot, moisture)
 - Filter smoke, soot, and/or moisture test plan development is planned in FY09 with Hanford and Oak Ridge representatives and NNSA group performing review of DOE Standard 1066-99



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Summary of: Structural Integrity Initiative for HLW Tanks in the DOE Weapons Complex

(originally presented by Bruce Wiersma, SRNL February 2009)

- **Issue: Assuring the structural integrity of HLW Tanks is critical given that many of the tanks have exceed their original design life and need to continue to store HLW**
- **DOE-EM TDD Program supports technology improvement opportunities and interface for SRS and Hanford Sites, including:**
 - Improved inspection equipment, tools and techniques
 - Improved monitoring of corrosion processes in tanks
 - Improved chemistry controls for extended storage and waste removal
 - Improved structural analysis for SSTs
 - Integration of structural integrity programs (to the extent possible)
- **Accomplishments and Plans**
 - Hosted a Structural Integrity Workshop in 2008
 - Plan to issue a structural integrity technology roadmap in 2009



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Summary of: Pipeline Plugging and Prevention

(originally presented by Dwayne McDaniel, FIU February 2009)

- **Issue: Plugging during HLW transfers can result in worker exposure and costly schedule delays**
- **DOE-EM TDD Program supports leveraging and integration of FIU demonstration work, WTP work, and computational modeling efforts to generate the data and validate predictive tools needed to reduce the risk of impacts to the Complex due to pipeline plugs**
 - Avoiding potential worker exposure for pipeline replacement and allowing cost-effective operation
 - Ensure tank farm cleanup milestones are met by mitigating the risk of schedule delays
- **Accomplishments and Plans**
 - Assessed further advances in technologies since first evaluated in 2000
 - Combine lessons learned from unplugging evaluations to support computer simulations and bench scale testing
 - Integrate with PNNL examination of WTP piping conditions that could lead to sedimentation and plugging



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Summary of: Advanced Mixing Models

(originally presented by Rich Dimenna, SRNL February 2009)

- **Issue: Models (CFD) are needed to more accurately predict HLW tank mixing performance to determine time required for homogeneity which would reduce pump maintenance and replacement costs by extending life and thereby reducing worker exposure**
- **Improved modeling is designed to address:**
 - Reducing conservatism in current mixing times
 - Identification of turbulence models for jet mixing to evaluate turbulence parameters
 - Advance the theoretical understanding of large waste tank mixing across the DOE Complex
- **Accomplishments and Plans**
 - Literature studies have been performed on turbulence models and mixing mechanisms
 - Hanford mixing codes and capabilities have been reviewed
 - Test cases on three geometries, three turbulence models and three turbulence parameters (mixing indicators) have been completed
 - Compared a test case mixing time to Grenville-Tilton correlation
 - Theoretical development of turbulent mixing characteristics and indicators is planned for completion in FY2009



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Summary of: Basic Science Opportunities in HLW Storage and Processing Safety

(originally presented by Paul Breddt, PNNL February 2009)

- **Issue: Challenges that face the EM cleanup mission require investments in fundamental discovery-based research**
- **This activity identifies specific risks to the EM cleanup mission that require investments in fundamental research.**
 - Reducing potential worker of exposure
 - Prevent releases and mitigate catastrophic system failure
 - Reduce risk of plant upsets and at-risk materials by accelerating processing
- **Accomplishments and Plans**
 - Publication of “Scientific Opportunities to Reduce Risk in Nuclear Process Science”
 - Continued dialogue and communication of the basic science needs to support the EM mission is planned
 - Development of a similar science and risks assessment for Soil & Groundwater is planned



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Summary of: Cementitious Barriers Partnership

(originally presented by David Kosson, Vanderbilt University/CRESP February 2009)

- **Issue: Degradation mechanisms of cementitious barriers and waste forms are not fully understood.**
- **The objective of this partnership is to develop a reasonable and credible set of tools to predict the structural, hydraulic, and chemical performance of cement barriers used in nuclear applications over extended timeframes**
 - Uncertainty reduction and improved consistency supporting Performance Assessment
 - Guidance document updates
 - Industry-wide technical basis for evaluation amongst stakeholders
 - Improved technology foundation
- **Accomplishments and Plans**
 - Formation of the partnership with national and international partners is complete and technical work has started
 - State of the art review of modeling performance of cementitious materials, and initial demonstrations to assess structural performance, chemical evolution and containment using models are planned
 - A review of opportunities to reduce uncertainty associated with cementitious materials in performance assessments is planned



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Summary

- **Waste Processing TDD Program incorporates nuclear safety improvements by including nuclear safety criteria in the annual prioritization process for project funding**
- **TDD Program activities presented at the forum represented key projects/tasks that will serve to improve nuclear safety in EM**
- **EM needs to continue its involvement and participation in the Nuclear Safety R&D Forum**



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