

FCT Quality Assurance Program Document

Appendix E FCT Document Cover Sheet

Name/Title of Deliverable/Milestone	Engineering Analysis Year End Status Report
Work Package Title and Number	ST Engineering Analysis – ORNL FT-12OR081003
Work Package WBS Number	1.02.08.10
Responsible Work Package Manager	John Wagner
	(Name/Signature)

Date Submitted 9/28/2012

Quality Rigor Level for Deliverable/Milestone	<input checked="" type="checkbox"/> QRL-3	<input type="checkbox"/> QRL-2	<input type="checkbox"/> QRL-1 <input type="checkbox"/> Nuclear Data	<input type="checkbox"/> N/A*
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This deliverable was prepared in accordance with Oak Ridge National Laboratory
(Participant/National Laboratory Name)

QA program which meets the requirements of
 DOE Order 414.1 NQA-1-2000

This Deliverable was subjected to:

Technical Review

Technical Review (TR)

Review Documentation Provided

- Signed TR Report or,
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Peer Review

Peer Review (PR)

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LETTER REPORT

Reactor and Nuclear Systems Division

Project Title: Storage and Transportation Engineering Analysis
Subject of Document: Engineering Analysis Year End Status Report
Type of Document: Letter Report
Authors: J. C. Wagner
Date Published: September 28, 2012
Responsible Individual: J. C. Wagner, ORNL Work Package Manager

Prepared for the
Used Fuel Disposition Campaign
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Office of Nuclear Energy
DEPARTMENT OF ENERGY

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1. INTRODUCTION AND BACKGROUND

This letter report provides a summary of work performed supporting the Department of Energy-Office of Nuclear Energy (DOE-NE) Fuel Cycle Technologies Used Fuel Disposition Campaign (UFDC) under work breakdown structure element 1.02.08.10—Storage and Transportation (S&T) Engineering Analysis. In particular, this report fulfills the M4 milestone M4FT-12OR0810032, “Engineering Analysis Year End Status Report.” This report summarizes the FY 2012 S&T Engineering Analysis multi-laboratory efforts that are not directly related to the design and evaluation of the integrated canister concept (also referred to as “can-in-can”), including analyses of selected applications and plans for FY 2013. The multi-laboratory efforts to design and evaluate an integrated canister concept are documented in a separate report that fulfills the M4 milestone M4FT-12OR0810038, “Status Report on Integrated Canister Design and Evaluation.”

The S&T Engineering Analysis control account was established in FY 2012 to apply and develop analysis capabilities to address the technical issues and data gaps associated with extended storage (ES) of UNF and transport of UNF following ES periods. The scope spans the broad technical areas and associated data needs for ensuring the safety of UNF storage and transport, including used fuel characterization, materials, structural, thermal, radiation shielding/characterization, containment/confinement and nuclear criticality safety. The work is to be prioritized and coordinated with other control accounts within the UFDC to develop an improved understanding of UNF performance characteristics and develop validated analysis capabilities that can be used to extend the technical bases for the safe storage and transport of UNF during protracted time periods. Sensitivity analyses and uncertainty quantification (UQ) techniques will be used to support prioritization of experimental research and quantify uncertainties in the extrapolation of analytic and experimental results.

2. FY 2012 ACTIVITIES AND STATUS

In the first year (FY 2012) of this multi-year S&T Engineering Analysis activity, efforts were devoted to establishing the multi-laboratory team and development of improved understanding relative to establishing the technical basis for ES and subsequent transportation. The FY 2012 multi-laboratory team included Oak Ridge National Laboratory (lead), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Pacific Northwest National Laboratory (PNNL), and Sandia National Laboratories (SNL), as well as representation and contributions from the Department of Energy (DOE). The scope during this FY included:

- (1) establishment of the objectives, purpose, scope and a multi-laboratory team for the S&T Engineering Analysis control account;
- (2) assessment of specific applications for modeling and analysis;
- (3) investigations to identify technical data gaps that can best be resolved through modeling and analysis; and
- (4) directing and coordinating a multi-laboratory team for design and concept identification and evaluation of an integrated storage, transport and disposal canister.

The originally planned FY 2012 scope was expanded via Baseline Change Proposal (BCP-FT-2012004) to include efforts related to the design and evaluation of the integrated canister system. The affected work packages were modified and approved in early calendar year 2012. Following the BCP, the control account budget was split approximately evenly between the original scope activities and the integrated canister system activity.

Specific activities and milestones, and their associated status, for each of the laboratories that support the above scope are provided below.

Oak Ridge National Laboratory

- M3FT-12OR0810031 Report on the Identification of specific applications for early analysis
Delayed due to other, higher priorities within the UFDC and delays in receiving input to this report from the laboratory contributors. To be completed late, expected October 2012.
- M4FT-12OR0810032 Engineering Analysis Year End Status Report (this report)
To be completed on schedule, 09/28/2012.
- Activity FT-12OR0810037 Support RD&D Roadmap for Used Fuel Storage and Transport
Completed on schedule; RD&D Roadmap report, "Used Nuclear Fuel Storage and Transportation Research, Development, and Demonstration Plan," FCRD-FCT-2012-000053, INL/EXT-12-24529.
- M4FT-12OR0810038 Status Report on Integrated Canister Design and Evaluation
To be completed on schedule, 09/28/2012.
- Activity FT-12OR0810036 Integrated canister (can-in-can) design and analysis
Completed on schedule.

Idaho National Laboratory

- M4FT-12IN0810014 Status report for ORNL analyses activities
Delayed. To be completed late, expected October 2012.
 - Activity FT-12IN0810011 Support modeling initiative for extended storage
- M4FT-12IN0810012 Support for early analysis report
Completed late, 07/27/2012.
 - Activity FT-12IN0810015 Support for Early Analysis
- M4FT-12IN0810013 Operational Assessment of Cask Drying
Completed on schedule
 - Activity FT-12IN0810016 Support for Operational Assessment of Drying
- Activity FT-12IN0810017 Support for End of Year Status
Completed
- M4FT-12IN08100110 Can-in-Can Letter Report
Completed late, expected 09/27/2012
 - Activity FT-12IN0810019 Support for can-in-can design

Los Alamos National Laboratory

- Activity FT-12LA0810021 LANL Input to Report on Specific Applications for Early Analysis
Completed on schedule.
 - Activity FT-12LA0810023 Assess specific activities for modeling and analysis
- M4FT-12LA0810022 Status Report on LANL Early Analysis Activities and Proposed Future Work
Completed on schedule.
 - Activity FT-12LA0810024 Conduct analyses on selected mechanisms
- M4FT-12LA0810026 Postclosure Aspects of Can-in-Can Concept
Completed on schedule.
 - Activity FT-12LA0810027 Evaluate Operational Aspects of Can-in-Can concept

Pacific Northwest National Laboratory

- M3FT-12PN0810041 Report on Realistic Temperature Profiles Activity FT-12LA0810023
Completed on schedule; report "Thermal Modeling of NUHOMS HSM15 Storage Module at Calvert Cliffs Nuclear Power Station ISFSI" FCRD-UFD-2012-000114, May 2012.
- Activity FT-12PN0810042 Can-in-Can
Completed on schedule.
- M3FT-12PN0810043 Report on Realistic Temperature Profiles - Second Canister
Draft report submitted on schedule; report "Thermal Modeling of NUHOMS HSM-15 and HSM-1 Storage Modules at Calvert Cliffs Nuclear Power Station ISFSI," PNNL-XXXXX, Sept. 2012.
- Activity FT-12PN0810044 Provide Fuel Assembly Structural Models to Support Sandia Shaker Table Tests
Completed on schedule.

Sandia National Laboratories

- M4FT-12SN0810053 Preliminary report
Completed late, 04/19/2012.
 - Activity FT-12SN0810051 Assess specific applications for modeling and analysis
- M3FT-12SN0810054 Final report
Expected to be completed on schedule 09/30/2012
 - Activity FT-12SN0810052 Analyze the identified potential degradation mechanisms

3. FY 2013 PLANNING

As expected during the first year of a multi-organizational effort, the focus and direction evolved and changes were implemented accordingly. Technical gaps that will be addressed under the S&T Engineering Analysis Control Account in FY 2013 include:

- Thermal Profiles (Rank 1)
- Stress Profiles (Rank 1)
- Drying Issues (Rank 6)
- Burnup Credit (Rank 7)
- Cladding H₂ Effects: Hydride Reorientation and Embrittlement (Rank 7)
- Cladding - Creep (Rank 11)
- Cladding - Annealing of Radiation Damage (Rank 12)

The preliminary planned FY 2013 activities and milestones for each of the laboratories supporting S&T Engineering Analyses are provided below. Note: the planning information below has not been approved at the time of this writing.

Oak Ridge National Laboratory

- Activity FT-13OR0810011 Provide Strategy and Coordination for Control Account – 10/1/2012-9/30/2013
 - M4FT-13OR0810015 End of Year Report on S&T Engineering Analysis Accomplishments – 9/30/2013
- Activity FT-13OR0810012 Quantify Sensitivities and Uncertainties in UNF Characteristics – 10/15/2012-9/30/2013

- M4FT-13OR0810013 Report documenting covariance data development – 3/29/2013
- M3FT-13OR0810014 Report Quantifying Sensitivities and Uncertainties in UNF Characteristics – 9/30/2013
- Activity FT-13OR0810016 Provide Source Terms to Support Thermal Analyses – 11/1/2012-9/30/2013

Pacific Northwest National Laboratory

- Activity FT-13PN0810021 Perform thermal analyses – 11/1/2012-9/27/2013
- M3FT-13PN0810022 Report on Inspection 1 – 8/30/2013
- M3FT-13PN0810023 Report on Inspection 2 – 9/27/2013
- Activity FT-13PN0810024 Perform Sensitivity Analysis – 12/3/2012-8/30/2013
- M3FT-13PN0810025 Perform Sensitivity Analysis Report – 8/16/2013
- Activity FT-13PN0810026 Radiolysis model – 10/1/2012-9/30/2013
- M3FT-13PN0810027 Radiolysis model report – 9/20/2013
- Activity FT-13PN0810028 Modify structural models – 12/3/2012-9/30/2013
- M3FT-13PN0810029 Modify structural models report – 9/27/2013
- Activity FT-13PN08100210 Statistical matrix design – 11/1/2012-3/29/2013

Sandia National Laboratories

- M2FT-13SN0810031 Report on methodology to estimate used fuel cladding hydride re-orientation during thermal excursions simulated during drying – 10/1/2012-7/31/2013

4. SUMMARY

The S&T Engineering Analysis team has achieved considerable progress and significant accomplishments in its first year. Through the experiences gained in this first year and a refined understanding of priorities, the second year promises to be even more productive.