



U.S. Department of Energy  
**Office of River Protection**

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Richland, Washington 99352

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DNF SAFETY BOARD

12-WTP-0241

AUG 01 2012

The Honorable Peter S. Winokur  
Chairman  
Defense Nuclear Facilities Safety Board  
625 Indiana Avenue, NW, Suite 700  
Washington, D.C. 20004-2901

Dear Mr. Chairman:

DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB) RECOMMENDATION 2010-2  
IMPLEMENTATION PLAN (IP) QUARTERLY PROGRESS REPORT FOR APRIL THROUGH  
JUNE 2012

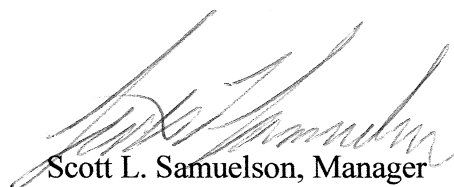
Reference: DOE-HQ letter from S. Chu to P. S. Winokur, DNFSB, "Department of Energy Plan to Address Waste Treatment and Immobilization Plant Vessel Mixing Issues, Revision 0, Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2010-2," dated November 10, 2011.

The Quarterly Progress Report to DNFSB on Recommendation 2010-2 for the period April through June 2012 is attached. This report meets commitment 6.3.1 of the IP to provide quarterly progress reports and describes the status of activities undertaken and results achieved to meet the U.S. Department of Energy's commitments as described in the above Reference.

During this reporting period, it was determined that Newtonian techniques are not appropriate to assess non-Newtonian vessel performance. This determination will require the IP to be revised. In addition, progress to date on accomplishing IP Commitments to reconstitute the Pretreatment Facility authorization basis and make improvements in integration between tank farm and WTP will impact the IP. DOE has continued to make progress this quarter toward closing safety issues related to Pulse Jet Mixing at the Waste Treatment and Immobilization Plant. Activities are continuing to complete a revision of the IP. Details may be found in the attached report.

If you have any questions, please contact me at (509) 376-8830 or your staff may contact Ben Harp, WTP Start-up and Commissioning Integration Manager at (509) 376-1462.

Sincerely,

  
Scott L. Samuelson, Manager  
Office of River Protection

WTP:WRW  
Attachment

cc w/attach: (See Page 2)

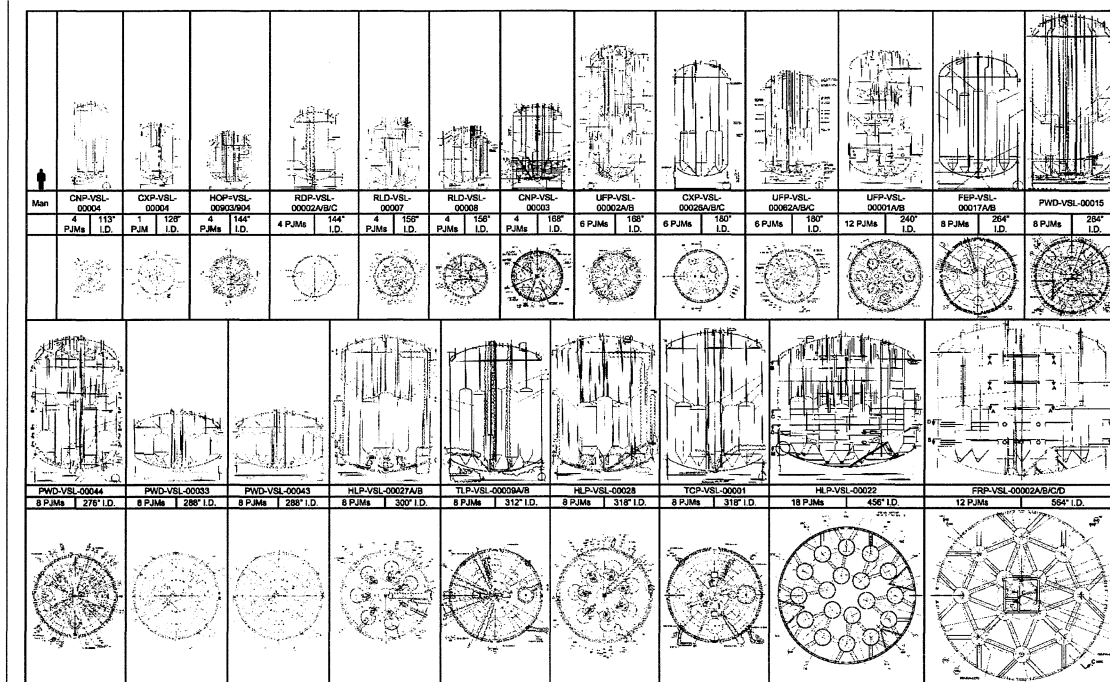
Hon. Peter S. Winokur  
12-WTP-0241

-2-

AUG 01 2012

cc w/attach:

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# DEFENSE NUCLEAR FACILITIES SAFETY BOARD

## RECOMMENDATION 2010-2 QUARTERLY PROGRESS REPORT

# PULSE JET MIXING AT THE WASTE TREATMENT AND IMMOBILIZATION PLANT

APRIL 1 TO JUNE 30, 2012

## EXECUTIVE SUMMARY

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On December 17, 2010, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*. The recommendation addressed the need for the U.S. Department of Energy (DOE) to ensure the Hanford Waste Treatment and Immobilization Plant (WTP), in conjunction with the Hanford tank farm waste feed delivery system, will operate safely and effectively during a 40-year operating life. The purpose is to eliminate safety hazards posed by Hanford Site tank wastes.

On November 10, 2011, U.S. Department of Energy Secretary Chu forwarded the DOE Implementation Plan (IP) for DNFSB recommendation 2010-2 to Chairman Winokur. This IP includes Commitment 6.3.1 to provide quarterly progress reports and briefings to the DNFSB and DNFSB staff, including updates on the status of completing actions identified in the IP. This quarterly report is for the period from April through June 2012.

On May 23, 2012, during the Recommendation 2010-2 IP quarterly briefing, the DOE Senior Advisor for Environmental Management informed the DNFSB that based on scoping test data, non-Newtonian vessel (NNV) verification would not be performed with Newtonian techniques and, as a result, an IP revision is required to address an alternative NNV verification approach. Additional drivers to revise the IP include the following: 1) integrating the resolution paths for known technical issues identified in deliverable 5.7.3.1 into the schedule and reflecting them in the IP, 2) providing adequate time to develop complete versus interim IP deliverables, 3) improving detail in the IP to ensure the scope of deliverables is clearly understood, 4) incorporating activities to update the Criticality Safety Evaluation Report and the Pretreatment Facility authorization basis, and 5) improving integration between Tank Farm and WTP, per the One System approach.

A systematic review of the IP technical assumptions and schedule logic is ongoing to improve integration of technical issues into the schedule and ensure alignment between engineering and nuclear safety activities. DOE is working to prepare a revised IP for Recommendation 2010-2 by the fourth quarter of this calendar year. An open dialogue with the DNFSB and its staff will be maintained as DOE proceeds with revising the IP.

During this reporting period, five deliverables were provided on schedule, but because of the pending IP revision, several deliverables scheduled for completion were not submitted. The balance of the scheduled deliverables will be rescheduled, pending IP revision. Similarly, four actions identified in Table 4 of deliverable 5.7.3.1 were originally planned for completion during this period. Two were completed, and the others will be rescheduled in the development of the IP revision. Revised dates for completion of impacted deliverables will be provided with the revised IP.

Progress was made on readying test platforms for large-scale integrated testing (LSIT). The 8-ft test platform at Mid Columbia Engineering (MCE) was commissioned, and operator training has commenced. Construction continued on the facility to house the 14-ft test vessel; the siding was installed and utility system installation begun. Testing was initiated in support of waste feed delivery mixing and sampling.

IP Commitment 5.3.3.1, *Update assessment of use of Newtonian analysis techniques to assess non-Newtonian vessel performance*, concluded that Newtonian techniques will not be used to assess non-Newtonian vessel performance based on inconclusive results from initial testing and extensive analyses needed to assess the assumption. This commitment was issued on July 17, 2012 ahead of schedule. In addition, IP Commitment 5.3.3.2, *Independent review of paper concluding non-Newtonian conditions can be assessed using Newtonian techniques* and IP Commitment 5.3.3.3, *Conclusion regarding use of Newtonian techniques to assess non-Newtonian conditions* are being cancelled based on the results from IP Commitment 5.3.3.1. The replacement approach for evaluation of non-Newtonian vessels will be provided with the revised IP.

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### 1. PURPOSE

On December 17, 2010, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*. The

recommendation identified safety issues associated with pulse jet mixer (PJM) vessels mixing, sampling, and transfer capabilities in WTP. The Board also identified issues with integrating Tank Farm feed staging system mixing, sampling, and transfer system capabilities.

The DOE commitments outlined in *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2010-2*, submitted to the DNFSB on November 10, 2011, are fulfilled by a program of tests, analyses, and other activities. Each DOE commitment has a corresponding deliverable and a due date falling between January 30, 2012, and May 9, 2016. During this period, Commitment 6.3.1 to the DNFSB requires quarterly progress reports on completion of IP milestones and deliverables, the status of ongoing and planned activities, as well as a description of issues and identified risks and how they are being managed and closed. This Quarterly Progress Report fulfills that commitment.

## 2. HIGHLIGHTS FOR THIS QUARTER

### 2.1 DELIVERABLES SUBMITTED

During the period from April 1, 2012 to June 30, 2012, DOE submitted the following deliverables to the DNFSB:

- 5.1.3.14 Vessel configurations for testing
- 5.2.3.1 Physical properties important to mixing and scaling
- 5.3.3.5 National Energy Technology Laboratory (NETL) independent review of data sets to support computational fluid dynamics (CFD) verification & validation (V&V)
- 5.5.3.2 Evaluation of waste transferred to WTP
- 5.5.3.6 Test plan to establish Tank Farm performance capability

Other deliverables scheduled to be submitted during the period are being rescheduled in conjunction with the IP revision. Based on scoping test data, non-Newtonian vessel (NNV) verification will not be performed with Newtonian techniques, and an alternative NNV design verification approach will be developed and documented in an IP revision. Additional drivers to revise the IP exist, including integrating the resolution paths for known technical issues identified in deliverable 5.7.3.1 into the schedule and reflecting them in the IP, providing adequate time to develop complete versus interim IP deliverables, improving detail in the IP to ensure the scope of deliverables is clearly understood, incorporating activities to update the Criticality Safety Evaluation Report and the Pretreatment Facility authorization basis, and improving integration between Tank Farm and WTP, per the One System approach.

Specific actions associated with reconstituting the Pretreatment Facility authorization basis discussed in Table 4 of Deliverable 5.7.3.1 are also being rescheduled in

conjunction with the IP revision. Actions to update Engineering procedures and extent of condition review (CPR5-14) were completed.

## 2.2 WORK COMPLETED

### WTP

#### Deliverable-Related Activities

The initial deliverable for Commitment 5.7.3.1, 24590-PTF-PL-ENS-11-0007, Rev 0, *Plan and Schedule to Systematically Evaluate the Hazards of Known Technical Issues, M3 Vessel Assessment Summary Reports, LOAM Benchmark Data and LSIT Results*, provided a plan and target schedule for activities discussed in the report. The plan and schedule were summarized in Table 4 of the report. All the actions were entered into either problem identification/evaluation reports (PIERs) or the Action Tracking System (ATS). Work on completion of these actions is ongoing. Two of the four actions originally scheduled for this period: 1) Update engineering procedures to implement DOE-WTP contract direction for nuclear safety deliverables, and 2) extent of condition review [CPR5-14] were completed. The others will be rescheduled in the development of the IP revision.

As discussed in the previous quarterly report, the deliverable for commitment 5.1.3.13, Scaling Basis, was not transmitted on April 30, 2012. Because this document forms a critical foundation for near full-scale testing and will underpin the application of scaled testing information to assess full-scale mixing performance, it requires careful consideration and review. As such, the draft document has been reviewed by the technical community, and reviewer comments are being reconciled.

The initial draft of a companion document to the scaling basis has been completed and is in the review cycle. This document focuses on application of the scaling basis. Development of this document is being closely coordinated with Pacific Northwest National Laboratory (PNNL) staff, authors of the scaling basis document. It is our intent to submit both documents in fulfillment of deliverable 5.1.3.13.

The scaling documents support scaled testing that will begin after approximately 10 months of testing to support V&V of the CFD tool. The later completion of deliverable 5.1.3.13 will not adversely impact preparations for follow-on large-scale testing.



### Testing- and Design-Related Activities

Modifications of the scaled test platform at Mid Columbia Engineering (MCE) were completed. The 8-ft acrylic test vessel at MCE was commissioned, and operator training and subsystem qualification has commenced.

Construction continued on the Engineering Laboratory Building at WSU Tri-Cities. This facility will house the 14-ft test vessel for large-scale integrated mixing, sampling and transfer testing. During this quarter the building was closed in, and utility system installation began. DOE-WTP is initiating procurement of selected long lead components for outfitting the 14-ft test stand.

The external review team (ERT) was actively engaged in reviewing the WTP and One-System test programs. The ERT reviewed deliverables for Commitments 5.1.3.13, 5.1.3.14, 5.5.3.2, and 5.5.3.6 during this quarter. The ERT visited the Hanford Site the week of May 29th to tour the 8-ft test platform at MCE and discuss the 5.1.3.13 scaling basis documents being prepared and reviewed with the authors. ERT comments to date have been very good and have resulted in improvements to approaches and documentation.

U.S. Secretary of Energy Steven Chu visited the Hanford Site in June and toured the test platform and MCE on June 14<sup>th</sup>.

The previous quarterly report included information on development of a statement of work and request for proposal for a single PJM test platform to support development work on the PJM control system in advance of integrated 14-ft testing. During this quarter, expressions of interest were solicited from potential vendors, and a strategy document for the single PJM test campaign was developed and is being reviewed.

### **WRPS**

Documentation was completed and submitted in support of waste feed delivery mixing and sampling testing. Specifically, WRPS completed *One System Waste Feed Delivery Mixing and Sampling Program Limits of Performance and Solids Accumulation Scouting Studies Test Plan* (Commitment 5.5.3.6). This test plan covers the first group of testing planned, which focuses on defining limits of performance of tank farm systems and understanding the solids accumulation tendencies in mixed double-shell tanks. WRPS also completed *One System Evaluation of waste transferred to the WTP* (Commitment 5.5.3.2). This report provides a preliminary examination of the ranges of physical properties for waste that could be transferred to the WTP. Based on the analysis included in the report, the postulated largest particle of plutonium metal (100 um) and largest gibbsite agglomerate (9525 um) is possible for transport to WTP. Information from this report will be used to support development of the initial gap analysis between WTP waste acceptance criteria and tank farm sampling and transfer capability

(Commitment 5.5.3.1) and will be included in efforts to update the WTP waste acceptance criteria (WAC).

Limits of performance testing began in the small-scale mixing demonstration (SSMD) test tank and the remote sampler demonstration (RSD) test loop. Solids accumulation scouting studies began in the scaled tank at Savannah River National Laboratory. Construction began at the full-scale limits of performance transfer pump test facility.

### 3. SUMMARY OF TEST RESULTS

#### 3.1 TANK FARM FEED STAGING, MIXING, SAMPLING, AND TRANSFER TESTS

Although limits of performance and solids accumulation testing began this quarter, testing is still in progress and results are not available this reporting period. Solids accumulation study testing is progressing as planned, but the more extreme simulant used for the limits of performance testing is causing equipment wear and performance issues with the small-scale test equipment. Mitigation of this issue is being accomplished through moving the suction to the top of the vessel and using screens in order to prevent large particles from impacting equipment. This is being accomplished without impacting test objectives. In addition, equipment improvements are being pursued with alternative pump seals and pumps.

#### 3.2 WTP PJM MIXING, SAMPLING, AND TRANSFER TESTS

No NQA-1 testing was conducted during this period. However, the 8-ft acrylic test vessel at MCE was commissioned, and operator training and subsystem qualification commenced. Examples of the subsystem qualification activities included dye tests to inform the location of instrumentation for miscible fluids blending tests, and testing of instruments such as conductivity probes, velocity probes, and level instruments to support completion of data collection and accuracy plans.

The determination that Newtonian techniques will not be used to assess non-Newtonian vessel performance will require revision of the strategy planned for design verification of NNV PJM mixed vessels. This revision will reflect the change in approach for design verification of non-Newtonian vessels by means other than CFD models. The IP will be revised to reflect this strategy by the fourth quarter of this calendar year.

### 4. DISCUSSION

#### 4.1 IMPACT OF THE RESULTS ON WTP DESIGN AND CONTROL

Nothing to report.

## 4.2 ISSUES AND RISKS IN MIXING, SAMPLING, AND TRANSFER

### 4.2.1 PREVIOUSLY IDENTIFIED ISSUES AND RISKS

#### **WTP**

Commitment 5.7.3.1, *Establish the plan and schedule to systematically evaluate the hazards of known technical issues, M3 vessel assessment summary reports, LOAM benchmark data, and LSIT results*, was submitted to the DNFSB on January 30, 2012. The deliverable included a list of known technical issues for the Pretreatment Facility, which was developed by evaluating issues and concerns documented in an established WTP system. Planning for resolution of the identified technical issues was committed to be completed in future updates.

During this quarter, multiple planning workshops were conducted to identify the top level path forward for resolving each known technical issue identified in 5.7.3.1. Both Engineering and E&NS staff participated in the workshops. The team identified which test campaign(s) and analyses would be required to support resolution of each issue. Incorporation of this information into the working schedule is in progress. When completed, approaches for resolving technical issues will support revision of the IP, the annual update of deliverable 5.7.3.1, and allow visualization of the activities to plan and accomplish issue resolution, integrate nuclear safety into Pretreatment Facility design, and develop a documented safety analysis.

In the previous quarterly report DOE-WTP noted it had requested BNI to provide a plan and schedule for updating the Criticality Safety Evaluation Report (CSER) and that work on the plan was ongoing. The purpose of the update was to evaluate new information concerning the form and location of fissile material in the Tank Farms. During this quarter, WTP issued the 2012 Plan for updating the CSER to accomplish this task. The schedule included in that plan is being integrated into the working schedule and will be reflected in the IP revision.

#### **Tank Farm Issues and Risks**

Previously identified tank farm critical risks TOC-12-64 and TOC-12-65 (formerly TOC-08-65) are being addressed through the continued implementation of the Tank Farm Mixing and Sampling Program as recently defined by *Waste Feed Delivery Mixing and Sampling Program Plan and Test Requirements* (Commitment 5.5.3.4) and *Waste Feed Delivery Mixing and Sampling Program Simulant Definition for Tank Farm Performance Testing* (Commitment 5.5.3.5). These two documents define the testing activities scheduled to occur during FY 2012 and FY 2013. Test

details are further defined in the *One System Waste Feed Delivery Mixing and Sampling Program Limits of Performance and Solids Accumulation Scouting Studies Test Plan* (Commitment 5.5.3.6).

#### 4.2.2 EMERGING ISSUES AND RISKS

Multiple test phases with four different tank farm test platforms make it impractical to issue one document (Commitment 5.5.3.6) to cover all tank farm performance testing. An IP modification will be proposed to allow for multiple test plans sequenced in time such that earlier testing informs the later test plans. Tank farm solids accumulation scouting study testing is progressing as planned at Savannah River National Laboratory. However, the more extreme simulant used for the limits of performance testing is causing equipment wear and performance issues with the small-scale test equipment. This has the potential to impact the complete schedule for the scaled tank testing and the subsequent results report (Commitment 5.5.3.7). These issues are being managed through test process changes to reduce the impact of large particles and procurement of improved pump seals and pumps.

## 5. FORWARD LOOK

The DOE expects to submit conditional IP deliverables associated with CFD V&V testing (e.g., requests for technology development, test specs, test plans, and simulant basis documents) during the period starting July 1, 2012. These conditional deliverables are being revised to reflect the strategy for using alternative methods to CFD for verification of vessel performance.

Deliverables associated with the IP are being revised based on the IP revision.

## 6. ACRONYMS

ASME	American Society of Mechanical Engineers
ASX	automatic sampling system
BNI	Bechtel National, Inc.
CFD	computational fluid dynamics
CFR	Code of Federal Regulations
CCN	correspondence control number
cP	Centipoise
CRESP	Consortium for Risk Evaluation with Stakeholder Participation
CSER	Criticality Safety Evaluation Report
DBE	design basis event
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DQO	data quality objective
DSA	documented safety analysis
DST	double-shell tank
EFRT	External Flowsheet Review Team
EM	Environmental Management
EPA	Environmental Protection Agency
ERT	expert review team
FEP-17	Evaporator feed vessel 17
FLUENT	Software made by ANSYS Corporation used to model flow, turbulence, heat transfer, and chemical reactions
FRP-02	Feed receipt vessel 02
Ft	Feet
FY	fiscal year
HAR	hazards analysis report
HLP-22	high-level waste feed vessel 22
HLW	high-level waste
HPAV	hydrogen in piping and ancillary vessels
ICD	interface control document
IDF	Interim Disposal Facility
IP	Implementation Plan
ISARD	Integrated Sampling and Analysis Requirements Document
LAW	low-activity waste
LOAM	Low order Accumulation Model
LSIT	Large-scale integrated testing
ml	milliliter
NETL	National Energy Technology Laboratory
ORP	Office of River Protection
Pa	Pascal
PDSA	preliminary documented safety analysis
PJM	pulse jet mixer
PNNL	Pacific Northwest National Laboratory

RTD	request for technology development
SAC	specific administrative control
SDS	Safety Design Strategy
SRD	Safety Requirements Document
SRNL	Savannah River National Laboratory
SSC	structures, systems, and components
TOC	Tank Farm Operations Contractor
UFP-01	Ultrafilter feed preparation vessel 01
V&V	verification and validation
WAC	Waste Acceptance Criteria
WRPS	Washington River Protection Solutions, Limited Liability Corporation (the Hanford Tank Farms operations contractor)
WTP	Waste Treatment and Immobilization Plant