

March 23 2017

To: A. S. Chambers, Manager, US DOE Nuclear Criticality Safety Program (NCSP)

From: *dge*
D. G. Erickson, Chair, US DOE NCSP Criticality Safety Support Group (CSSG)

Subject: CSSG Tasking 2017-01 Response

In Tasking 2017-01 the CSSG was tasked to review and comment on a January 24, 2017 Department of Energy (DOE) letter to the DNFSB, and documenting any discrepancies between those conclusions and the documented results of the most recent CSSG review.

The Tasking 2017-01 CSSG Review Team consisted of the following:

Robert Wilson (Team Leader)

David Erickson

Michaele Brady-Raap

The draft report was provided to the entire CSSG for review. The Review Team addressed all comments received as they deemed appropriate.

The Review Team is available to answer any questions, that may arise in working with the provided report.

The report from the review, which includes a copy of approved Tasking 2017-01, is included as an attachment to this transmittal.

cc: CSSG Members
D. G. Bowen
L. Scott

Attachment: CSSG Tasking 2017-01 Response

Response to CSSG Tasking 2017-01

22 March 2017

Executive Summary

The Criticality Safety Support Group (CSSG) reviewed a January 24, 2017 letter from DOE to the Defense Nuclear Facilities Safety Board (DNFSB). The letter addressed various issues raised by the Board regarding the safety basis for the Waste Treatment Plant (WTP) at the Hanford Site and concluded the issues were resolved. The CSSG does not understand the basis for and does not agree with this conclusion. The CSSG currently concludes that the WTP nuclear criticality safety (NCS) safety basis for the various types of waste needs considerable upgrade and development before all NCS related technical issues can be considered resolved. The CSSG reviewers also noted the ambiguity on the various options available to deal with the heavy plutonium particles (HPP) and did not have sufficient information to judge if technical issues have been sufficiently resolved to permit resumption of design and construction related activities. The concern is that proceeding with design/build of WTP, without fully compliant NCS documentation, could lead to costly future design changes or operational restrictions.

Introduction

In Tasking 2017-01 (included as Appendix A) the CSSG was tasked to review and comment on a January 24, 2017 Department of Energy (DOE) letter to the DNFSB. The letter addressed various issues raised by the Board regarding the safety basis for the WTP with the hope that the information provided would permit the Board to agree that the halted construction on the plant should proceed. One of the Board's issues involved NCS.

In 2016 the Office of River Protection (ORP) requested a CSSG review of the WTP contractor's plans to address the many Recommendations and Opportunities for Improvement (OFI) from prior reviews in 2008, 2009, and, in particular, 2012. In addition they requested a review of the revised Criticality Safety Evaluation Report (CSER) on the treatment of Tank Farm material from those tanks which did not contain HPP (e.g., containing co-precipitated plutonium) and to hear a presentation on a plan for the other tanks (e.g., those containing HPP). The 2016 ORP request was to determine if issues identified in the various prior assessments had been adequately resolved and to receive a briefing on a proposal for further actions. The CSSG team did not address whether the remaining issues identified from past reviews, the ORP proposal presented, or the CSSG options recommended, would involve WTP design.

The 2012 review team had many concerns with the provided WTP CSER but focused on the possibility of the Pu separating from the various chemical and thermal processes in the WTP. The 2012 team was also concerned about the identified possibility of the HPP causing a criticality safety concern in the Pulse Jet Mixer (PJM). **A path forward to deal with the HPP issue was not provided by the WTP contractor at that time.** The 2012 team was aware that the HPP surrogate material in the test PJM did segregate; however, they were not convinced that the problem particles from the tank farm mixes would also separate to the extent that they would pose a criticality concern. They drafted a laboratory test plan to

show if, or how much, separation would occur in the actual operation of the PJM. Based on review of test results from similar tests, the 2012 team was reasonably sure that following the proposed test plan would provide a technical basis for resolution of the issue of the HPP at the WTP. The test plan was socialized with a dozen hydrodynamic experts around the nation and received concurrence that it should succeed in dispositioning the issue.

ORP Rationale for Resolution of DNFSB Concerns Related to Criticality Safety

The DOE Letter, in Attachment 2, identified seven actions (provided in italics) that, in total, were judged by ORP to resolve the DNFSB criticality safety concerns. The following are the CSSG judgements for each action:

- *Assessments to estimate the mass, particle size and location of HPP in the Hanford tank farm (HTF).*
This has been completed and appears appropriate for this stage of the process development.
- *Chemistry studies, criticality calculations, and hazards analyses, demonstrating that the co-precipitated plutonium waste form can be safely processed in WTP.*
This has been completed and documented. However, there are still concerns about the adequacy of the criticality analysis. (See **Assessment of Corrective Actions from Prior Reviews**, below).
- *Engineering study with supporting analyses identifying proposed controls for treatment of waste containing HPP in the Pretreatment Facility.*
Though treatment of most of the tanks containing HPP appears acceptable (with the caveat that a control scheme to effectively control mass throughout the quasi-batch process has yet to be identified) it is not understood how the tank potentially containing more than 2,700 g of HPP will be treated.
- *Identification of proposed controls identified in the WTP Criticality Safety Evaluation Report (CSER) and the Criticality Safety Evaluation Engineering Study (CSE-ES) for management of tank wastes containing fissile material, considering both uranium and plutonium.*
These appear acceptable for the co-precipitated fissile materials, but as indicated previously, there are still questions regarding the HPP.
- *Independent review by the DOE Nuclear Criticality Safety Program CSSG on the proposed control strategy for treatment of HPP containing wastes.*
See **Assessment of Corrective Actions from Prior Reviews**, and **Conclusions**, below.
- *Commitment to deliver waste feed to the WTP complying with the design basis.*
Without implementing the 'proposed' Tank Waste Characterization and Staging Facility (TWCSF), including a rigorous sampling process, it is unknown how this will be accomplished.
- *Evaluation of an improved PJM vessel design that will improve mixing performance and the ability to effectively remove heavy solids.*
It appears this study is underway and should resolve the related concerns.

Review of CSER for Co-Precipitated Plutonium

The ORP specifically requested that the CSSG review the *Preliminary Co-Precipitated Plutonium Critically Evaluation Report for the WTP Project* (24590-WTP-CSER-ENS-08-0001, Rev. 1) This review resulted in many suggestions to strengthen the Hazard Assessment part as well as the presentation of the proposed criticality safety limits. Much of the recent concern was directed at the rigor of validating the computer code used to develop the limits. Use of the required Industry standard for validation (ANSI/ANS 8.24) was recommended.

Review of HPP Presentation

The proposed scheme for processing the 16 tanks known to contain HPP was presented in slide format. A mass control for each tank was postulated. Four of these tanks were considered to contain fewer than 450 g Pu, and these were proposed to be processed with no extra controls. The five tanks with listed mass between 450 g and 2,700 g were to be processed with the addition of sufficient nuclear poison boron (sodium pentaborate) to provide a safety basis feature in addition to a mass control protocol. The 2,700 g limit was from a calculated geometry considered to be a worst case configuration developing from actions of the PJM. The configuration is referred to in safety documents as resembling a 'fluted horn'. The three tanks with Pu mass considered to exceed 2,700 g did not yet have a proposed safety basis processing scheme nor was a specific control scheme to measure the mass of plutonium particulate independent of the co-precipitated plutonium identified. The possibility of using neutron poisons was discussed. Compliance with ANSI/ANS-8.14 was not included in their discussions.

The CSSG team agreed that the proposal was better than no vision to handle the HPP issue and considered this welcome progress. However, they also noted that it, with a yet to be developed mass control scheme, might not succeed and even if successful would likely be difficult and expensive. The Independent Review Team (IRT) report had provided a testing strategy, affirmed by the hydrostatic community, which would have a high probability of providing technical support that that no additional controls beyond the Waste Acceptance Criteria would be needed. The 2016 CSSG report again recommended the IRT approach but noted that if this path was rejected, then other schemes would have to be pursued.

Several proposed structural changes to the design were also presented but the review team was unable to factor these changes into the safety argument.

Assessment of Corrective Actions from Prior Reviews

The following summarizes the current known status of the open Recommendations and Opportunities for Improvement, identified in CSSG Tasking 2016-03 (provided here in italics), and judgment of which ones could be considered still open and still relevant.

Open co-precipitated plutonium Recommendations:

- *The CSER should identify required samples and location.*
It appears that this has not been fully addressed. The only sample 'location' identified is of 'staged waste', and performed by HTF prior to transfer.

- *Move key information from the CSER to AB documents and delete the CSER as a stand-alone AB document.*

This has not been addressed at this stage.

Open co-precipitated plutonium Opportunities for Improvement:

- *WTP should use guidance from the ANS 8 standards on nuclear poisons.*
There is no evidence this has been addressed.
- *Update the validation documentation with currently available benchmark experiments.*
There is no evidence this has been addressed. This calls into question the adequacy of the calculational analyses performed to date.
- *Temperature effects on cross-sections and reactivity feedback coefficients should be evaluated and impacts considered for systems considerably different than room temperature.*
There is no evidence this has been addressed. As some of the processes at WTP will utilize high temperatures there is still a need for this to be addressed
- *Basis should be provided for the stated 30% “non-representativeness” and applicability of samples. (Value revised from 5% to 30%)*
There is no evidence this has been addressed. (See prior Recommendation, and CSSG Tasking 2016-03 report, regarding samples)
- *NCS staff should review technical basis for control schemes at other similar DOE facilities.*
No evidence was provided that this has been addressed.

New co-precipitated plutonium Recommendations from the 2013 review:

- *The WTP Contractor should address the applicability of ANS-8.14 on soluble neutron absorbers. (Revised from OFI, above)*
There is no evidence this has been addressed. (See prior OFI)
- *The basis needs to be provided for the stated 30% “non-representativeness” and applicability of the sample to other tanks. (Revised from OFI, above)*
There is no evidence this has been addressed. (See prior OFI)
- *There needs to be a process defined for tracking “open items” in the Hazards Analysis (HA) and how consistency will be maintained as both the HA and CSER are living documents.*
Though this should not impact the process at this stage, there is still no evidence this has been addressed.
- *Recommend that the use of sensitivity/uncertainty techniques be used to support the appropriateness of the selected benchmarks, particularly in cases where no additional margin for the Area of Applicability (AoA) is utilized.*
There is no evidence this has been addressed.
- *The CSSG review team concluded that the validation report as reviewed does not meet all the requirements of ANS-8.24 and should be revised.*
There is no evidence this has been addressed. With a less than adequate validation there are ongoing concerns about the adequacy of the results and proposed controls, based upon the calculations performed.
- *Recommend that additional effort is applied to ensure the assumptions are properly categorized, managed and controlled as applicable.*

Though this should not impact the process at this stage, there is no evidence this has been addressed.

- *Recommend the Criticality Safety Limits be restructured to support understanding of the safety margin and assist with response to potential abnormal events.*

There is no evidence this has been addressed.

- *Develop a CSER for the co-precipitated material that presents a better defined picture of the safety basis.*

There is no evidence this has been addressed.

Open HPP Recommendations

- *Assure a Pu heel management system is available.*

Though it appears heel removal is considered, there is no evidence as to how this has been addressed.

New/Revised HPP Recommendations

- *Proceed with the HPP distribution test to provide a technical basis for including some of the distributed nuclear poison in the criticality safety basis.*

No evidence of intent to pursue these tests.

- *Consider potential management of HPP criticality safety concerns via addition of caustic boron.*

It appears that a Tank Waste Characterization and Staging Facility (TWCSF) is being proposed that may be able to address this.

Conclusion

The January 24, 2017 letter notes the *Independent review by the U.S. Department of Energy (DOE) Nuclear Criticality Safety Program Criticality Safety Support Group (CSSG) on the proposed control strategy for treatment of HPP containing waste* and asserts that this is anticipated to help address the DNFSB's criticality safety related concerns.

The 2016 CSSG report will likely assuage some concerns and, if agreed to, should provide a path forward which would likely not result in NCS-related process or equipment changes. However, the CSSG currently concludes that the WTP NCS safety basis for the various types of waste needs considerable upgrade and development before all NCS related technical issues can be considered resolved. A prime example of the concern is the need to address compliance with several ANSI/ANS-8 Standards. Thus the CSSG reviewers noted the ambiguity on the various options available to deal with the HPP and did not have sufficient information to judge if technical issues have been sufficiently resolved to permit resumption of design and construction related activities.

Appendix A
Approved Tasking 2017-01

CSSG TASKING 2017-01
Date Issued: February 6, 2017

Task Title: *Review of EM Letter to the DNFSB closing Criticality Safety issues at the Waste Treatment Plant*

Background:

Per Tasking 2016-03 the Criticality Safety Support Group (CSSG) performed, and documented, a review of the most recent criticality safety basis for the Waste Treatment Plant (WTP) being built at Hanford. The results of the CSSG review indicated there were still a number of opportunities to improve the WTP operational criticality safety posture.

On January 24, 2017 DOE EM sent a letter to the DNFSB (included as the Attachment to this Tasking) indicating the prior issues had been adequately addressed. Enclosure 2 of that letter addresses the criticality safety aspects.

Task Statement:

The CSSG is tasked with reviewing the DOE EM letter and documenting any discrepancies between those conclusions and the documented results of the most recent CSSG review.

The CSSG should pay close attention to issues relating to the use of ANS-8.10, ANS-8.14, and ANS-8.24 as presented in the CSSG report, and the conclusions documented in the DOE EM letter.

Resources:

CSSG Task 2017-01 Team Members:

Robert Wilson (Team Leader)
David Erickson
Michael Brady Raap

Contractor CSSG members of the team will use their NCSP CSSG support funding as appropriate; DOE CSSG members of the team will utilize support from their site offices.

Task Deliverables:

1. CSSG Subgroup to hold task 'kickoff' telecom by February 9, 2017.
2. CSSG Subgroup to provide a draft of the review documentation to full CSSG for review: February 23, 2017
3. Full CSSG to provide review comments to Task Team Leader: March 2, 2017
4. CSSG team to issue final report to NCSP Manager: March 9, 2017

Task Completion Date: March 16, 2017, 2016

Signed: 
Angela Chambers, Manager US DOE NCSP
Office of the Chief of Defense Nuclear Safety, NA-511