

EA Operational Awareness Record		Report Number: OAR-EA-WTP-LAW-2017-03-09	
Site: Hanford Site Office of River Protection		Subject: Review of the Waste Treatment and Immobilization Plant Low-Activity Waste Facility Preliminary Documented Safety Analysis Addendum	
Dates of Activity:	03/09/2017 – 03/31/2017	Report Preparer:	James O. Low
Activity Description / Purpose:			
<p>The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments (EA-31), within the Office of Enterprise Assessments (EA), conducted a review of a preliminary documented safety analysis (PDSA) addendum (ref. 1) to the Low-Activity Waste (LAW) Facility PDSA (ref. 2). The addendum incorporates the hazard controls defined in five safety strategy summary documents (SSSDs) that were developed collaboratively between the Office of River Protection (ORP) and Bechtel National, Inc. (BNI). This Operational Awareness Record supports the phased oversight of WTP LAW safety basis development (ref. 3). EA’s review focused on select aspects of the LAW PDSA addendum nuclear safety hazards and controls using DOE-STD-3009-1994, Change Notice (CN) 3, <i>Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses</i>, and DOE-STD-1104-2014, <i>Review and Approval of Nuclear Facility Safety Basis Documents</i>.</p> <p>The addendum was issued after the submittal of the 85% draft PDSA (ref. 4) on December 5, 2016, which EA-31 reviewed (ref. 5). Following ORP review of the 85% draft, the safety basis review team (SBRT) concluded that the draft PDSA was not acceptable based on a number of identified issues. As an interim measure to facilitate continued procurement and construction activities at the LAW Facility, BNI submitted a PDSA addendum that implements the SSSDs as the basis for the LAW nuclear safety hazard control sets and associated safety functional classifications. The first draft of the PDSA addendum was provided to EA-31 (ref. 6) and was formally submitted to ORP for review on March 23, 2017 (ref. 7).</p> <p>EA’s review of the addendum assessed whether the hazards evaluation, accident analysis, and control strategy met the requirements in 24590-WTP-PL-NS-14-0002, Rev. 1, <i>Implementation Plan for the WTP Contract DE-AC27-0JRV14136, Section C, Standard 9 and 10 CFR 830 Subpart B</i>, (ref. 8). EA-31 also determined whether comments that had been submitted (ref. 5) during its review of the 85% draft PDSA were addressed. EA’s review of the addendum focused on select aspects, including controls developed for the dominant nuclear safety hazard events. The addendum incorporates the control strategies identified in the SSSDs. In reviewing the addendum, EA-31 examined the safety functions, functional classifications, functional requirements, and identification of applicable design requirements for select safety structures, systems, and components (SSC).</p>			
Results:			
<p>In the PDSA addendum review, EA-31 submitted 14 comments to BNI for resolution (ref. 9). The comments from EA-31 covered three areas:</p> <ul style="list-style-type: none"> • The PDSA and PDSA addendum present an incomplete hazard analysis (2 comments). • Functional requirements are inadequately defined, system evaluations are incorrect or incomplete, or functional classifications are inappropriate (9 comments). • Facility boundaries are inappropriately identified to exclude systems without proper analysis or technical justification (2 comments). <p>BNI provided satisfactory responses to all of EA’s comments (ref. 10).</p>			

The addendum appropriately references the associated SSSDs and includes summaries of the hazards, the unmitigated and mitigated consequences to the co-located worker (CLW) and the public, the credited SSCs and specific administrative controls, and defense-in-depth controls. The hazards were evaluated for radiological or toxicological hazards and compared against guidelines to determine the need for safety class (SC) or safety significant (SS) controls. Overall, the set of developed controls effectively prevents or mitigates the effects of the dominant SSSD-identified accidents by using the DOE-preferred hierarchy of controls to protect the public and CLW.

Although generally the addendum presents effective control strategies to prevent or mitigate the hazards, EA-31 identified several issues. First, the PDSA (rev. 6b) and PDSA addendum do not present a complete hazards analysis that provides reasonable assurance that the future nuclear facility can be operated safely. Most of the hazard evaluations in PDSA (rev. 6b) are replaced by the PDSA addendum sections, which do not present a complete hazards analysis but defer to the SSSDs and planned actions in a future LAW PDSA (Rev.7x). Section 5.5.1 of the contract Standard 9 implementation plan requires hazard and accident analyses for the preliminary safety design basis to ensure compliance with DOE-STD-3009-1994, CN3 methodologies.

Second, the PDSA addendum in some cases inadequately defines functional requirements, incompletely performs control evaluations, or inappropriately defines certain functional classifications. Functional requirements and control evaluations are necessary to support the nuclear safety control safety functions and the subsequent derivation of technical safety requirements. Controls must be properly evaluated to ensure the capability of the safety SSC to meet performance criteria; improper evaluation can result in an ineffective control set.

Finally, without a completed hazard analysis and appropriate technical justification, the PDSA addendum defines the nuclear facility boundary to exclude the ammonia (AMR) and carbon dioxide (CDG) systems external to the LAW building structure. The AMR and CDG systems consist of storage tanks, piping, and supporting refrigeration/vaporization equipment that are on designated pads outside of the LAW building structure. The current PDSA (rev. 6b) defines these two systems as part of the LAW Facility with SC and SS controls. Redefining the facility boundary to exclude the CDG and AMR storage vessels and supporting equipment outside the LAW Facility concrete structure impacts the method of safety analysis and derivation of controls associated with the LAW safety analysis. Hazard initiators outside the nuclear facility boundary are considered external man-made events. External man-made events with no impact on the nuclear safety of the facility (e.g., releases of carbon dioxide and ammonia) are no longer analyzed in the PDSA and will be regulated under 10 CFR 851 using national consensus codes and standards. Previously identified AMR and CDG safety SSCs are subsequently downgraded to commercial grade under this external man-made hazard construct.

Boiling liquid expanding vapor explosions (BLEVE) due to AMR or CDG vessel failure are postulated as events that can impact the LAW Facility structure or nuclear safety systems due to overpressure or fragmentation. BLEVEs may occur due to external fire coupled with a loss of pressure relief function or a physical impact that damages the vessel, leading to catastrophic failure. For the AMR and CDG systems, BLEVEs are asserted to be prevented (i.e., frequency of $<10^{-6}$ /year conservatively calculated) through a combination of approved equipment, instrumentation and control systems, and pressure relief system design. This frequency cutoff for external man-made events excludes evaluation as a facility hazard under DOE-STD-3009-1994, CN3.

In addition, ammonia release events evaluate unmitigated event consequences assuming a flow restriction on the ammonia supply line to the building due to control valves installed at the AMR tank, with no controls on the valves. Identification of the facility boundary on the AMR system as the piping enters the building would require identification of controls on valves outside the nuclear facility boundary. Design alternatives that place the restriction inside the facility structure may need to be considered, or the facility boundary may need to be extended to components at the AMR pad.

Although the hazard control sets identified in the addendum are generally adequate to prevent or mitigate identified hazards, the identified issues prevent full compliance with DOE-STD-3009-1994, CN3. BNI has appropriately addressed the issues that EA-31 identified, creating new or identifying existing Planned Design and Operational Improvements that require evaluation and incorporation into the next revision of the PDSA. BNI plans to include a

detailed, comprehensive hazard analysis in the next revision of the LAW PDSA. The code and standard provisions for defining the facility boundary, which allow evaluations of hazards outside the boundary as external man-made events, may require technical interpretation to ensure compliance with the intent of the DOE standard for proper analysis of hazardous events and derivation of control sets that protect workers and the public. (See **OFI-LAW-1**.)

Opportunity for Improvement:

EA-31 identified an Opportunity for Improvement (OFI) to assist cognizant managers in improving programs and operations. EA-31 offers this OFI only as a recommendation for line management consideration to provide a potential solution to the facility boundary issue identified during the review.

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OFI-LAW-1: Consider requesting an office of primary interest (i.e., DOE/HQ AU-30) or Central Technical Authority technical interpretation of the requirements in DOE-STD-3009-1994, CN3, as they apply to the delineation of the LAW Facility boundary and designation of the AMR and CDG systems as external man-made hazards.

Review of Safety Evaluation Report:

EA-31 reviewed the Safety Evaluation Report (SER) prepared by the SBRT to determine the adequacy of the SER as the approval basis for the PDSA addendum using DOE-STD-1104-2014. The SBRT prepared the SER in accordance with ORP procedure TRS-ENS-ENG-IP-01, *Waste Treatment and Immobilization Plant Safety Basis Management*. This procedure establishes the process by which ORP reviews and approves safety basis documents for WTP nuclear facilities and provides guidance on the review approach, risk acceptance, format, and content of SERs.

The SER conditionally approved the addendum, with two directed actions for BNI (ref. 11):

- BNI is to submit a further revision to the PDSA for review and approval, consistent with the completion of the hazard analyses and the resolution of the open items described in PDSA Addendum Section 5.
- Based on uncertainties associated with moving the carbon dioxide vessel outside the LAW nuclear facility boundary, BNI is to delay implementation of the downgrade of the functional classification of the CDG vessel and its pressure relief valves until ORP has concurred on a CDG BLEVE hazard analysis to justify classification as an external man-made event as part of a Planned Design and Operational Improvement.

The SER appropriately concluded that the dominant accident scenarios affecting the facility worker, CLW, and public continue to be the potential for fires in the carbon bed media, release of nitrogen oxides from the melters, and events which result in spills or sprays of reagents (ammonia, carbon dioxide, sodium hydroxide) and the LAW process stream. The SER also appropriately determined that the strategies developed to prevent or mitigate the consequences for these dominant accident scenarios have been improved to provide reasonable assurance that the health and safety of the public, the workers, and the environment will not be adversely affected.

The SER recognizes that the addendum does not meet all the requirements of DOE-STD-3009-1994, CN3, such as a fully documented, comprehensive, and thorough hazard analysis and the development of supporting calculations and design documentation. The SER views the addendum as an intermediate step towards the development of the final, fully compliant PDSA and as a means to allow design, procurement, and construction activities to proceed. The SER also correctly identified the incomplete hazard evaluation and the lack of technical justification for consideration of BLEVE hazards associated with the CDG system as an external, man-made event.

<p>EA-31 Participants</p> <ol style="list-style-type: none"> 1. James O. Low (lead) 2. Kevin Bartling 3. Roy Hedtke 4. David Odland 5. Jeff Robinson 	<p>References (Key Documents, Interviews, and Observations)</p> <ol style="list-style-type: none"> 1. 24590-LAW-PDACP-NS-17-0001, Attachment 1a, <i>Safety Strategy Summary Document Addendum</i>, 3/3/2017 2. 24590-WTP-PSAR-ESH-01-002-03, <i>Preliminary Documented Safety Analysis to Support Construction Authorization: LAW Facility Specific Information</i> (rev. 6b), April 28, 2016 3. DOE/HQ EA-31, <i>Plan for the Office of Enterprise Assessments – Assessment of the Waste Treatment and Immobilization Plant Low-Activity Waste Facility Safety Basis at the Hanford Site (May 2016-February 2018)</i>, May 10, 2016 4. 24590-WTP-PSAR-ESH-01-002-0X, <i>Preliminary Documented Safety Analysis to Support Construction Authorization: LAW Facility Specific Information</i> (Rev. 7), DRAFT December 5, 2016 5. FN-EA-31-WTP-LAW-2-13-2017, <i>Operational Awareness Visit to the Waste Treatment and Immobilization Plant Low Activity Waste Facility Draft PDSA Review</i>, February 13, 2017 6. Email, N. Hetro (BNI) to Distribution, <i>SBRT Team Review – Interim SSSD Addendum Change Package to the LAW PDSA</i>, 3/9/17 7. CCN 296037 CK Binns (BNI) to WF Hamel (ORP), <i>Contract No. DE-AC27-01RV14136 Contract Deliverable 9.1 – Submittal of Nuclear Safety Document Change Package 24590-PDSACP-NS-17-0001, Safety Strategy Summary Document Addendum</i>, March 23, 2017 8. CCN 289781, Contract No. DE-AC27-01RV14136 - <i>Submittal of the Implementation Plan for Revision of WTP Contract, Section C, Standard 9, Nuclear Safety</i>, 10/4/2016, (Issued 3/22/17) 9. Email, JO Low (EA-31) to JP Harris, <i>LAW PDSA Addendum Expedited Review Comments Consolidated 3-20-17 final</i>, March 20, 2017 7:33 AM 10. Email, JO Low (EA-31) to JP Harris (ORP), <i>LAW PDSA Expedited Review Comments Consolidated 3-20-17 final (BNI proposed responses) v0004.docs</i>, March 23, 2017, 2:10 pm 11. 17-NSD-0015, <i>Approval of Preliminary Documented Safety Analysis Interim Change Package</i>, Attachment to 17-NSD-0015, <i>Safety Evaluation Report of Nuclear Safety Change Document 24590-LAW-PDACP-NS-17-0001, Safety Strategy Summary Document Addendum</i>, 3/31/17
<p>Were there any items for EA follow-up? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>	
<p>EA Follow-up Items:</p> <ol style="list-style-type: none"> 1. Review PDSA Rev7x for verification of closure of existing EA-31 comments. 	
<p>ATTACHMENTS: None</p>	