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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



February 28, 2023

The Honorable Jennifer M. Granholm
Secretary of Energy
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Granholm:

The Defense Nuclear Facility Safety Board (Board) has reviewed the integration of the safety basis documents that implement the Direct-Feed Low Activity Waste (DFLAW) mission. The enclosed report provides the results of that review. The Board understands that treating Hanford's tank waste using the DFLAW approach is a key component of the Department of Energy's (DOE) strategic cleanup vision and is projected to begin operations in 2023.

The Board finds it encouraging that personnel from the Hanford Tank Farms contractor, Washington River Protection Solutions (WRPS), informed our staff that they plan to convert the waste characteristics administrative control key element to a specific administrative control (SAC) and make associated changes to the respective safety basis documents in early 2024. The increased rigor and validation associated with a SAC will help ensure that tank farms operations remain within the conditions outlined in the safety bases. Therefore, the Board views WRPS's plan to elevate the waste characteristics administrative control to a SAC as a positive step that could be beneficial at DFLAW and other defense nuclear facilities throughout the DOE complex.

The Board identified a concern with the implementation strategy for a cover block removal SAC that controls waste leak hazards at the tank farms. Specifically, a tank farms SAC requires safety-related actions in the Low Activity Waste (LAW) facility, but the SAC is not included in the LAW safety basis and the interface control documents do not define the roles and responsibilities for implementing the SAC. Without inclusion in the LAW safety basis, it is more likely that the SAC safety controls will not be maintained over the life of the LAW facility.

Pursuant to 42 United States Code (USC) § 2286b(d), the Board requests a written response within 60 days outlining how DOE plans to ensure the effective implementation of the cover block removal SAC.

Sincerely,



Joyce L. Connery
Chair

Enclosure

c: Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

December 19, 2022

Direct-Feed Low Activity Waste Facility Integration of Safety Bases

Summary. The Defense Nuclear Facilities Safety Board (Board) is conducting a series of reviews to support start-up of the Low Activity Waste (LAW) facility at the Hanford Waste Treatment and Immobilization Plant (WTP). The series included a review of the hazard categorization for the LAW facility that the Board has already forwarded to the Department of Energy (DOE) [1].

DOE and its contractor updated the WTP LAW facility safety basis to follow DOE Standard 1228, *Preparation of Documented Safety Analysis for Hazard Category 3 DOE Nuclear Facilities* [2]. This update downgraded safety significant controls for the off-gas system because the most significant hazards were chemical. The controls for chemical hazards now rely on safety management programs. In addition, the documented safety analysis (DSA) uses a specific administrative control (SAC) to implement waste acceptance criteria that protect the initial assumptions regarding the waste forms expected to enter the LAW facility that could impact the safety bases.

Given this revised control approach, the Board's staff initiated this review of the integration of the safety bases associated with the Direct-Feed Low Activity Waste (DFLAW) mission. The staff did not identify any major concerns that should delay the upcoming operation of DFLAW; however, this staff report highlights areas for DOE to consider when evaluating the operational readiness of the DFLAW mission.

Implementation of Waste Leaks SAC—The Hanford Tank Farms DSA [3] identifies a SAC requiring removal of the motive force from LAW facility waste pumps while workers are performing maintenance in structures that support the waste transfer lines. However, the interface control documents do not identify roles and responsibilities for personnel at each facility to implement this SAC. Further, the LAW DSA [4] does not include a corresponding SAC with controls to be implemented in the LAW facility. Without this information, it is not clear how this SAC will be implemented by each contractor with the rigor required for a SAC or how the implementation of this control would be verified during operations.

Tank Side Cesium Removal (TSCR) System Access Restriction Directive Action SAC—The TSCR process area access restriction SAC is improperly identified as a directive action SAC. Directive action SACs should be used when it is essential that the SAC be performed every time when called upon and without any delay. However, the TSCR process area access restriction SAC contains a requirement to develop and execute a recovery plan, which cannot be completed without delay.

Safety Classification for Waste Characterization—For Hanford Tank Farms, waste characteristics are controlled through an administrative control key element rather than a SAC. This does not meet guidelines found in DOE Standard 1186-2004, *Specific Administrative Controls*. WRPS personnel informed the Board’s staff that they plan to convert the key element to a SAC and make associated changes to the respective DSAs and technical safety requirements (TSR) via a draft safety basis amendment by January 31, 2024.

Background. WTP is a new complex of facilities designed to vitrify tank waste for eventual disposal. The original concept had waste entering a pretreatment facility, which would treat the waste and then direct the waste to either the LAW facility or the High-Level Waste facility for vitrification. Safety and technical issues with the pretreatment process have delayed its progress. In response, DOE has pursued alternate approaches to start operation of the LAW facility.

The selected approach, DFLAW, is a collection of interdependent projects and infrastructure, managed as a program, that will operate together to vitrify and dispose of LAW. This allows the direct transfer of Hanford Tank Farms treated LAW feed to the LAW facility without the need for the WTP Pretreatment facility. Instead, tank farm waste is pretreated using the TSCR system. TSCR is a basic filtration and ion exchange system to remove solids and cesium to acceptable levels. TSCR is located adjacent to the AP Tank Farm and is intended to operate for the initial DFLAW configuration. The treated waste is transferred to a staging tank for eventual transfer to the LAW facility. The ion exchange resin columns are removed from the system when loaded with cesium and stored on a pad adjacent to the TSCR process equipment.

At the LAW facility, glass formers are added to the treated waste and introduced into the melter to produce LAW-infused glass. This glass is poured into stainless steel waste containers, sealed, decontaminated, and eventually transferred to the Integrated Disposal Facility. Several liquid waste streams are generated during the glass forming process. These include the off-gas condensate from the LAW melter and other incidental waste streams. The Effluent Management Facility (EMF) receives and treats these liquid waste streams.

Higher radioactivity liquid waste is reintroduced into the melter feed or in off-normal situations returned to the tank farms. The secondary liquid waste output stream (e.g., process condensate) from EMF with lower radioactive material content is sent to the Liquid Effluent Retention Facility (LERF) for treatment and disposal. Finally, the process will generate a variety of solid wastes from daily consumables to spent melters. These will be sent the Hanford Central Waste Complex for disposal.

The Board’s staff team reviewed the integration of the safety bases associated with the liquid waste streams of the DFLAW mission. These safety bases include the LAW facility DSA (which includes EMF) [4], the Tank Farms DSA (which includes the TSCR process) [3], and the LERF hazard category-3 upgrade DSA [5]. The scope of this review concentrated on the interaction of the existing control sets and consistency of the implementation of requirements for safety control development between the DSAs. The review did not include a systematic evaluation of the control selection and control development within each DSA. Those areas have been or may be the subject of other DNFSB reviews.

The Board's staff team also evaluated the safety risk of cesium-137 ion-exchange media storage and removal. Hydrogen is the primary hazardous energy source associated with storage of the ion exchange columns from the TSCR system. During review, the tank farms safety analysts identified that flammable conditions can be reached in under six hours. The control strategy for the columns is: 1) prevent pressurization of the hydrogen, thus limiting the energy of the deflagration, and 2) ensure the design of the ion exchange column and vent stacks can withstand the limited deflagration.

Discussion. The Tank Farms DSA [3] identifies a spray leak hazard for workers when working in pits containing equipment used for waste transfer through pipelines between the tank farms and the LAW facility. Ideally this type of hazard would be managed with installed components: e.g., a set of isolation valves where each organization controls a valve. In general, this type of arrangement is much easier to install if the hazard is identified during the facility design phase. For the existing tank farms facility, the tank farms contractor chose to implement a SAC, *4.5.13 AP-02D and AP-06A Cover Block Removal*, to de-energize pumps in the LAW facility or install pipeline blanks to prevent the spray leak. In any case, installation of blanks would also likely require the pumps to be de-energized. The Board's staff team evaluated how this SAC was implemented at the LAW facility. The LAW DSA did not contain a corresponding SAC. With regard to the interface control documents, while the interface SAC is identified in the Tank Farms DSA, no specific roles and responsibilities for implementing the SAC are identified in the interface documents [6] [7].

This situation raises multiple potential concerns with SAC implementation. The first is that if the tank farms organization is allowed to be responsible for de-energizing the pumps in the LAW facility, the LAW organization will not be maintaining configuration control of its facility. If the LAW organization is responsible, not having the SAC incorporated in its DSA could result in a condition such that the required safety controls for the tank farms SAC are not maintained in implementing procedures because the procedures are developed using the LAW DSA and not necessarily the Tank Farms DSA.

The Board's staff team evaluated how similar situations are managed at other sites, such as the Savannah River Site (SRS). At SRS, the potential for interarea transfer accidents has a SAC that is described both in the Concentration, Storage, and Transfer Facilities DSA [8] and the Defense Waste Processing Facility Final Safety Analysis Report [9]. This SRS approach addresses the safety concerns raised by the Board's staff team and should be considered by DOE for implementation at the LAW facility.

The Board's staff team also identified the following staff observations.

TSCR Access Restriction Directive Action SAC—The TSCR process area access restriction SAC is improperly identified as a directive action SAC.

One of the purposes of this SAC is to protect the facility worker from a flammable gas deflagration or detonation by requiring that flammable gas hazards be controlled prior to initiating manned work activities on TSCR process vessels and piping. Prior to entering

maintenance mode, this SAC requires that facility workers 1) lock transfer pumps, 2) verify that the depressurization valve is open, and 3) remove liquid from process vessels by “blowdown.”

DOE Standard 1186-2004, *Specific Administrative Controls* [10], notes that “SACs are addressed through the TSRs generally by two forms: [...] a. LCO [Limiting Condition of Operation]/Surveillance Requirement [...] b. Specific “Directive Action” AC [Administrative Control]. The TSCR access restriction SAC is written in the directive action format because it is included in the administrative controls section of the TSR document [11] rather than in the LCO section. DOE Standard 1186-2004 [10] notes that the directive action format “may be appropriate when it is essential that the Specific AC be performed when called upon every time and without any delay.”

The Tank Farms TSR document [11] includes the following as the last SAC requirement for this SAC: “If blowdown cannot be completed successfully, entry into the TSCR process area and recovery actions necessary to complete [this SAC] shall be controlled per a Recovery Plan. DOE approval of the Recovery Plan shall be obtained prior to performing actions of the Recovery Plan.” Writing and approving a recovery plan will take time to complete: i.e., there will be a delay in SAC performance. Therefore, the TSCR process area access restriction SAC does not meet the guidance on directive action SACs because it requires a recovery plan, and therefore a delay, if blowdown cannot be completed successfully.

DOE Standard 1186-2004 [10] (the version implemented in the Tank Farms DSA) does not clearly note whether failure to meet a directive action SAC constitutes a TSR violation. However, DOE Standard 1186-2016 [12], states that “a violation of a Directive Action SAC is a TSR violation.” DOE and WRPS staff did not consider failing to complete the blowdown step as a TSR violation because they asserted that the facility would be in a safe configuration while the recovery plan was developed and approved.

The Board’s staff acknowledges that the way the SAC is written in the TSR document prevents the facility from entering maintenance mode if the blowdown step cannot be performed. Therefore, facility workers would not be able to enter the facility, so there would be no hazard for them during the time it takes to write the recovery plan.

Because the hazard is prevented during the delay that would be caused by writing and approving a recovery plan, the Board’s staff concludes that the TSCR access restriction SAC does not meet the criteria for a directive action SAC. It could be more appropriate as a LCO with specific required actions and completion times.

Alternatively, if this SAC remains designated as a directive action SAC, the Board’s staff concludes that a recovery plan should not be used. DNFSB Technical Report 45, *Violations of the Nuclear Safety Basis* [13], issued on August 7, 2020, notes that “Recovery actions represent an undefined risk acceptance by DOE when directive action SACs are not met. By approving directive action SACs with recovery actions, DOE is approving safety bases that allow for the accumulation of unquantified risk during the time period the directive action SAC is not met....”

Safety Classification for Waste Characterization—The Board’s staff identified the following as a best practice for protecting waste characterization assumptions: WRPS personnel informed the Board’s staff that they plan to convert the waste characteristics administrative control key element to a SAC and make associated changes to the respective DSAs and TSRs via a draft safety basis amendment in 2022.

Currently, in the Tank Farms DSA [3], waste characteristics are controlled through an administrative control key element rather than a SAC. The DSA notes that “The safety function of the waste characteristic control is to protect assumptions on waste characteristics used to estimate accident consequences.” The calculated unmitigated consequences from some of the tank farms accidents require safety significant controls (e.g., flammable gas accidents). DOE Standard 1186-2004 [10] notes that “Programmatic ACs [administrative controls] should not be used to provide specific or mitigative functions for accident scenarios identified in DSAs where the safety function has importance similar to, or the same as, the safety function of safety class or safety significant SSCs [structures, systems, and components].”

DOE Standard 3009-1994, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, [14] (the version of DOE Standard 3009 invoked in the Tank Farms DSA) does not specifically describe the parameters for administrative control key elements. However, DOE Standard 3009-2014 states that “It is not appropriate for a key element to be identified in lieu of a SAC.” This is because when a control is elevated to the class of SAC, DOE and contractors should ensure the “effectiveness and dependability of these important administrative controls beyond that which might be experienced if the specific action AC were simply to be implemented under the auspices of a Safety Management Program” (from DOE Standard 1186-2004 [10]).

This concern was included in DNFSB Technical Report 48, *Hanford Tank Farms Safety Basis Review* [15], issued on September 15, 2021. Technical Report 48 notes, “instead of using a SAC to prevent an inappropriate transfer, WRPS uses a TSR administrative control key element requiring that certain characteristics be evaluated prior to each waste transfer as part of a safety management program.” Further, “This ambiguity and level of control appear to be inconsistent with the intent of DOE requirements and guidance. It may be appropriate to designate these controls as SACs to clear up ambiguity as to the control strategy or implications stemming from potential violations.”

After Technical Report 48 was issued, the DOE Office of Enterprise Assessments (DOE-EA) issued an assessment on the SACs at the Hanford Site Tank Farms on December 20, 2021 [16]. The DOE-EA assessment notes that the waste characterization administrative control key element is inappropriately categorized and implemented as an administrative control rather than SAC. DOE-Hanford distributed the DOE-EA report as an operational awareness report on January 3, 2022 [16].

After Technical Report 48 and the operational awareness report were issued, WRPS issued a condition report action [17] that notes, “Corrective action will be launched indicating that directive action statements, and the requirements of [the Waste Characteristics Controls] that fulfill the stated safety function, will be converted into a new SAC.” Further, WRPS plans to

make associated changes to the respective DSAs and TSRs via a draft safety basis amendment by January 31, 2024.

The Board's staff team views the conversion of the waste characteristics control to a SAC as a best practice for protecting the assumed waste characterization for tank farms. Because this waste characterization data is used for consequence determinations, the additional rigor and validation associated with implementation of a SAC will help ensure that tank farms operations remain within the conditions outlined in the Tank Farms DSA.

Conclusion. The staff did not identify any major concerns that should delay the upcoming operation of DFLAW; however, this staff report highlights areas for DOE to consider during future DSA updates and when evaluating the operational readiness of the DFLAW mission, including:

- Implementation of waste leaks SAC,
- TSCR access restriction directive action SAC, and
- Safety classification for waste characterization at the Tank Farms.

References

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- [2] Department of Energy, DOE Standard 1228, *Preparation of Documented Safety Analysis for Hazard Category 3 DOE Nuclear Facilities*, May 2019.
- [3] Washington River Protection Solutions, *RPP-13033 Rev 8-A, Tank Farms Documented Safety Analysis, Revision 8-A*, October 2021.
- [4] Bechtel National Inc., *Documented Safety Analysis for the Low-Activity Waste and Effluent Management Facilities*, 24590-LAW-DSA-NS-18-0001, Rev 4, May 2021.
- [5] Washington River Protection Solutions LLC, *Liquid Effluent Retention Facility Documented Safety Analysis*, Rev 0 Draft, RPP-RPT-63029, May 2022.
- [6] Bechtel National Inc., *ICD30-Interface Control Document for DFLAW Feed*, 24590-WTP-ICD-MG-01-030, Rev1, 2021.
- [7] Bechtel National Inc., *ICD31-Interface Control Document for DFLAW Effluent Returns to Double-Shell Tanks*, 24590-WTP-ICD-MG-01-031, Rev1, 2020.
- [8] Savannah River Remediation LLC., *Concentration, Storage, and Transfer Facilities Documented Safety Analysis*, WSRC-SA-2002-00007, Rev. 22, December 2021.
- [9] Savannah River Remediation LLC., *Final Safety Analysis Report Savannah River Site Defense Waste Processing Facility*, WSRC-SA-6, Rev. 38, August 2019.
- [10] Department of Energy, DOE Standard 1186, *Specific Administrative Controls*, 2004.
- [11] Washington River Protection Solutions, *Tank Farms Technical Safety Requirements, Revision 10-A*, HNF-SD-WM-TSR-006 Rev 10-A, October 2021.
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- [13] Defense Nuclear Facilities Safety Board, *Violations of the Nuclear Safety Basis*, DNFSB/TECH-45, May 2020.
- [14] Department of Energy, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, DOE Standard 3009, 1994.
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- [16] Department of Energy, *EA Memorandum transmitting results of EA assessment of SAC implementation at Tank Farms and 242-A Evaporator*, DOE-ASMT-2022-1224, January 2022.
- [17] Washington River Protection Solutions, *Condition Report WRPS-CR-2022-0501*, January 5, 2022.