DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

July 19, 2022

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 Facilities Safety Board (Board) completed a review of a revised preliminary documented safety analysis for the High-Level Waste Facility at the Waste Treatment and Immobilization Plant project located at the Hanford Site. The review was limited to the hydrogen control strategy, as well as fire protec ion and chemical safety programs.

The Board found that, while the Department of Energy has made progress in resolving some long-standing technical issues, the hydrogen control strategy for process vessels is not fully defined. During the review, project personnel stated that they plan to draft technical safety requirements several years earlier than originally planned, which the Board views as a positive development. The Board finds drafting technical safety requirements will aid in informing the Department of Energy on the gaps in the hydrogen control strategy where additional safety analyses and research are needed.

The enclosed staff report, provided for your information and use, further describes the safety observations that the Department of Energy should address as the facility design matures to ensure the High-Level Waste Facility meets the Department of Energy's safety requirements. The Board and its staff will continue to evaluate the facility design as it develops.

Sincerely,

Joyce L. Connery
Chair

Enclosure

c: Mr. William I. White
Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

April 19, 2022

Review of the Preliminary Documented Safety Analysis for the High-Level Waste Facility

Summary. The staff of the Defense Nuclear Facilities Safety Board (Board) reviewed an updated preliminary documented safety analysis (PDSA) for the High-Level Waste (HLW) Facility at the Waste Treatment and Immobilization Plant (WTP) project located at the Hanford Site [1]. The PDSA included revisions addressing long-standing technical issues such as the hydrogen control strategy for process vessels. Overall, the staff concludes that the Department of Energy (DOE) and its contractors made progress towards resolution of these technical issues. The staff identified seven safety observations that should be addressed in future PDSA revisions. These safety observations are summarized below:

1. ***Hydrogen Control Strategy Is Not Fully Defined*—**The hydrogen control strategy needs further refinement to ensure proper integration of safety into the design.

2. ***Hydrogen Control Strategy Is Inconsistent with Approved Safety Requirements for the WTP Project*—**The safety requirements document (SRD), which provides formal documentation of the safety requirements and standards applicable to the facility, contains safety requirements that will not be met with the revised hydrogen control strategy [2]. The SRD should be updated.

3. ***Independent Evaluation of the Hydrogen Explosions Analysis Is Warranted*—**The hydrogen control strategy relies on high efficiency particulate air (HEPA) filters' ability to survive an explosion and prevent an unfiltered release. The calculation validating the HEPA filters' ability to survive the explosion warrants an independent review by an outside entity (e.g., a national laboratory) supporting the DOE Office of River Protection (ORP) because of its importance to safety, its complexity, and the result's proximity to the HEPA filters' design limit.

4. ***Temperature Effects Are Not Fully Considered in the Volcanic Ashfall Safety Strategy*—**Project personnel are considering a passive safe shutdown of the facility during a volcanic ashfall event. This involves securing ventilation and other cooling systems, which will cause the facility's temperature to increase. The safety analyses of hydrogen hazards during the ashfall event do not consider this temperature increase.

5. ***Vessel Baffles Should Be Analyzed as Design Features*—**The HLW melter feed process system (HFP) vessels have baffles placed around the internals of the vessel that are designed to enhance the mixing of the agitator. The baffles should be analyzed to determine whether their presence needs preservation as a design feature in the technical safety requirements (TSR).

6. ***Preliminary Fire Hazards Analysis (PFHA) and the PDSA Are Misaligned—***The current PFHA is not aligned with the latest PDSA revision, as noted in the planned improvement section of the PDSA hazard analysis.

7. ***Chemical Safety Management Program (CSMP) Yet to Be Developed—***Project personnel identified the HLW Facility CSMP as an area for safety improvement.

Background. The HLW Facility is a partially constructed Hazard Category 2 facility and is part of the WTP project located at the Hanford Site in southeastern Washington State. The HLW Facility's mission is to vitrify liquid high-level radioactive waste from the Hanford Tank Farms into stainless steel canisters suitable for permanent disposal. The HLW Facility is designed for a nominal 40-year operating life.

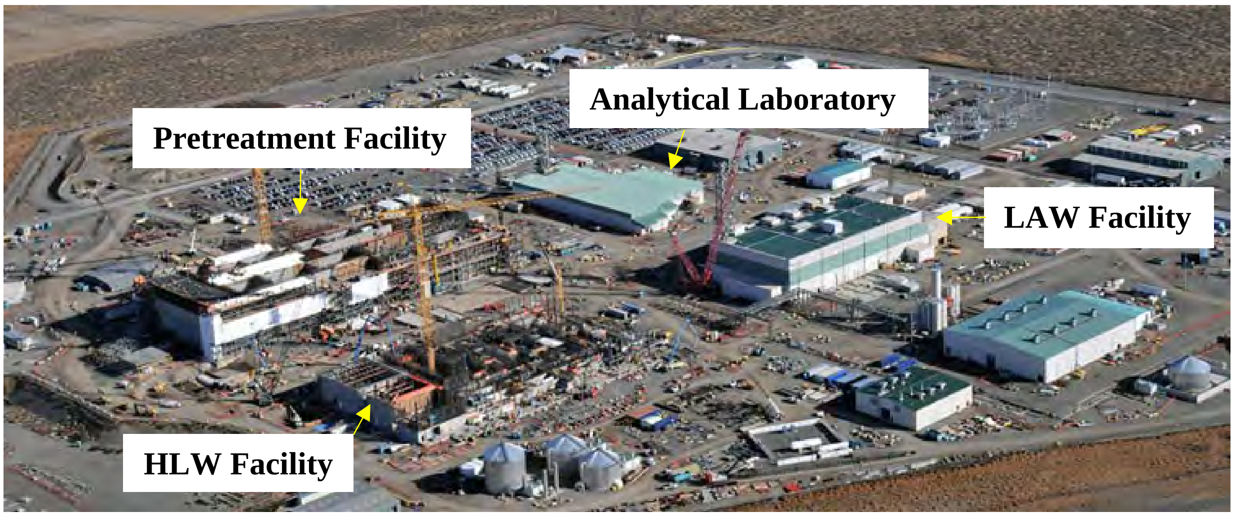

Figure 1. *An aerial photograph of the WTP construction site. WTP is composed of four major nuclear facilities: HLW, Pretreatment, Low-Activity Waste (LAW), and Analytical Laboratory. Balance of Facilities provides utilities and support in surrounding non-nuclear structures.*

In 2002, ORP approved full construction of the HLW Facility. In 2012, ORP restricted engineering, procurement, and construction work due to unresolved safety and programmatic issues, as well as misalignments between the design and safety basis. In August 2014, DOE approved a safety design strategy to guide future hazard analyses, design activities, and technical issue resolutions.

In late 2014 and early 2015, the Board sent four letters to DOE outlining concerns with the safety design strategy involving the hydrogen control strategy, unanalyzed melter accidents, and seismic qualifications of safety-related controls [3-6]. In October 2018, the ORP manager sent a response letter that stated the safety issues identified by the Board had been resolved with the issuance of a revised PDSA [7]. In May 2019, the Board responded with an additional letter agreeing that DOE identified acceptable strategies for resolution of these issues, but noted that, in some cases, further analysis would validate or clarify assumptions underpinning those strategies [8].

In April 2021, project personnel issued another revision to the HLW Facility PDSA (Revision 9) that, among other updates, included additional changes related to resolution of the Board-identified safety issues. Following issuance of this PDSA, the staff conducted a limited scope follow-up review that focused on the hydrogen control strategy, fire protection, and chemical safety:

- On July 16, 2021, the staff transmitted a review agenda to ORP.
- On September 21–23, 2021, the staff conducted video-teleconferences to discuss the proposed hydrogen control strategy and supporting calculations, the CSMP, and fire protection. The staff found that project personnel were well prepared for all meetings, provided thoughtful responses to all lines of inquiry, and facilitated exceptional discussion on the issues.
- On January 11, 2022, the staff concluded its review with a factual accuracy video-teleconference with ORP and its contractors.

Discussion. The staff made seven safety observations from this limited scope review of the PDSA. The first five safety observations are related to the hydrogen control strategy in the HFP vessels. The remaining safety observations involve the fire protection and chemical safety programs. An overview of the hydrogen control strategy followed by a discussion of each safety observation is provided below.

Hydrogen Control Strategy Overview—There are four HFP vessels (two per melter train). After the HFP vessels receive HLW from the Pretreatment Facility, glass formers are added to the waste, mechanical agitators mix the waste, and then the waste is fed to the melters via pumps located in the vessels. Flammable gases including hydrogen are generated in these vessels by radiolysis and thermolysis[1] and present a safety hazard if allowed to accumulate to a concentration above their lower flammability limit (LFL).

The hydrogen control strategy during normal operations relies on two principles—mixing and dilution. A safety significant[2] mechanical agitator mixes the waste leading to release of hydrogen into the vessel headspace. A headspace air purge also credited as safety significant dilutes the hydrogen to a fraction of the LFL. Project personnel identified three accidents that can either fail or limit the availability of the agitator. These are as follows:

1. Agitator Failure: The agitator consists of a variable speed drive motor on top of each HFP vessel with a shaft that extends through the vessel's top and includes three impellers at various depths. The agitator is rotated nearly continuously during normal operations when the waste is above the lower agitator impeller. There are potential failure mechanisms of the agitator due to various mechanical or electrical faults. Agitator failure is an anticipated event. The agitator is designed to be replaceable

[1] Radiolysis and thermolysis refer to the processes by which hydrogen is generated from the decomposition of water and organic molecules.
[2] Safety significant controls are intended to provide a major contribution to defense-in-depth and/or worker protection from accidents. These controls supplement safety class controls designed to protect the public.

using remote operated cranes, and according to the PDSA (Section 4.4.2.6.2), it is expected to be replaced approximately every five years.

2. Seismic Event: Seismic activity and resulting ground motion can cause damage to structures, systems, and components (SSC). The PDSA (Section 4.4.1.1.4) states that the agitator will be qualified to seismic category[3] (SC)-III loads. More severe seismic events can compromise the agitator.

3. Volcanic Ashfall: The PDSA (Section 3.3.3.4.3) states: "The Cascade Range in western North America contains multiple active volcanos. Eruption of one of these volcanos could result in a substantial ashfall on the WTP site." Ashfall can clog ventilation systems, cause structural loading, and also cause loss of electrical power that will limit the availability of the agitator and other systems.

Because of the non-Newtonian nature of the waste, hydrogen can be trapped and accumulate in the waste without agitation. Accumulated hydrogen can episodically release to the vessel headspace, overwhelm the purge, and result in a flammable condition. Project personnel calculated that, within 36 hours following a loss of agitation, the waste can accumulate enough hydrogen that, if episodically released, could exceed the LFL in the vessel headspace. The hydrogen control strategy for a severe seismic event and volcanic ashfall will not prevent the hydrogen concentration exceeding the LFL. Additionally, project personnel stated that there may be situations where a flammable condition cannot be prevented following agitator failure from mechanical or electrical faults during normal operations.

The hydrogen control strategy for agitator failure, seismic event, and volcanic ashfall are designed to limit the time the vessel headspace remains flammable (i.e., time-at-risk) by increasing airflow through the headspace to dilute the hydrogen concentration. The PDSA (Section 4.4.2.5.4) states: "Purge air flow to the HFP vessels will be increased to at least 50 scfm [standard cubic feet per minute] on loss of agitation to reduce the time-at-risk in the event of an episodic hydrogen release to less than 30 minutes." In addition, the strategy for volcanic ashfall currently includes an air amplifier[4] credited as safety significant that provides additional airflow through the headspace and results in additional reduction of time-at-risk.

Given an ignition source, a hydrogen explosion is possible during the time-at-risk. The control strategy for these initiating events allows the possibility of an explosion. The surrounding area, known as the C5 confinement boundary, and its associated ventilation system (i.e., C5V) are credited as safety significant to filter the resulting aerosolized radioactive material to protect the workers, public, and environment. These controls also shield facility workers, who are located outside the C5 boundary, from the direct effects of the explosion.

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[3] According to the SRD, SC-III is equivalent to performance category (PC)-2. PCs are assigned based on potential consequences from an unmitigated accident [9]. The higher the PC, the more robust the SSC is to seismic hazards. PC-3 (SC-I) is the highest designation for DOE non-reactor facilities.

[4] Air amplifiers are installed on top of each HFP vessel. They use compressed air to create a low-pressure condition that causes the vessel headspace to be ventilated to the surrounding room.

During normal operations, fans in the HLW melter off gas treatment process system (HOP) provide the driving force for ventilating the HFP vessel headspaces and for exhausting the airflow through the HOP HEPA filters. The HOP HEPA filters provide filtration before this pipe route exits the C5 confinement boundary and exhausts through the stack. Because the HFP vessel headspace is connected to the HOP HEPA filters with piping, the filters can be exposed to high temperatures and pressures from a hydrogen explosion. The PDSA credits the safety significant HOP HEPA filters with surviving the explosion. The PDSA (page 3.3-101) states: "The C5 confinement boundary is augmented by the HOP HEPA filters, which are credited with ensuring that an unfiltered pathway from the vessel headspace to outside of the boundary is not realized following the explosion."

Observation 1: Hydrogen Control Strategy Is Not Fully Defined—Although an overall framework for the hydrogen control strategy is defined, it lacks some needed details and does not align with requirements in the SRD (see Observation 2). The hydrogen control strategy for agitator failure (an anticipated condition) is the most underdeveloped. Drafting TSRs would help in driving completion as the hydrogen control strategy for agitator failure will be executed via operator actions required by TSRs. Drafting TSRs should also aid in illuminating the gaps in this strategy where additional safety analyses and research is needed.

DOE Order 420.1B, *Facility Safety*, states: "Safety analyses must be performed as early as practical in conceptual or preliminary design processes to ensure that required safety SSCs are specified in the final design [10]." During the review, project personnel decided to draft TSRs in fiscal years 2023–2024, which is several years earlier than originally planned. The staff views this is as a positive development since it is important for integrating safety into the design. The staff's assessment of the hydrogen control strategy for agitator failure, seismic event, and volcanic ashfall is explained below.

Agitator Failure: Safety significant speed and power sensors will detect agitator failure and will trigger automatic safety actions consisting of sounding an alarm in the control room and increasing the flow rate of the safety significant headspace air purge. The air purge limits the time-at-risk for a hydrogen explosion from an episodic hydrogen release to less than 30 minutes. Additionally, the PDSA (Section 4.4.2.6.5) states: "A TSR shall be implemented requiring operator response to ensure that an alternative hydrogen mitigation safety function is performed."

Project personnel stated that agitator failure will result in the facility entering a limiting condition for operation (LCO)[5] in the TSRs. According to project personnel, LCO required actions will direct operators to de-inventory the vessels and restore agitation. De-inventorying the vessels can include pumping the waste forward to the melter or the next vessel in that melter train. It can also include pumping the waste to a vessel in the other melter train.

Loss of mixing complicates the LCO required actions. Additional research may be needed to fully understand the waste rheology as a function of time following loss of agitation as it affects the ability to pump waste (waste stratification) to other vessels. Project personnel also

[5] Title 10, Code of Federal Regulations, Part 830, *Nuclear Safety Management*, defines an LCO as "the limits that represent the lowest functional capability or performance level of SSCs required for safe operations [11]."

need to evaluate how long waste can be fed to the melter without mixing before the glass would become noncompliant (waste certification). Replacing the agitator and transferring waste to a vessel in the other melter train requires remote installation of equipment with cranes. The time required for agitator replacement and connecting equipment necessary to perform these actions has yet to be accurately estimated. Other factors, such as the storage location of jumpers, have not been defined and will impact the time required to perform these tasks. As a result of all these unknowns, project personnel stated they could not determine whether a flammable condition could always be prevented with the LCO required actions. The staff concludes that allowing an uncontrolled explosion hazard to develop from anticipated operational conditions (e.g., agitator failure) does not adhere to good engineering practice, particularly for a new hazard category 2 nuclear facility. The staff further concludes that the current control strategy for agitator failure is not well defined.

Seismic Event: As previously discussed, severe seismic events can disable the safety significant agitator. If agitator failure occurs, the safety significant air purge will limit the time-at-risk for a hydrogen explosion from an episodic hydrogen release to less than 30 minutes. Additionally, a safety class seismic monitoring system will detect seismic activity greater than SC-IV and will trigger automatic safety actions that, among other actions, include shutting valves downstream of the HOP HEPA filters. These valves were added with a recent design change to ensure that the ventilation system for the C5 confinement boundary (i.e., C5V) can maintain negative pressure and filter releases.

The PDSA (Table 4.4-20) shows that piping penetrations in the C5 confinement boundary greater than four inches in diameter, which would include HOP piping, are required to be isolated to support the C5V safety function during a seismic event. If a hydrogen explosion occurs during the time-at-risk, the isolation valves downstream of the HOP HEPA filters could be exposed to elevated temperatures and pressures. Project personnel stated they have not designed these valves for these conditions. Additionally, the PDSA states that the agitator will be qualified to SC-III loads. Project personnel noted that the agitator will be subjected to shake table testing to confirm the qualification, but the testing has not been completed.

The staff concludes the control strategy for a seismic event is defined but requires refinement. The staff found this control strategy has an advantage over the control strategies for agitator failure and volcanic ashfall. Once properly designed, the isolation valves that were added to the design downstream of the HOP HEPA filters will provide an additional barrier to prevent a release to the environment in the event of a hydrogen explosion in the HFP vessels. The control strategy for agitator failure and volcanic ashfall do not currently include shutting these isolation valves. Hence, they rely solely on the HOP HEPA filters surviving the explosion and preventing an unfiltered release to the environment (see Observation 3).

Volcanic Ashfall: Project personnel stated that, following notification from the Hanford Emergency Operation Center of a volcanic eruption, they plan to put the facility in a passive safe shutdown that includes securing electrical power to all systems until the ashfall event has passed and recovery activities are initiated. An independent building will be constructed with ashfall protection (baghouse) to support an air compressor, electrical generator, auxiliary equipment, and a climate-controlled operations haven. This equipment will operate the vessel headspace air purge, air amplifier, and the mechanical agitators during an ashfall event.

The air purge and air amplifier are credited as safety significant. Project documents state that together the air purge and air amplifier can reduce the time-at-risk for a hydrogen explosion from an episodic release to 1.1 minutes [12]. The agitator can also operate intermittently to eliminate the time-at-risk. However, if the agitator fails, there is no recourse to replace it during the passive safe shutdown, so it is only proposed as a defense-in-depth control.

The staff concludes the control strategy for volcanic ashfall is defined conceptually, not officially approved, and requires refinement. Some items in the volcanic ashfall strategy require further investigation. The rheology of the waste in the vessels will change over time due to high airflow through the headspace with no water addition. This effect needs to be evaluated. Additionally, project personnel have not generated recovery plans for the ashfall event. Finally, the facility air temperature will increase during the passive safe shutdown, which was not considered in ashfall safety analyses (see Observation 4).

Observation 2: Hydrogen Control Strategy Is Inconsistent with Approved Safety Requirements for the WTP Project—The SRD lists the safety requirements and standards that apply to the WTP project. The current proposed hydrogen control strategy is contrary to requirements in the SRD. For example, the SRD lists tailored requirements from National Fire Protection Association Standard 69, *Standard on Explosion Prevention Systems*, for vessels [13]. The SRD states: "The combustible concentration shall be maintained at or below 25 percent of the [LFL] during normal operations and less than the LFL under upset conditions." The proposed hydrogen control strategy will allow flammable conditions in vessel headspaces. Project personnel stated that they plan to update the SRD to reflect the current hydrogen control strategy.

Observation 3: Independent Evaluation of the Hydrogen Explosions Analysis May Be Warranted—As previously discussed, in the event of a hydrogen explosion in the HFP vessels, the controls strategies for agitator failure, seismic event, and volcanic ashfall credit the HOP HEPA filters with surviving a hydrogen explosion in the HFP vessel headspaces. The control strategy for a seismic event includes closing isolation valves downstream of the HOP HEPA filters, which pending proper design criteria, can provide an additional barrier. Currently, the control strategy for agitator failure and volcanic ashfall identify the HOP HEPA filters as a sole means of preventing an unfiltered release to the environment.

DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, states: "The total layers of defense in depth available are also key considerations in designating safety-significant SSCs. If many effective barriers are available, the significance of any one barrier is limited. If only one or two barriers can be realistically counted on, their individual significance increases [14]." Therefore, as DOE Standard 3009-94 illustrates, the HOP HEPA filters and the calculation confirming they can survive the explosion, are highly important.

Project personnel completed a calculation that analyzed an HFP vessel deflagration and detonation using the Facility Flow, Aerosol, Thermal and Explosion Model (FATE™) software

[15]. The FATE™ calculation simulates the effects of a postulated hydrogen deflagration and detonation and calculates the downstream conditions at the HOP HEPA filters. The FATE™ calculation found that these events result in a maximum differential pressure across the HEPA filters of 45.3 inches water column and a gas inlet temperature of 633 degrees Fahrenheit (°F). According to the FATE™ calculation, the HEPA filter differential pressure and temperature limits are 50 inches water column and 700 °F. This means the calculation results were within 10-percent of the failure criteria. Project personnel stated that they believe the FATE™ calculation is conservative.

The staff concludes that, given its importance to safety, its complexity, and the fact that the result is near the HEPA design limit, the FATE™ calculation warrants an independent review by an outside entity (e.g., a national laboratory) supporting ORP directly. This approach would ensure the independence of the federal review and approval as ORP evaluates the hydrogen control strategy.

Observation 4: Temperature Effects Are Not Fully Considered in the Volcanic Ashfall Safety Strategy—As discussed, the control strategy for a volcanic ashfall event includes a passive safe shutdown of the facility that secures electrical power to all systems. With ventilation and other cooling systems shut down, the facility's temperature will increase. This temperature increase was not considered in the safety analyses of hydrogen hazards during the ashfall event.

Project documents show that facility air temperatures could reach beyond 267 °F during the passive safe shutdown. There are three impacts to safety analyses for hydrogen hazards from an increased facility temperature:

1. Hydrogen generation rate increases with rising waste temperature. The hydrogen generation rate calculation is based on waste temperature in the HFP vessels. The waste temperature calculation assumes a maximum 113 °F ambient air temperature within the C5 confinement boundary that contains the HFP vessels [16]. A higher ambient air temperature will increase the waste temperature, which in turn, will increase the hydrogen generation rate.

2. Increased facility temperature impacts flow dynamics in the HFP vessel and connected piping post-explosion. The FATE™ calculation used to determine HOP HEPA filter survivability following an HFP vessel explosion assumes a maximum temperature within the C5 confinement boundary equal to 113 °F.

3. Hydrogen's LFL decreases with rising temperature. Figure 2 illustrates this effect.

DOE Standard 3009-94 states: "The range of accident scenarios analyzed in a DSA [documented safety analysis] should be such that a complete set of bounding conditions to define the envelope of accident conditions to which the operation could be subjected are evaluated and documented." Project personnel plan to update the safety analyses for a volcanic ashfall event to consider the increased facility temperatures during the passive safe shutdown. They expect revised analyses to show that the facility temperatures will be lower than originally calculated.

Project personnel are also evaluating how safety systems will be impacted by the increased air temperatures.

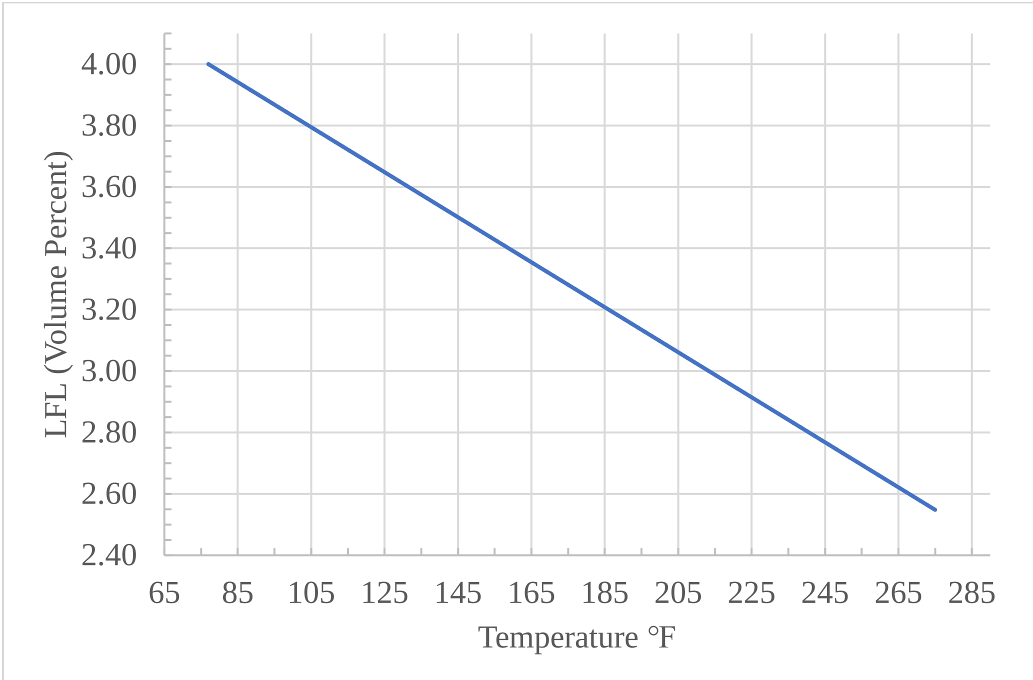

Figure 2. *A plot of the LFL of hydrogen as a function of temperature (derived from [17]).*

Observation 5: HFP Vessel Baffles Should Be Analyzed as Design Features—The HFP vessel agitators are credited as safety significant for "mixing the vessel contents to release trapped hydrogen and limit hydrogen accumulation to below the quantity that, when released, could cause the headspace to exceed LFL." Project documents state that the HFP vessels "are equipped with four baffles placed around the vessel internal perimeter. These baffles are supported in four points along their height off the vessel wall and have a gap between the vessel wall and the baffle. This arrangement enhances the mixing of the agitator and minimizes the vortex effect of the operation of the agitator. The dimensions and placement of these baffles, as well as the rest of the internal geometry in the vessels, are WAI [waste acceptance impacting] because the baffles and vessel internals influence the effectiveness of the mixing required to obtain representative samples [18]."

DOE Standard 3009-94 states that passive design features "if altered or modified, would have a significant effect on safe operation." DOE Guide 423.1-1B, *Implementation Guide For Use In Developing Technical Safety Requirements*, states: "DFs [design features] are normally passive attributes of the facility not subject to significant alteration by operations personnel." It also states: "The DF section captures those permanently built-in features critical to safety that do not require, or infrequently require, maintenance or surveillance [19]."

If the baffles are design features, DOE Guide 423.1-1B has guidance for inspections. DOE Guide 423.1-1B states: "Methods necessary to ensure DF are available as credited should be identified. Some DFs have the potential to be degraded by the effects of aging. Surveillance requirements for DFs are typically located in programs such as configuration management or in-service inspections (ISIs). It is appropriate to consider inclusion or reference to applicable ISIs for DFs in section 6 of the TSR."

The baffles were present in the test vessel used to validate the agitator's mixing effectiveness. The HFP vessels are also replaceable. Therefore, the staff concludes that the baffles should be evaluated as a TSR design feature. Project personnel stated they have not evaluated the baffles as design features but stated they plan to do so and that hazard analysis discussions would be required to evaluate their importance.

Observation 6: PFHA and PDSA Are Misaligned—The current PFHA is not aligned with Revision 9 of the PDSA [20]. The planned and operational safety improvements listed in the PDSA (Section 3.3.2.3.1) acknowledge the misalignment. Protection related to fire barriers and C5V, as well as documentation of conformance to DOE Standard 1066-97, *Fire Protection*, have not been completely addressed [21]. DOE Order 420.1B, states that: "FHA conclusions [must be] incorporated into the DSA and integrated into design basis and beyond design basis accident conditions." This provision also applies to documents during design to ensure that fire hazards are appropriately identified, evaluated, and controlled in the safety basis.

Project personnel stated that a draft PFHA (Revision 6) will be sent to ORP in November 2022, which will align with Revision 9 of the PDSA. Fire barriers will be addressed in PDSA Revision 10, and C5V protection will be addressed in Revision 11 of the PDSA. Revision 7 of the PFHA (to be issued in late 2022) will align with PDSA Revision 11, at which time the fire protection issues noted above should be resolved.

Observation 7: Chemical Safety Management Program (CSMP) Yet to Be Developed—The planned and operational safety improvements listed the PDSA (Section 3.3.2.3.1) acknowledges that a CSMP is needed and states that it should be developed consistent with the LAW Facility CSMP (Chapter 19 of the LAW Facility DSA) [22]. Project personnel are currently developing the HLW Facility CSMP per chemical safety standards (namely 10 CFR 851, *Worker Safety and Health Program* and 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*) and have preliminarily determined that sodium hydroxide, nitric acid, and cerium nitrate should be managed under a CSMP [23-24]. The staff notes that project personnel do not plan to export the ammonia control sets out from the HLW Facility PDSA to a CSMP due to significant consequences to the credited off-gas system, facility workers, and screening requirements per DOE Standard 3009-94.

Conclusion. The staff reviewed Revision 9 of the PDSA for the HLW Facility. The staff made seven safety observations regarding the hydrogen control strategy for HFP vessels, fire protection, and chemical safety management programs. The staff found that project personnel made progress in resolving some long-standing technical safety issues. However, the safety observations should be addressed as the facility design matures to ensure the HLW Facility meets DOE's safety requirements.

References

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[20] Bechtel National Incorporated, *Preliminary Fire Hazards Analysis for the High-Level Waste Building*, 24590-HLW-RPT-ESH-01-001, Rev 5, January 2014.

[21] Department of Energy, *Fire Protection Design Criteria*, DOE Standard 1066-97, March 1997.

[22] Bechtel National Incorporated, *Documented Safety Analysis for the Low-Activity Waste and Effluent Management Facilities*, 24590-DSA-NS-18-0001, Rev 4, July 2021.

[23] Title 10 Code of Federal Regulations, Part 851, *Worker Safety and Health Program*.

[24] Title 29 Code of Federal Regulations, Part 1910, Subpart H, *Hazardous Materials*, Section 1910.119, *Process Safety Management of Highly Hazardous Chemicals*.