

Progress Updates for the Hanford Waste Treatment and Immobilization Plant Project – 17275

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ABSTRACT

The Waste Treatment and Immobilization Plant (WTP) Project is vital to the U.S. Department of Energy's (DOE) mission to cleanup radioactive waste at the Hanford Site, located in southeastern Washington State. The overall WTP Project objective is to design, build, and commission the facilities and systems that will treat and immobilize approximately 211 983 m³ (56 million gallons) of radioactive waste stored in Hanford's 177 underground storage tanks. The combination of technologies in the WTP makes it a first-of-a-kind facility at a scale larger than ever built for radioactive waste processing. In 2012, DOE suspended production work on the WTP's Pretreatment (PT) Facility and to a lesser degree the High-Level Waste (HLW) Facility because of unresolved technical issues associated with those facilities. DOE is proceeding with its approach to complete the WTP Project in phases, which includes the following principal actions:

- Completing construction of the Low-Activity Waste (LAW) Facility, Balance of Facilities (BOF), and Analytical Laboratory (LAB), collectively known as LBL
- Implementing a direct-feed low-activity waste (DFLAW) process to treat low-activity waste independent of the PT Facility
- Completing the design and construction of the HLW Facility
- Resolving the technical issues associated with the PT Facility
- Completing all WTP facilities to enable integrated WTP operations.

In March 2016, a federal judge amended the 2010 Consent Decree¹, establishing revised milestone dates for the Hanford WTP that generally align with DOE's plans for completing the WTP facilities in sequence. In December 2016, DOE executed a contract modification and approved a change to the project's performance baseline to complete the LBL facilities and incorporate modifications needed to accommodate direct feed of low-activity waste to the LAW Facility. The contract modification and revised performance baseline support completion of hot commissioning of the WTP facilities needed for DFLAW operations no later than December 31, 2023.

INTRODUCTION

The WTP Project is the cornerstone to the DOE's mission to cleanup approximately 211 983 m³ (56 million gallons) of radioactive and chemical waste stored in 177 underground storage tanks at the Hanford Site in southeastern Washington State. The project's objective is to design, build, commission, and operate facilities

¹ State of Washington v. United States Department of Energy, case 2:08-cv-05085-FVS, October 25, 2010.

and systems that will treat and immobilize the Hanford tank waste. The WTP includes several facilities that will contribute to waste processing:

- PT Facility: Designed to receive waste retrieved from the Hanford tank farms and separate it into low-activity and high-level waste streams
- LAW Facility: Will vitrify the low-activity waste stream
- HLW Facility: Will vitrify the high-level waste stream
- LAB: Will support operations of both vitrification facilities
- BOF: Will provide industrial support capabilities and infrastructure, like electricity and steam, needed for WTP operations.

Pretreatment Facility

When all WTP facilities are completed and WTP is operating as an integrated plant, the PT Facility will serve as the starting point in the process of vitrifying Hanford's tank waste. The PT Facility is the largest of the four major nuclear facilities that compose the WTP. It is 180 m (540 feet) long, 72 m (215 feet) wide, and 40 m (120 feet) tall. When complete, its total area will be more than 45 500 m² (490,000 ft²).

Waste will be pumped from the Hanford tanks via underground pipes to the PT Facility's interior waste feed receipt vessels. There, during the first phase of pretreatment, the waste will be concentrated using an evaporation process. Solids will be filtered out, and the remaining soluble, highly radioactive isotopes will be removed using an ion-exchange process. The high-level solids will be sent to the HLW Facility, and the low-activity liquids will be sent to the LAW Facility for further processing.

High-Level Waste Facility

In the HLW Facility (Figure 1), high-level waste will be mixed with glass-forming materials in two 82 t (90 ton) melters and heated to 1 422 °K (2,100 °F). The mixture will then be poured into stainless steel canisters, which are approximately 0.6 m (2 feet) in diameter, 4.4 m (14.5 feet) tall, and weigh more than 3.6 t (4 tons) when loaded with glass. When fully operational, the HLW Facility will produce an average of 480 immobilized high-level waste canisters per year.



Fig. 1. Waste Treatment and Immobilization Plant High-Level Waste Facility.

Low-Activity Waste Facility

In the LAW Facility (Figure 2), concentrated low-activity waste will be mixed with silica and other glass-forming materials. The mixture will be fed into the LAW Facility's two melters and heated to 1 422 °K (2,100 °F). The 272 t (300 ton) melters are approximately 6 m (20 feet) by 9 m (30 feet), and 5 m (16 feet) high. The glass mixture will then be poured into stainless steel containers that are 1.2 m (4 feet) in diameter, 2 m (7 feet) tall, and weigh more than 6.4 t (7 tons). The low-activity waste containers will be disposed at a permitted facility on the Hanford Site.



Fig. 2. Waste Treatment and Immobilization Plant Low-Activity Waste Facility.

Analytical Laboratory

The LAB will serve as a process link between the PT, HLW, and LAW facilities. The LAB is approximately 98 m (320 feet) long, 55 m (180 feet) wide, and 14 m (45 feet) high. The LAB's key function is to ensure that all glass produced by the LAW and HLW facilities meets regulatory requirements and standards. Each year, when the WTP is operational, the LAB will analyze approximately 10,000 waste samples. Samples will be used initially to confirm the correct glass-former recipe that will produce a consistent glass form. Once the recipe is identified, the glass-forming materials and the waste will be transferred to the LAW or HLW Facility, as appropriate, for further processing. Samples will also be taken throughout the vitrification process to ensure a high-quality glass product and good process controls.

Balance of Facilities

The BOF contains the overall support services infrastructure essential for WTP operations. The BOF includes multiple support buildings and approximately 100 systems across the WTP site, and provides interconnecting utilities and support

to the PT, HLW, LAW, and LAB facilities. The BOF infrastructure consists of the following groupings of facilities and types of support buildings:

- Switchgear buildings and emergency generator facilities
- Steam plant and a fuel oil facility
- Cooling towers, water treatment facility, chiller/compressor facility, and a firewater facility
- Glass former storage facility, wet chemical storage facility, and the anhydrous ammonia storage facility
- Spent melter staging pad and the nondangerous, nonradioactive effluent facility
- Administration building, simulator facility, warehouse, and site infrastructure (e.g., roads, grading, lights, sanitary waste, storm drains).

DISCUSSION

Technical Risks and Challenges

Hanford tanks contain 211 983 m³ (56 million gallons) of radioactive and chemical waste in the form of sludge, salts, and liquids, necessitating a variety of unique waste retrieval and treatment methods. As the design and construction of the WTP has progressed, a number of complex technical issues have emerged. The most significant WTP technical issues are centered on the ability of the PT Facility to mix and transfer high-level waste slurries with high solids concentrations, and the adequacy of the piping and vessel designs in inaccessible black cells to support the WTP's 40-year operational life.

Because of the impact of unresolved technical issues on the facility design, the DOE restricted certain engineering, procurement, and construction work on the HLW and PT facilities in 2012 and early 2013. All construction work on the PT Facility was suspended and remains suspended to date. For the HLW Facility, only limited equipment procurements and civil construction work was continued in areas not directly impacted by the technical issues.

Sequenced Approach to Completing the WTP

In mid-2013, DOE first introduced a new approach to start the Hanford tank waste treatment mission in phases, beginning with the less-complex low-activity waste stream. This sequenced approach to completing WTP facilities enables DOE to begin treatment of the most mobile tank waste at Hanford without awaiting resolution of the outstanding technical issues at the PT and HLW facilities.

The WTP Project has begun the activities necessary to implement the sequenced approach to initiating WTP operations with the following priorities:

- Completing construction of LBL

- Implementing a DFLAW process to treat low-activity waste independent of the PT Facility
- Completing the design and construction of the HLW Facility
- Resolving the technical issues associated with the PT Facility
- Completing the WTP facilities to enable integrated WTP operations.

Current Status and Path Forward

In March 2016, a federal judge amended the 2010 Consent Decree, establishing revised milestone dates for the Hanford WTP that generally align with DOE's plans for completing the WTP facilities in sequence. The Amended Consent Decree² includes milestones for:

- LAW Facility Hot Commissioning Complete: December 31, 2023
- HLW Hot Commissioning Complete: December 31, 2033
- PT Facility Hot Commissioning Complete: December 31, 2033
- Achieve Initial Plant Operations for the WTP: December 31, 2036.

In December 2016, DOE executed a contract modification and approved a change to the project's performance baseline to complete the LBL facilities and incorporate modifications needed to accommodate direct feed of low-activity waste to the LAW Facility. The contract modification and revised performance baseline support completion of hot commissioning of WTP facilities needed for DFLAW operations so those operations can commence by December 31, 2023.

In August 2014, DOE authorized the WTP contractor to resume all engineering work necessary to finalize the design of the HLW Facility. Work continues to fully resolve technical and design issues for the HLW Facility while concurrently updating the HLW safety basis. Full production work for the HLW Facility will resume at a future date when all design changes and safety basis updates support a revision to the HLW Facility performance baseline.

DOE has made substantial progress in resolving the long-standing technical issues associated with the PT Facility over the past year. Issues associated with hydrogen in vessels, inadvertent criticality, and hydrogen in piping and ancillary vessels were resolved at the end of 2016. The final phase of full-scale vessel testing to demonstrate adequate mixing of high-solids slurries and control of pulse-jet mixing systems is scheduled to be completed by the end of 2017.

CONCLUSION

DOE is moving forward with its plans for a sequenced start of the Hanford tank waste treatment mission in alignment with Amended Consent Decree milestones. The WTP Project has focused its priorities on first establishing the capability within WTP to treat low-activity waste feed directly from the Hanford tank farms, while

² State of Washington v. United States Department of Energy, case 2:08-cv-05085-RMP, March 11, 2016.

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concurrently resuming design engineering for the HLW Facility and progressing the resolution of the remaining technical issues for the PT Facility. Updates to the WTP Project performance baseline will be accomplished incrementally, starting with the LAW Facility and DFLAW modifications to WTP in late 2016.