

Implementing a Low-Activity Waste Direct Feed Capability in the Waste Treatment and Immobilization Plant Project – 15594

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ABSTRACT

The current design of the Waste Treatment and Immobilization Plant (WTP) requires that all waste be processed through the Pretreatment (PT) Facility. The U.S. Department of Energy (DOE) has developed a strategic, phased approach to completing the WTP Project, beginning with feeding some liquid waste from the tank farms to the Low-Activity Waste (LAW) Facility, bypassing the PT Facility. To accomplish this, the DOE Office of River Protection (ORP) will construct a new capability outside WTP to remove cesium and solids from the liquid portion of the tank waste before transferring that waste to the LAW Facility. This new capability, referred to as the Low-Activity Waste Pretreatment System, is outside WTP and not included in the project's scope.

The primary driver for the Direct-Feed LAW (DFLAW) approach is to enable commissioning of the LAW Facility for low-activity waste processing before the PT and High-Level Waste Facilities are complete and operational. As such, the functions intended to be provided to the LAW Facility by the PT Facility and the common functionality with the High-Level Waste Facility must be refined and modified. The DFLAW approach will provide necessary systems and facilities to replace these enabling PT Facility functions until the PT Facility is completed and commissioned.

In February 2014, ORP requested the WTP contractor to develop separate contract modification proposals for completing: (1) the LAW Facility, Balance of Facilities, and Analytical Laboratory work scope in the current contract through hot commissioning in a manner to accommodate a phased start of the WTP mission; and (2) initial planning and design for incorporating a permanent capability to accommodate DFLAW in the WTP.

INTRODUCTION

The Waste Treatment and Immobilization Plant (WTP) is designed to process tank farm waste during a roughly 40-year period. The current design requires waste to be processed through the Pretreatment (PT) Facility, where it will be separated into a low-activity waste stream to be vitrified in the Low-Activity Waste (LAW) Facility, and a high-level waste stream to be vitrified in the High-Level Waste (HLW) Facility. The Analytical Laboratory (Lab) and Balance of Facilities (BOF) support these vitrification activities.

DOE has established a strategy to begin treating waste in the Hanford tank farms with the LAW Facility by providing pretreated feed independent of the WTP PT Facility [1]. This operation is referred to as direct-feed LAW (DFLAW). Under this plan, low-activity waste will be pretreated in a Low-Activity Waste Pretreatment System for cesium and solids separation to meet LAW Facility safety basis requirements and produce an acceptable low-activity waste product. The waste feed will then be transferred to the LAW Facility where it will be immobilized in glass, poured into stainless steel containers, and then transported by truck to the Integrated Disposal Facility, a mixed waste burial ground located in the Hanford 200-East Area.

Liquid effluents from the LAW Facility, primarily melter offgas condensate, would be processed in a new Effluent Management Facility and sent to the Hanford Liquid Effluent Retention Facility/Effluent Treatment Facility, recycled back into the incoming LAW waste feed, and/or returned to the tank farms. The operation would begin to deliver about 3 785 m³ (1 million gallons) of double-shell tank (DST) waste for treatment each year of operation, and nominally produce 21 metric tons of glass per day. The resultant freed space in the DSTs will support safe tank farm operation and staging of additional waste for treatment. This direct-feed approach is beneficial because it will enable tank waste vitrification to begin well before the PT Facility is ready for operations. The integrated DFLAW capability is illustrated in Fig. 1.

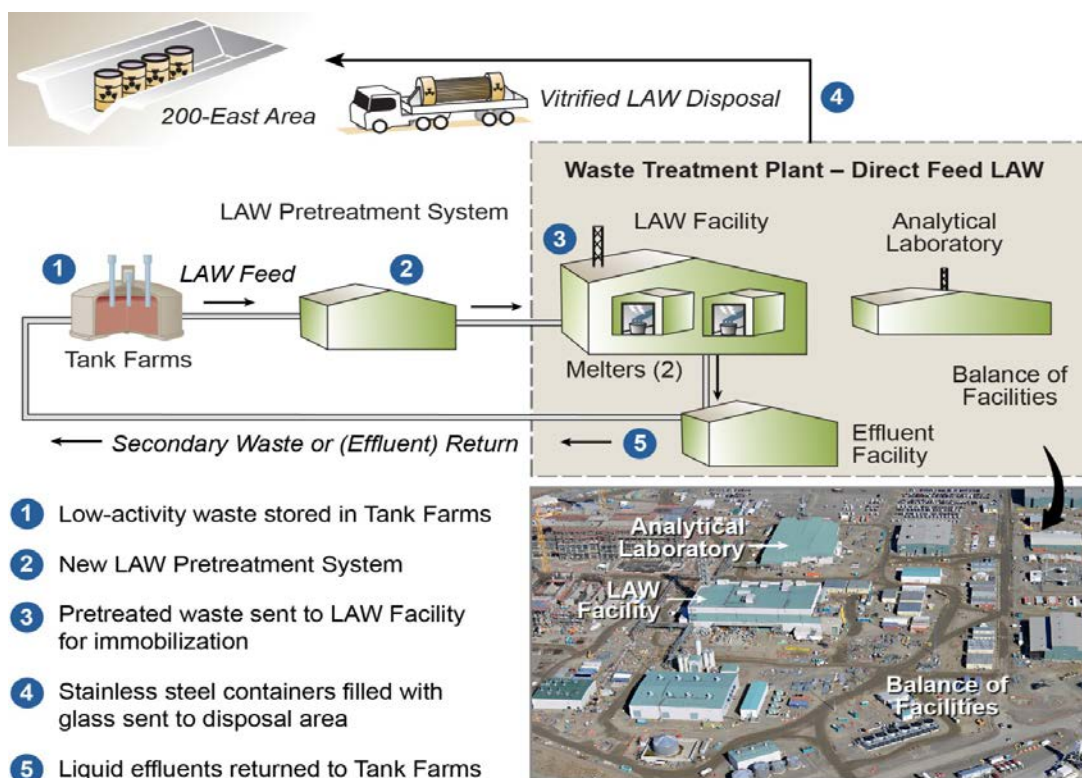


Fig. 1. Integrated Direct-Feed Low-Activity Waste Concept.

Initiating operations in the LAW Facility before the PT and HLW Facilities will reduce significant programmatic risks and will provide attendant benefits. First, treatment of the DST supernatant significantly draws down DST waste inventory. The additional DST space allows for more efficient tank waste transfer and tank farm evaporator operations, and allows further single-shell tank retrieval actions. Second, startup of the LAW Facility before PT and HLW Facilities reduces the commissioning and startup risk of WTP's production facilities by phasing commissioning of the LAW Facility, BOF, and Lab, relative to the PT and HLW Facilities. This approach also has the benefit of demonstrating hot operations of the WTP filtration and ion-exchange technology in the Low-Activity Waste Pretreatment System, shortening the mission life cycle by starting the mission and subsequently supplementing the PT Facility, and having a backup for the PT Facility during planned or potential unplanned outages. An additional benefit is that early validation of the low-activity waste glass performance models is accomplished in an actual production environment with DFLAW.

The overall DFLAW concept is to transfer pretreated waste from the tank farms through existing and modified waste transfer piping directly to the LAW Facility. The design would be capable of providing LAW operations feed to produce nominally 21 metric tons of glass per day, using two melters, with the necessary support from BOF and Lab. A new effluent treatment capability would store, treat, and route the LAW liquid secondary waste streams. Additional WTP modifications would include various modifications in the BOF facilities to operate a subset of the overall WTP plant; final grade and road modification; additional support facilities, as required; and fencing to segregate the operating LAW Facility, BOF, and Lab from the PT and HLW Facilities while HLW and PT Facilities are still under construction.

Balance of Facilities Utility Modifications

The current BOF facilities are designed for full WTP operation; therefore, modification of these facilities is required to support partial WTP operations in a DFLAW configuration. Thirteen BOF facilities are required to support DFLAW operation, eight of which will require some level of modification. Modifications include such things as updating control system software, providing for mechanical and electrical isolation, installing new instrumentation, providing piping modifications for extended layup, making piping modifications for secondary headers with additional pumps, and adding new ancillary equipment (e.g., air compressors). These are permanent plant modifications that allow operation of DFLAW in the event the PT Facility is not available at any time during the operational life of the plant.

Balance of Facilities Effluent Facility

Under full WTP operation, effluent from the LAW Facility would be returned to the PT Facility for further processing and/or return to the Hanford Liquid Effluent Retention Facility/Effluent Treatment Facility. In addition, all secondary waste and effluent lines from WTP facilities and the feed lines from the tank farms would slope to the PT Facility. The PT Facility also would handle all flush water from the tank farms feed lines to WTP.

The new BOF effluent facility would receive and process secondary waste streams from the LAW Facility submerged bed scrubber, wet electrostatic precipitator, plant wash systems, and caustic scrubber. The early conceptual design for the facility includes an evaporator and other components to process, sample, and condition various effluent streams from the LAW Facility, route the conditioned waste streams to the Liquid Effluent Retention Facility/Effluent Treatment Facility, recycle waste back into the incoming LAW waste feed, and/or return effluent back to the tank farms.

Balance of Facilities Underground and Site-Wide Modifications

As previously noted, the BOF infrastructure currently is designed to support full WTP operation. Therefore, modifications to support DFLAW operation will be required. Modifications of the BOF yard include:

- Site security
- A fence around the LAW Facility, BOF, and Lab “operating island”
- Modified roadways
- Final grade and storm water drainage
- Sanitary sewer system
- Utility isolation
- Beneficial use contractor interface

- Underground utilities
- Effluent and waste transfer lines
- LAW Facility waste and effluent valve pit
- A sodium hydroxide offloading pad.

These are permanent plant modifications that would allow operation of DFLAW in the event that the PT Facility is not available at any time during the operational life of the plant. The major DFLAW waste feed and effluent return lines are shown in Fig. 3.

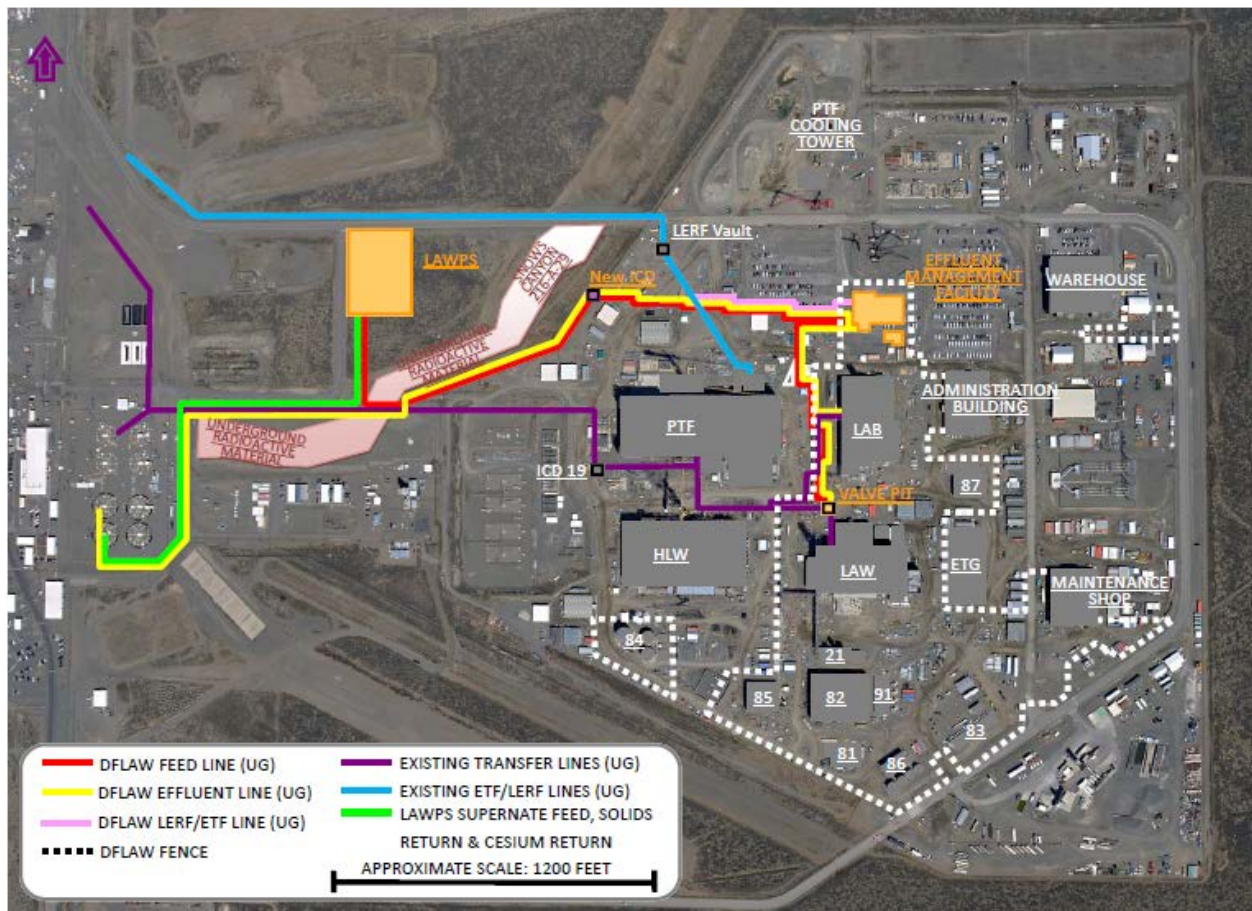


Fig. 3. Proposed Direct-Feed Low-Activity Waste Feed and Effluent line Routing.

Support Facilities

New or modified facilities are required to conduct DFLAW operations while construction of the PT and HLW Facilities continues. These facilities include an administration building to house operating and operations support personnel, including an incident command post, a warehouse for spare parts for the operating facilities, and an equipment maintenance shop.

Current Status

The WTP contractor started conceptual design activities for the DFLAW capability in WTP in early 2014. At the request of DOE, the contractor submitted a contract proposal to complete initial planning and design for the DFLAW capability in the WTP in June 2014, and a subsequent amendment to the proposal in September 2014. DOE authorized the WTP contractor to commence some of the early detailed design

activities for the BOF utility modifications and the BOF effluent facility. Evaluation and negotiations for the full contract proposal are proceeding as of the date of this paper.

CONCLUSIONS

In alignment with the DOE's strategy to start the Hanford tank waste treatment mission in phases, ORP and the WTP contractor have initiated the planning and design activities necessary to incorporate a capability to accept and process low-activity waste feed directly from the Hanford tank farms, bypassing the WTP's PT Facility. The DFLAW approach to starting the Hanford tank waste treatment mission accelerates treatment of low-activity waste and reduces future risk on a number of levels, both at WTP and in the tank farms. The benefits of initiating operations with DFLAW include demonstrating hot operations of the WTP filtration and ion-exchange technology in a Low-Activity Waste Pretreatment System, shortening the Hanford tank waste treatment life cycle by starting the mission before completing the PT Facility, and having a backup to the PT Facility during future planned or potential unplanned outages of the PT Facility.

REFERENCES

1. DOE, 2013, Hanford Tank Waste Retrieval, Treatment, and Disposition Framework, U.S. Department of Energy, Washington, D.C. Available online at <http://energy.gov/sites/prod/files/2013/09/f3/DOE%20Hanford%20Framework%20FINAL.pdf>.

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