.

# WTP Modifications to Support DFLAW: LAW, BOF, Lab - 16219

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## ABSTRACT

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a one-of-a-kind nuclear waste treatment facility being designed and constructed for the U.S. Department of Energy by Bechtel National, Inc. and principal subcontractor URS to process and vitrify radioactive waste stored in underground tanks at the Hanford Site. The Tank Operations Contractor, Washington River Protection Solutions, has responsibility to retrieve, stage, pretreat, and deliver the tank waste feed to WTP. To treat tank waste as soon as practicable, a scenario is being considered to deliver pretreated feed straight to WTP's Low-Activity Waste (LAW) Vitrification Facility. This scenario is called the Direct Feed LAW (DFLAW) program.

Balance of Facility utility and system facilities are designed for full WTP operation. Thirteen of these are needed to support reduced throughput during DFLAW operation, of which eight require moderate to extensive changes. Extensive changes include permanent plant modifications that allow DFLAW to operate if the Pretreatment (PT) Facility is unavailable.

Under full WTP operation, effluents from the LAW Facility will be returned to the PT Facility for further processing and/or transfer to the Liquid Effluent Retention Facility/Effluent Treatment Facility. The PT Facility also handles all flush water from the tank farm transfers.

To address these requirements, a Value Improvement Project was performed. The recommended approach is to provide a "split stream" Effluent Management Facility (EMF) with an evaporator to support DFLAW. The required modifications for DFLAW facilities are discussed in this paper.

# WTP Modifications to Support Direct Feed LAW

## INTRODUCTION

The 586-square-mile Hanford Site is located along the Columbia River in southeastern Washington State and is home to the world's first plutonium production complex. Beginning with the Manhattan Project and throughout the Cold War, Hanford played a pivotal role in providing nuclear materials for the nation's defense program. However, more than 40 years of plutonium production also yielded a challenging nuclear waste legacy—approximately 56 million gallons of radioactive and chemically hazardous wastes stored in 177 underground tanks located on Hanford's Central Plateau.

The mission of the U.S. Department of Energy (DOE) Office of River Protection (ORP) is to remove waste from the past production of nuclear materials stored in the underground tank farms at the Hanford Site, treat the waste to standards that are protective of human health and the environment, and close the tanks and treatment facilities.

Over the last several years, a number of risks and technical challenges have emerged in the tank farms, in the design of the Waste Treatment and Immobilization Plant (WTP), and in the interfaces between the tank farms and the WTP. While these challenges are being addressed, DOE has engaged the contractors in looking at different ways to expedite the treatment of the liquid phase from the double-shell tanks (DST) at the LAW Facility at WTP. DOE has placed a high priority for utilization of its WTP resources on construction of LAW, Balance of Facilities (BOF), and Analytical Laboratory (Lab), collectively referred to as the LBL to support this goal. The key WTP facilities and current construction status are depicted in Figure 1.

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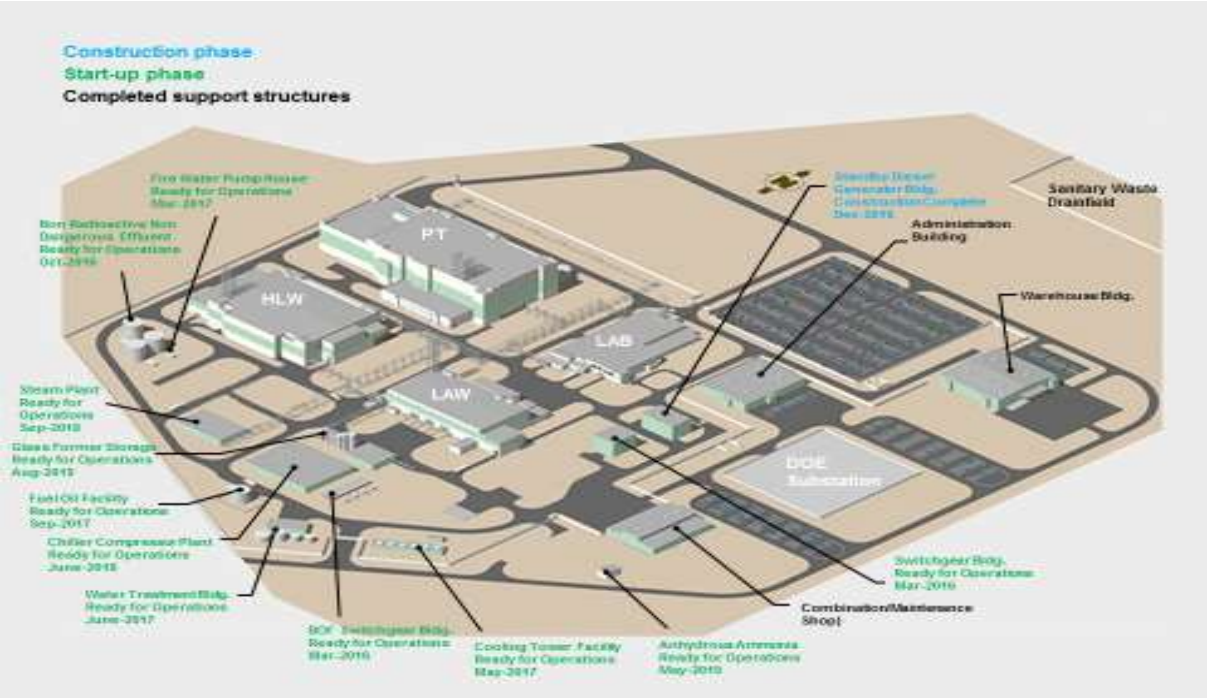


Figure 1: Key WTP Facilities

## DISCUSSION

To operate the LAW phase of WTP prior to completion of the Pretreatment Facility, modifications are required to WTP and Hanford tank farm facilities. The initial LAW phase involves a direct feed approach to processing low activity waste.

This initial phase has been labeled Direct Feed LAW or DFLAW. Key performance requirements established by ORP-WTP include the following:

- The Direct Feed LAW option shall demonstrate a throughput of 30 MTG per day
- The Direct Feed LAW shall be designed to operate until the PT Facility is commissioned, and is to be designed as a permanent capability.
- The WTP modifications to implement Direct Feed LAW shall provide the capability to operate LBL in an integrated configuration, with feed from either the PT Facility or from the Tank farm, but not simultaneously.
- The BOF and other facilities necessary to operate Direct Feed LAW during construction of the HLW and PT facilities must be included in the scope and corresponding estimates.

This phased approach has beneficial impacts on completion, which will be ready with trained personnel to function in a DFLAW configuration to make glass much earlier. Key benefits associated with this strategy include:

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- Shortens the mission life cycle and produces glass sooner by processing waste in the LAW Facility during the time that technical decisions on the PT and HLW facilities are being resolved
- Demonstrates hot operations of the filtration and ion exchange technology in the Low-Activity Waste Pretreatment System (LAWPS) to treat supernatant stored in the tank farm.
- Draws down waste inventory in double-shell tanks (DST) during this time, making space available earlier to transfer waste from the older single-shell tanks (SST)
- Reduces commissioning and startup risk to WTP's production facilities by (1) starting up the LAW Facility first in a phased approach, (2) training personnel, and (3) validating processes and procedures in the LAW facility before applying them to the PT and HLW facilities
- Provides early confirmation of the low-activity waste glass performance models in an actual production environment
- Creates a valuable alternate pathway for liquid waste treatment that will be available during planned PT Facility maintenance or outages, ensuring continuity of operations

The key benefits demonstrate a significant opportunity for DOE and stakeholders to move forward with a responsible alternative to the baseline approach to concurrent commissioning of LAW, PT and HLW. Figure 2 provides a basic depiction of the DFLAW concept.

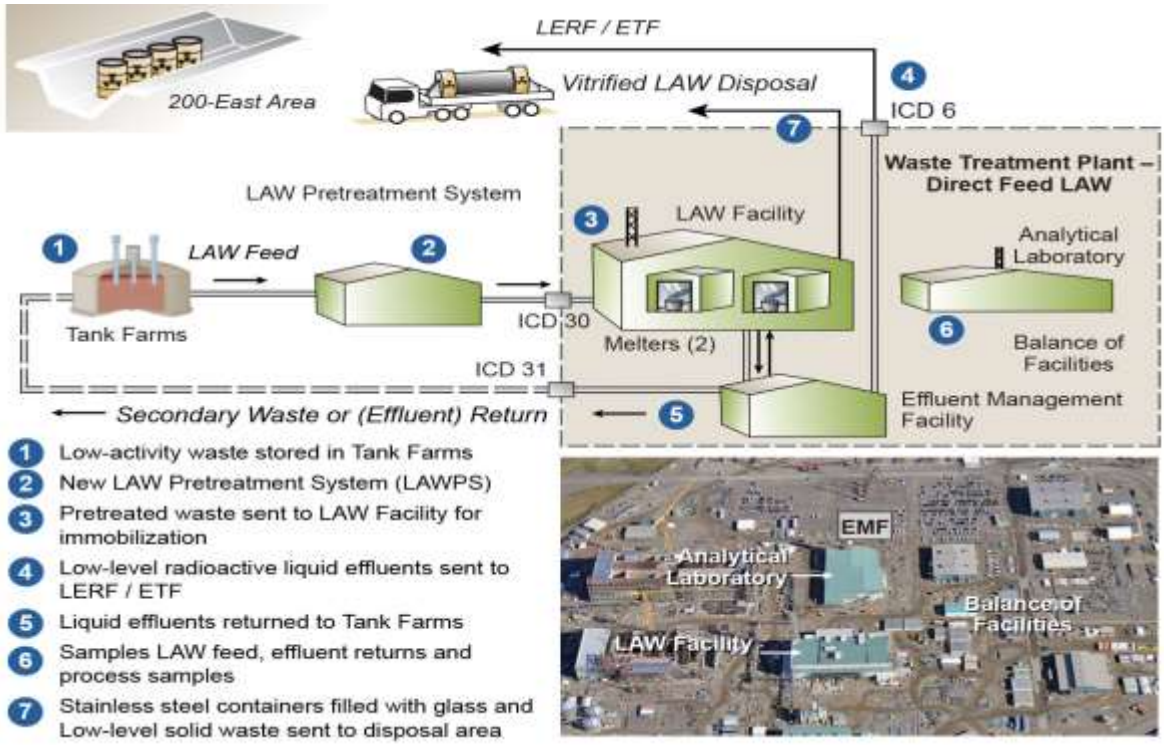


Figure 2: Direct Feed LAW Strategy

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## Low-Activity Waste Pretreatment System

To meet project requirements and produce an acceptable low-activity waste product, cesium and solids must be removed from the liquid portion of the waste prior to its transfer by a direct feed line from the tank farms to the LAW Facility. A LAW Pretreatment System (LAWPS) will be constructed between tank farms and WTP for this purpose. This pretreatment facility, outside the scope of the WTP project, will pretreat waste that is then sent to the LAW Facility where it is vitrified, 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.

## Low Activity Waste Facility

The LAW Facility was designed to receive waste from the PT Facility. To support DFLAW, modifications are required to receive the treated feed from the LAWPS facility and still maintain the capability for receiving feed from the PT Facility. One of the challenges addressed by the DFLAW team was to provide modifications for DFLAW that would minimally impact the LAW Facility that has already been substantially constructed.

An example of this approach was the new transfer lines from the LAWPS to the LAW Facility. The new waste transfer lines are designed to enter the LAW Facility adjacent to the existing transfer lines, to and from the PT Facility. The new lines will be connected to the existing piping within the LAW Facility with minimal disruption and impact to the existing piping. Valves will be included near the connection points to allow transfer of waste to and from the facility in either configuration.

A view of the full DFLAW approach is provided in Figure 3.

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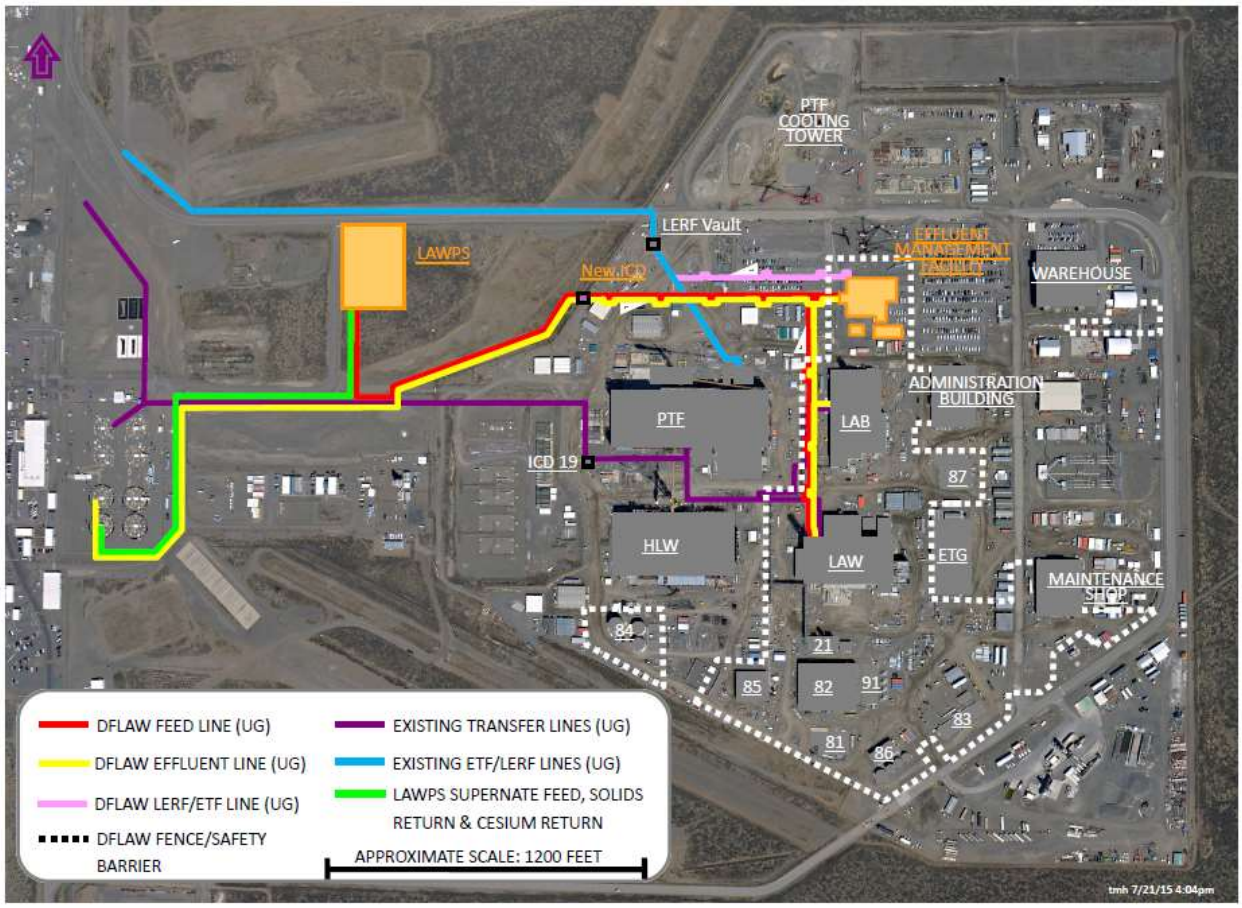


Figure 3: Plan View of DFLAW Modifications

As glass is produced in the LAW Facility, liquid effluents are generated by off-gas treatment stages. These liquid effluents from the LAW Facility will be captured and sent to an Effluent Management Facility (EMF) where they will be conditioned and processed. To insure that the LAW Facility effluent could be effectively managed, a Value Engineering (VE) Study was performed to define the EMF and optimize the disposition of the liquid effluents. The study team included management and technical personnel from all organizations involved in the treatment and disposition of the effluents including WTP, ORP and WRPS, the Tank Farm contractor. The team assessed twelve options and configurations and performed a thorough assessment, ranking and cost comparison of the alternatives. The team looked at operability, maintainability, and reliability of the configurations and determined that a "split stream" approach to effluent management utilizing an evaporator to concentrate the effluent which could not be directly processed at the existing Hanford Liquid Effluent Retention Facility/Effluent Treatment Facility (LERF/ETF). This would minimize the waste volumes which would need to be either returned to the tank farms or recycled into the LAW Facility, thus maximizing the net reduction in low activity waste. A third disposal option for the concentrate, disposal at a

licensed off-site low activity waste disposal facility, was also selected to allow flexibility in waste disposal. The VE team determined that flexibility in the disposal was essential to minimize the probability that the LAW Facility would need to be idled due to effluent disposition challenges.

A conceptual layout of the EMF is depicted in Figure 4.

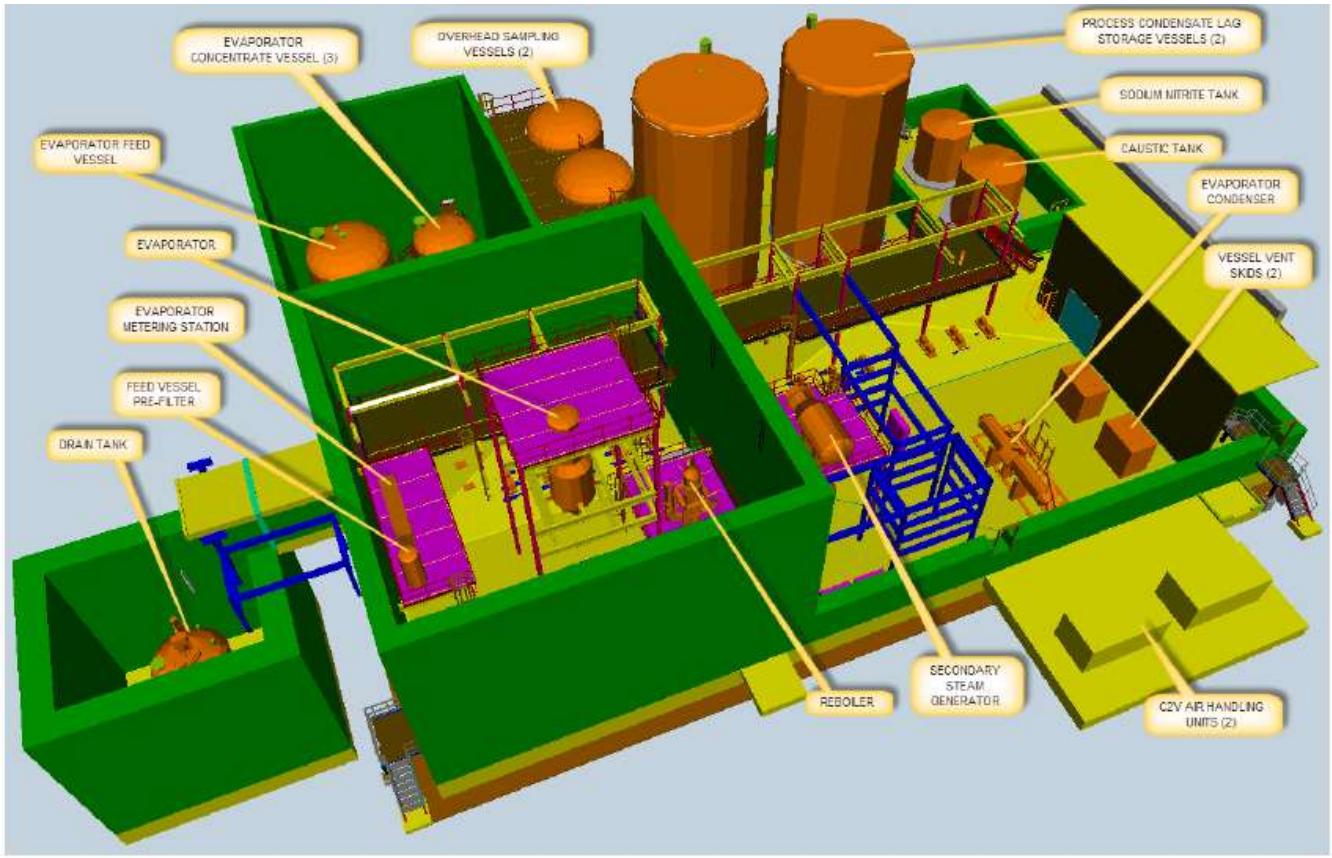


Figure 4: DFLAW Effluent Management Facility

The EMF being designed by BNI provides the capability of treating and dispositioning liquid discharges generated by the LAW Facility submerged bed scrubber, wet electro-static precipitators, plant wash, laboratory drains and caustic scrubber. The EMF will use an evaporator to concentrate the effluent. This treatment will allow disposition of the majority of the effluent at an existing low activity treatment facility on the Hanford Site. The concentrate from the evaporator process will be blended in with the LAW feed and incorporated into glass. The EMF is designed with flexibility to also return the evaporator concentrate to the DSTs or to off load the concentrate into tankers for other treatment.

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## Balance of Facilities

As shown in Figure 1, there are many support facilities needed to operate WTP. These facilities were designed to support the full operation of the WTP and require modifications to support the DFLAW system, while still maintaining the capability to run at full operations. For effective LAW Facility operations, modifications to the BOF systems and services are required. This involves relocation of isolation points with the PT and HLW facilities and modifications to the BOF operating systems, since DFLAW operations does not require the full BOF utility requirements. Design changes have been identified for each of the BOF systems to function in the DFLAW turndown configuration. Examples included reduced requirements for steam, chilled water, and compressed air.

## Summary

Design is progressing at an accelerated pace for the DFLAW modifications. Conceptual design, value engineering studies and baseline requirements documents are in place, and the 30 percent design review for the modifications was held in October 2015. The design modifications provide the required flexibility to operate in the DFLAW mode and to operate for the full WTP configuration. Agreements are in place to establish key interface requirements between the organizations that are involved in DFLAW implementation. Regular coordination sessions are held by the One System organization to align schedules and facilitate key decisions and interfaces across organizations. The WTP DFLAW project is on track to achieve the project objectives as established by DOE-ORP.