# Waste Treatment Plant – 12508

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The Waste Treatment Plant (WTP) will immobilize millions of gallons of Hanford's tank waste into solid glass using a proven technology called vitrification. The vitrification process will turn the waste into a stable glass form that is safe for long-term storage. Our discussion of the WTP will include a description of the ongoing design and construction of this large, complex, first-of-a-kind project.

The concept for the operation of the WTP is to separate high-level and low-activity waste fractions, and immobilize those fractions in glass using vitrification. The WTP includes four major nuclear facilities and various support facilities.

Waste from the Tank Farms is first pumped to the Pretreatment Facility at the WTP through an underground pipe-in-pipe system. When construction is complete, the Pretreatment Facility will be 12 stories high, 540 feet long and 215 feet wide, making it the largest of the four major nuclear facilities that compose the WTP. The total size of this facility will be more than 490,000 square feet. More than 8.2 million craft hours are required to construct this facility. Currently, the Pretreatment Facility is 51 percent complete.

At the Pretreatment Facility the waste is pumped to the interior waste feed receipt vessels. Each of these four vessels is 55-feet tall and has a 375,000 gallon capacity, which makes them the largest vessels inside the Pretreatment Facility. These vessels contain a series of internal pulse-jet mixers to keep incoming waste properly mixed. The vessels are inside the black-cell areas, completely enclosed behind thick steel-laced, high strength concrete walls. The black cells are designed to be maintenance free with no moving parts. Once hot operations commence the black-cell area will be inaccessible.

Surrounded by black cells, is the "hot cell canyon." The hot cell contains all the moving and replaceable components to remove solids and extract liquids. In this area, there is ultrafiltration equipment, cesium-ion exchange columns, evaporator boilers and recirculation pumps, and various mechanical process pumps for transferring process fluids.

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 High-Level Waste (HLW) Vitrification Facility, and the low-

activity liquids will be sent to the Low-Activity Waste (LAW) Vitrification Facility for further processing.

The high-level waste will be transferred via underground pipes to the HLW Facility from the Pretreatment Facility. The waste first arrives at the wet cell, which rests inside a black-cell area. The pretreated waste is transferred through shielded pipes into a series of melter preparation and feed vessels before reaching the melters. Liquids from various facility processes also return to the wet cell for interim storage before recycling back to the Pretreatment Facility.

The HLW Facility contains two identical, remotely operated melter caves. Due to potentially high levels of radioactivity in the caves, all operations and maintenance activities are performed using remote-handled large overhead cranes and manipulators. Each cave contains a series of complex utilities to support two high-level waste vitrification melters. The melters are supported by offgas cleaning systems that include a submerged bed scrubber vessel and two high-efficiency mist eliminators.

The waste will be mixed with glass-forming materials in one of two 90-ton melters and heated to 2,100 degrees Fahrenheit. The mixture will then be poured into stainless steel canisters that are approximately two feet in diameter, 14.5 feet tall and weigh more than four tons. The HLW Facility will produce an annual average of 480 canisters. About 30 percent waste and 70 percent additives are contained in each canister. The canisters will be temporarily stored on the Hanford Site in the 200 Area until being shipped to the future national geological repository for permanent, long-term storage.

When complete, the HLW Facility will be six stories high, 440 feet long and 275 feet wide. The facility itself rests on a 6-foot thick, steel-laced concrete foundation with walls measuring up to 5-foot thick. The facility will contain a basement, which rests 21-feet below ground level. More than 5.3 million craft hours are required to construct the facility. The HLW Facility is currently 57 percent complete.

The low-activity waste will be transferred via underground pipes from the Pretreatment Facility to the LAW Facility. The waste feed first arrives at the concentrate receipt vessel in the process cell. A melter feed preparation vessel mixes the waste feed with glass formers; and another feed vessel supplies the mixed waste feed to the melters. The process cell also contains three offgas treatment vessels to cool and treat melter offgas.

In the melters the waste and glass-forming materials will be heated to 2,100 degrees Fahrenheit. The facility will contain two identical 300-ton melters that produce containers that will contain 20 percent waste and 80 percent additives. The containers will be four feet in diameter, seven feet tall and weigh more than seven tons. The LAW Facility will produce approximately 1,100 containers annually. These containers will be decontaminated and permanently stored on the Hanford Site.

When complete, the LAW Facility will be seven stories high, 330 feet long and 240 feet wide. The facility rests on a 5-foot thick, steel-laced concrete foundation with walls

measuring up to 3-foot thick. The facility will also have a basement that reaches 21-feet below ground. More than 2.3 million craft hours are required to construct this facility. The LAW Facility is currently 67 percent complete.

The fourth major nuclear facility at WTP is the Analytical Laboratory. The Lab's key function is to ensure that all glass produced by the LAW and HLW Facilities meets all regulatory requirements and standards. When WTP is operational, the Lab, which includes 14 hot cells, will analyze approximately 10,000 waste samples annually. Samples will be taken at key junctures throughout the vitrification process. Samples will be used to confirm the correct glass-former "recipe" that will produce a consistent glass form. Samples will also be taken throughout the vitrification process to ensure a high-quality glass product and good process controls.

The Lab will be four stories high, 320 feet long and 180 feet wide. More than 635,000 craft hours are required to construct the Lab. The Lab will feature a 68-foot stack assembly to filter radioactive and chemical contaminants from the ventilation systems. That assembly contains three emission stacks and sits atop the Lab. The Lab will also have an underground hot cell collection vessel that is a collection, containment, staging, transfer and secondary containment area for waste streams from the Lab. The contents of the vessel are recycled back to the Pretreatment Facility. A floor and sink drain collection vessel collects water overflow in the event of a fire. The Lab is currently 50 percent complete.

The 65-acre WTP includes 20 support buildings and a vast infrastructure that makes up the Balance of Facilities. These facilities will support overall operations of the WTP. Some of these facilities include the chiller-compressor building, steam plant, water treatment facility, diesel generator facilities, and administration buildings. Balance of Facilities is currently 47 percent complete.

The WTP Project is currently 62 percent complete overall, and scheduled to begin hot commissioning in 2019, with full operations planned for 2022.