The Hanford Site

Direct Feed Low-Activity Waste (DFLAW)

EFFLUENT MANAGEMENT FACILITY (EMF)
Evaporates effluent from the Low-Activity Waste Facility

LOW-SOLIDITY WASTE (LSW) FACILITY
Mescale LAW with glass forming materials produces vitrified waste in stainless steel containers for long-term storage

INTEGRATED DISPOSAL FACILITY (IDF)
Accepts containers of vitrified low-activity waste for disposal

EFFLUENT TREATMENT FACILITY (ETF)
Liquid Effluent Retention Facility (LERF)
Provides storage and treatment for a variety of aqueous liquid waste

TANK-SIDE CESIUM REMOVAL SYSTEM (TSR)
Pretreats tank waste to remove cesium and prepare LAW waste for immobilization

AP Farm Tanks: AP-105 | AP-106 | AP-107 | AP-108
Feeds unthreshold tank waste to cesium removal systems and prepares waste for the Low-Activity Waste Facility

TANKS

OFFICE OF RIVER PROTECTION
United States Department of Energy
DFLAW Fast Facts

- Double-shell tank (DST) AP-107 is the feeder tank to the Tank-Side Cesium Removal System (TSCR)
- Pretreated low-activity waste feed will be stored in DST AP-106 and transferred in 9,000 gallon batches to the Waste Treatment and Immobilization Plant (WTP) Low-Activity Waste (LAW) Facility

The Tank-Side Cesium Removal System (Low-Activity Waste Pretreatment System sub-project 1) will filter out suspended solids and remove radioactive cesium to produce low-activity waste feed from tank waste liquid

- Mixes low-activity waste feed with glass-forming material and heats them in a high-temperature melter
- The process incorporates the wastes into the glass through vitrification for storage in waste containers
- The containers are allowed to solidify and cool and then transported for disposal

Treats the liquid effluent from the LAW Facility in an evaporator
- The decontaminated liquids are pumped to the Effluent Treatment Facility for further treatment
- The more-contaminated evaporator slurry may be returned to the LAW Facility for vitrification

Engineered disposal facility
- Accepts containers of vitrified low-activity waste for long-term disposal
- Accepts solidified secondary waste forms from WTP operations
The Office of River Protection (ORP) is responsible for the retrieval, treatment and disposal of 56 million gallons of radioactive and hazardous tank waste.

Waste is stored in 177 underground tanks – buried under at least 6 feet of soil to shield workers from radiation.

- 149 single-shell tanks (SSTs)
- 28 double-shell tanks (DSTs)

The waste is mostly the by-products of processing used reactor fuel to extract plutonium for the nation’s nuclear weapons arsenal.

The tank waste:
- Is moderately to highly radioactive
- Ranges from 60°F to 160°F
- Is highly caustic to preserve the carbon steel tanks
- Is complex and varies tank to tank
- Generates hydrogen, ammonia, and other vapors

Single-shell tanks:
- Were constructed from 1943 to 1965
- Vary in capacity from 530,000 gallons to 1,000,000 gallons
- Consist of a reinforced concrete tank with a carbon steel liner on the sides and bottom

Double-shell tanks:
- Were constructed from 1968 to 1986
- Vary in capacity from 1 million gallons to 1.2 million gallons
- Consist of a primary tank inside of a secondary tank – for leak detection and containment
- More than 60 of the SSTs were confirmed or suspected of having leaked to the ground
- A multi-decade SST stabilization effort transferred most of the pumpable liquids from SSTs into the safer DSTs by 2005
- Tank AY-102, the first DST constructed, was confirmed to be leaking in 2012 and has been emptied

The 56 million gallons of waste in the Tank Farms consist of:

- 21 million gallons of supernate – chemically-saturated liquids at a pH greater than 12 – residing mostly in DSTs
- 23 million gallons of saltcake – mostly soluble solids created through evaporation of tank liquids to save tank space
- 12 million gallons of insoluble sludges

28.6 million gallons of waste reside in the SSTs with approximately 90% of the waste consisting of saltcake and sludges.
Since the 242-A Evaporator began operating in 1977, the Evaporator has reduced the total volume of waste in Hanford's tanks by 80 million gallons, helping avoid the high cost of building new waste storage tanks.

Evaporated water is captured, condensed, filtered, sampled and sent to the nearby Liquid Effluent Retention Facility, which further treats the liquid before disposal.

The 242-A Evaporator is located in the 200 East Area of the Hanford Site and is critical to the safe management of Hanford's tank waste. It began operating in 1977 to reduce the volume of waste stored in Hanford's underground tanks.

The 242-A Evaporator is the only operating nuclear processing facility at Hanford. It operates under strict environmental regulations, stringent operational controls, and requires extensive maintenance and operator training to maintain the facility in a fully operable condition. In years where waste processing campaigns are not required to meet space management objectives, an evaporator "cold run" campaign is conducted using water instead of waste to ensure continued facility and systems operability, and to train and maintain the proficiency of operators.
The Process

Prior to processing waste through the Evaporator, the waste is extensively analyzed to determine its key constituents. This information is used to determine how the waste will behave both during and after the evaporation process and to determine how much water can be safely removed from the waste.

If acceptable for processing, the waste is pumped into the evaporator from nearby double-shell tanks via double-walled underground transfer lines. It goes into a sealed vessel where atmospheric pressure is reduced and steam heat is applied, boiling the waste at only 125 degrees F., much lower than it would under normal pressure. When the waste reaches a designated thickness, called specific gravity, the waste is transferred to a double-shell tank for storage.

The evaporated water is captured, condensed, filtered, sampled and sent to the nearby Liquid Effluent Retention Facility, which further treats the liquid before disposal. The evaporator is able to achieve a significant reduction in waste volume, which increases available tank storage space. This reduction in volume helps avoid the high cost of building and eventually disposing of new storage tanks.

Upgrades

In 1987 engineering and design studies were initiated to extend the operating life of the evaporator. In 1989 a series of additional changes were made to address environmental protection issues. Following facility modifications and upgrades the 242-A Evaporator was restarted in 1994. Since 1994 additional modifications and upgrades have been completed to extend the operating life of the facility. Recent upgrades, which include replacing the ventilation system and upgrading the monitoring and control system, will extend the operating life of the facility.

Evaporator Process Diagram
The 222-S Laboratory originally began operations in 1951 as the process control laboratory for the REDOX plutonium separations plant. The laboratory has undergone a series of upgrades and expansions, including a hot cell addition in 1994 and reconstruction of the exhaust ventilation system in 2004. In 2012, the American Recovery and Reinvestment Act, funded three projects related to the 222-S Laboratory: 2713-S, a new office building; 227-S, a new storage building; and upgraded the heating system from steam to electric.

**OVERVIEW**

The 222-S laboratory complex in the 200 West Area of the Hanford Site is the primary onsite lab for analysis of highly radioactive samples in support of all Hanford projects.

Washington River Protection Solutions (WRPS), under the direction of DOE’s Office of River Protection (ORP), provides the laboratory’s support functions, maintenance, waste services and analytical work. WRPS also develops process technology and analytical methods.

Another DOE contractor, Wastren Advantage, Inc. (WHIL-Veolia) performs analytical services production functions at the laboratory.

The 222-S Laboratory is a 70,000 square-foot full-service analytical facility that handles highly radioactive samples for purpose of organic, inorganic, and radiochemistry analyses. It contains 11 hot-cells, which gives the lab the capability to remotely handle highly radioactive samples of tank waste while minimizing radiation dose to workers.

The 222-S Laboratory complex contains over 100 pieces of analytical equipment, 156 fume hoods, and 46 manipulators to perform work, about half of which are in use at any one time. The laboratory plays many roles, which include testing of waste compatibility and physical characteristics to support tank-to-tank waste transfers, performing corrosion rate studies and chemical testing to support tank corrosion inhibition, and providing input to the engineering specifications for each of the 242-A Evaporator campaigns. The laboratory also studies the physical and chemical characteristics of waste necessary to enable waste retrievals, provides data to support tank closure requirements, and supports the Vadose Zone program.

The laboratory is expected to operate through completion of the Hanford cleanup mission. The major customer is the River Protection Project for tank waste characterization and support of retrieval, feed preparation and waste treatment. The laboratory also supports other Hanford contractors and projects, such as the Spent Nuclear Fuel Project and the Central Plateau Closure Project.