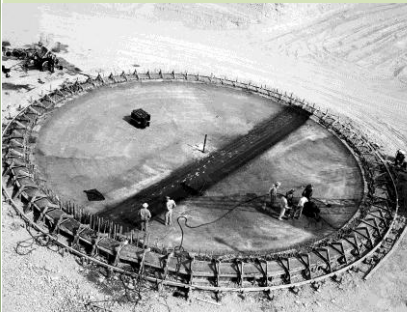


Safely dealing with Hanford's high-level radioactive waste



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Hanford's tank waste presents the most complex and costly challenge of the entire Hanford cleanup. The work is scheduled to take until at least 2047 to complete.



A high-level radioactive waste storage tank under construction at Hanford in 1947. This 530,000 gallon tank *still* holds waste!

Oregon Department of Energy
625 Marion St. NE
Salem, OR 97301
503-378-4040 or toll-free in
Oregon 1-800-221-8035
www.oregon.gov/energy

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Plutonium production created extensive amounts of waste

For more than 40 years, the federal government produced plutonium for America's nuclear weapons program at the Hanford nuclear site in southeastern Washington. That process created large amounts of radioactive and chemically hazardous waste. The most hazardous of the liquid waste was pumped into underground storage tanks. Since plutonium production ended in 1989, the focus at Hanford has shifted to cleaning up the waste. Safely dealing with the waste in these tanks is the most complex and expensive part of the entire Hanford cleanup.

Hanford's tank waste

In 1943, during the height of World War II, the federal government selected a remote area of southeastern Washington as the location to manufacture plutonium for a nuclear bomb. Plutonium is produced when uranium fuel rods are irradiated in a nuclear reactor. The nuclear reactions produce heat and new elements, including plutonium. Eventually, nine nuclear production reactors were built along the banks of the Columbia River at Hanford. Hanford's first reactor began operation in September 1944.

A series of chemical processes were used to separate the plutonium from the other elements. This process began at Hanford in December 1944. The uranium fuel was put into large tanks where nitric acid and other chemicals dissolved the fuel. Other chemical processes separated the plutonium from the other radioactive materials. Liquid waste was generated during each step in the process. The most highly radioactive portion of the waste was pumped into underground storage tanks. The remaining liquids were dumped into the soil.

New reactors and processing facilities were added throughout the Cold War. In each case, additional underground storage tanks were built. By 1964, Hanford had 149 tanks in 12 groups of tanks called tank farms. The earliest tanks were 55,000 and 530,000 gallons in size. Newer tanks ranged from 758,000 to one million gallons. By the late 1950s, Hanford officials realized that some of the tanks – designed to be used for only 10 to 20 years – had leaked. Eventually, to try and prevent future leaks, tanks with a double shell of steel were built, beginning in the late 1960s. Twenty-eight double-shell tanks – all at least one million gallons in size – were built.

In all, Hanford has 177 underground storage tanks that hold about 53 million gallons of highly radioactive waste. At least 67 tanks are suspected of or known to have leaked about one million gallons of highly radioactive waste into the soil.

Tank waste treatment plans

The plan to deal with Hanford's tank waste is to immobilize the waste through a process called *vitrification*. Glass-forming materials will be added to the waste at high temperature to form molten glass. The molten material will then be poured into stainless steel containers, where the glass will harden as it cools. The waste will still be radioactive, but no longer mobile and able to easily spread into the environment.

The U.S. Department of Energy (USDOE) is building a massive complex of facilities at Hanford to vitrify the tank waste. Construction on the Waste Treatment Plant (WTP) began in 2002. Previous attempts to build vitrification facilities at Hanford had failed. This project, too, has seen a number of challenges.

Construction on major portions of the WTP was slowed in late 2004, and then stopped in 2005, when it was determined that seismic requirements for the design had been underestimated by about 40 percent. That forced a delay to evaluate the construction work that had already been completed, and to review and revise engineering designs for the remainder of the construction.

In addition, USDOE determined that both the cost and schedule estimates were not accurate. Eventually, USDOE adopted a new baseline, which boosted costs from the original \$4 billion estimate to more than \$12 billion. Completion and operation of the facilities was pushed back from 2011 to 2019. Full construction resumed in September 2007. However, a number of technical challenges must be resolved to ensure the facilities work as intended.

When the WTP is operational, tank wastes will first be pumped to the pre-treatment facility. This largest and most complex of the WTP facilities is 540 feet in length, 215 feet in width, and 12 stories in height. The pre-treatment facility will separate out the most highly radioactive materials from the less radioactive materials, called *low-activity* waste. The high-level waste stream will be vitrified in the WTP's waste vitrification facility. The containers of vitrified waste will then be stored at Hanford until a national high-level waste repository is sited and constructed.

Some of the low-activity waste – which by volume will make up as much as 90 percent of the waste – will be vitrified through a similar process in the WTP's low-activity vitrification facility. The low-activity vitrification facility that is under construction is not large enough to vitrify all the waste. The canisters of low-activity waste will be buried at Hanford. USDOE will immobilize the remainder of the low-activity waste by vitrification or potentially using other technology.

Vitrification is a proven technology being used elsewhere in the United States and Europe. The chemical complexity and massive quantity of waste at Hanford requires Hanford's WTP to be larger and far more complex than existing facilities.

The WTP is scheduled to begin start-up operations in 2019 and reach full operations by 2022. It will then take 25 years to vitrify all of Hanford's tank waste.



A massive waste treatment complex is being built at Hanford