The River Protection Project — doing a tough job better and smarter

Office of River Protection

Sixty percent of our nation's high-level nuclear waste is stored at Hanford. The waste — the legacy of more than four decades of plutonium production for the national defense — is located in underground tanks just seven miles from the Columbia River.

The plan to solve this problem is straightforward: remove the waste from the tanks, vitrify the waste (turn it into glass logs) and close the tank farms. Vitrification is the technology that has been used to turn the radioactive tank waste into glass at two Department of Energy sites in the U.S. — West Valley and Savannah River — and numerous other worldwide sites including two in France and one each in the Unite Kingdom and Belgium.

The U.S. Department of Energy's Office of River Protection was established in 1998 to complete the Hanford tank cleanup. ORP manages all aspects of Hanford's River Protection Project, including tank-farm operations, waste retrieval, construction, commissioning and operation of the vitrification plant, disposal or storage of the glass and closing the tank farms.

The River Protection Project includes ORP and its prime contractors CH2M HILL Hanford Group, Inc. and Bechtel National, Inc., as well as DOE's Pacific Northwest National Laboratory (operated by Battelle Memorial Institute) for science and technology coordination. With an annual budget of approximately $1 billion, the River Protection Project is DOE's single largest and most challenging environmental cleanup project.

The River Protection Project made much important progress during fiscal year 2001. ORP, however, is not content with the status quo and is thinking about how to improve the plans for completing waste treatment and tank-farm closure. The goal is to complete the mission in a way that protects health and the environment and complies with regulations much sooner and at much lower cost.

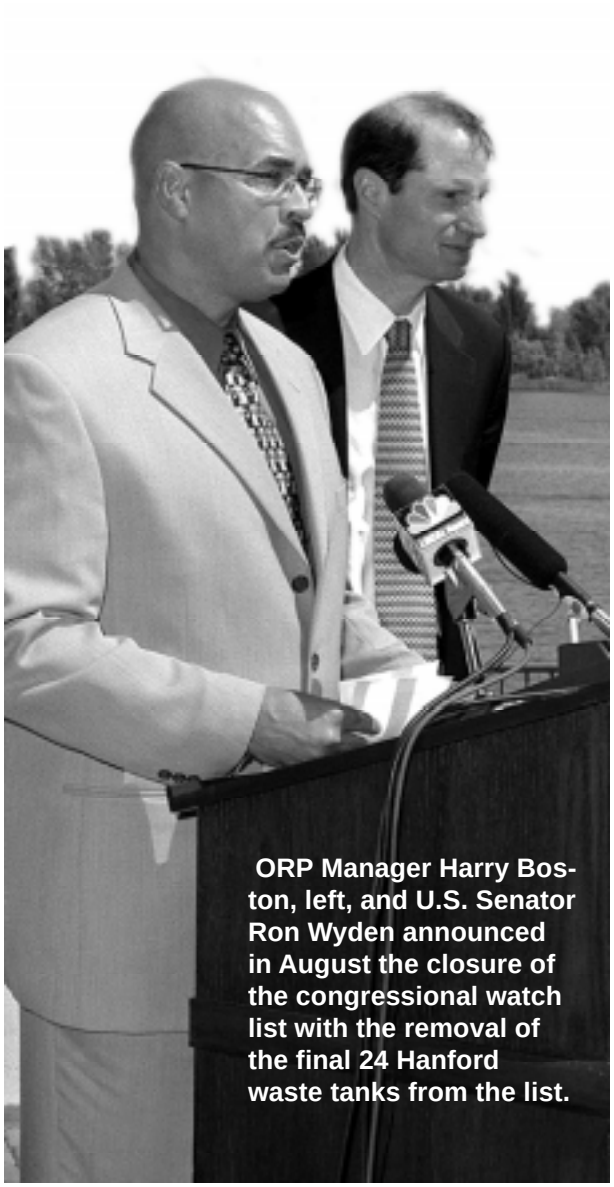
CH2M HILL progress has made the tank farms safer

The Hanford Site has been storing waste in underground tanks since creating radioactive waste products began during World War II.

- The site has 177 large underground tanks with approximately 53 million gallons of highly radioactive and hazardous waste.
- 149 single-shell tanks were built from 1943 to 1964.
- 28 double-shell tanks were built from 1968 to 1986.
- The tanks are grouped into 18 tank "farms."
- 67 of the single-shell tanks have leaked or are suspected of having leaked approximately 1 million gallons of waste in the past, including an estimated one million curies of radioactivity.

As the tank-farm contractor, CH2M HILL Hanford Group's responsibilities fall into four categories of work:

- Reducing risks through safe storage of tank waste
- Making preparations for retrieval of tank waste
- Preparing for tank waste treatment
- Preparing for disposal of treated tank waste
- Planning for closure of tanks.



ORP Manager Harry Boston, left, and U.S. Senator Ron Wyden announced in August the closure of the congressional watch list with the removal of the final 24 Hanford waste tanks from the list.

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Congressional tank safety watch list closed

Office of River Protection Manager Harry Boston announced in August the resolution of significant safety issues resulting in the removal of the final 24 high-level waste tanks from the Wyden congressional safety watch list. Closure of the final safety issue completed a Tri-Party Agreement milestone more than a month early.

Oregon Senator Ron Wyden authored the law in the early 1990s requiring DOE to watchdog the most dangerous tanks at Hanford. As many as 54 tanks were on the list at one time because of concerns over generation of flammable gases, the presence of flammable organic chemicals and potentially explosive ferrocyanide, and high heat levels generated by certain types of wastes.

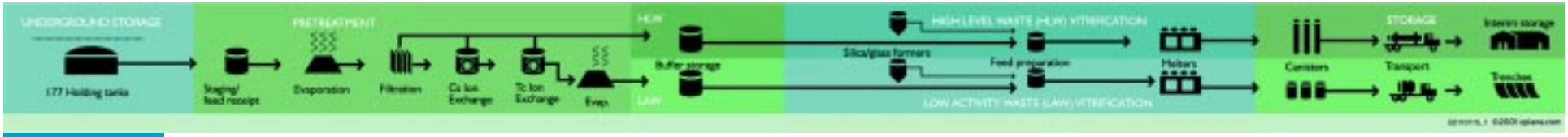
“We owe a special thanks to the Office of River Protection,” said Wyden, “because they’ve made it clear that they’re going to continue this effort of monitoring.”

“I, too, want to thank Harry Boston and the Office of River Protection, but also CH2M HILL, because it wouldn’t have worked without their perseverance and the workers out there getting the job done,” said Congressman Doc Hastings.

Famous ‘burping’ Tank SY-101 returned to service

Following safety reviews by the Department of Energy and its regulators and contractors, Hanford’s once-“burping” waste tank has been returned to service, marking the end of more than a decade of serious safety problems and a costly effort to solve those problems.

Tank SY-101 will be a key staging point for single-shell tank waste destined for the planned vitrification facility in the 200 East Area. Returning the million-gallon, double-shell tank to service closes the book on what was once Hanford’s and the Department of Energy’s top safety concern.



The Plateau. . .

Reducing the risk: safe tank waste storage, continued

Maintenance outage program begun

While double-shell tank farms continue their mission of safely storing radioactive and hazardous waste within aging facilities, those facilities are being upgraded and new systems constructed to prepare for delivering waste to the planned vitrification plant. Because of this dual role, those who perform daily tank-farm tasks and those on construction projects must vie for time and physical space within areas often quite crowded with equipment and workers.

To alleviate these conflicts and increase efficiency, CHG initiated a maintenance outage program, a common practice in the nuclear energy industry, for performing corrective and preventive maintenance in the double-shell tank farms. No construction project work is scheduled during these outages, and a dedicated team can then perform maintenance without interruption and free the tank farm for construction project work later.

Slowing the spread of contamination

Efforts to keep water out of areas where past tank leaks have contaminated the soil with radioactive and hazardous waste continue. Crews with ORP and CHG are cutting unneeded water pipes, building berms around tank storage areas, and installing drainage control on nearby roads to keep water from moving toward the tanks.

Sixty-seven of Hanford's older single-shell tanks have leaked or are assumed to have leaked an estimated 1 million gallons of waste into the ground in the past.

More than $1 billion in upgrades are under way in Hanford's tank farms, including installation of waste transfer pumps and pipelines and improvements to process pits that contain valves, pumps and other equipment. The upgrades will be needed to transfer millions of gallons of radioactive and hazardous waste to the planned vitrification facility.

Preparations for tank waste retrieval

ORP and CHG are making over $1 billion in upgrades to Hanford's tank farms to be ready for retrieving waste and sending it to the planned vitrification facility by 2006. The upgrades include installing thousands of feet of waste transfer piping and numerous tank mixing and transfer pumps. Other work includes preparations to remove solid waste from the aging single-shell tanks.

Single-shell tank preparations

While much of the liquid waste has been removed from Hanford's single-shell tanks, a major effort is under way to demonstrate technologies needed to remove the remaining solid waste.

The stage is set to demonstrate a prototype retrieval method in single-shell Tank U-107. Hanford crews are first pumping out a layer of liquid waste. Then they will begin to dissolve a portion of the underlying solid waste, or saltcake, by alternating gentle sprays of water with pumping. Over a three-month period, about 37,000 gallons of solid waste will be removed from the tank.

The demonstration will provide important information on the best and safest way to remove solid waste from other single-shell tanks. A regulatory milestone calls for ORP to remove enough waste with dilution water to fill at least 2 million gallons of double-shell tank space before October 2006.

Hanford Cold Test Facility

CHG awarded a $2.4 million contract to Los Alamos Technical Associates to design and build a test facility that will include a large simulated waste tank. The facility is needed to ensure that new technologies and cleanup systems work well before they're put in the highly radioactive and hazardous environment of a Hanford tank. The facility will cover nearly 10 acres near the HAMMER training facility and is expected to be ready for equipment development and testing in the summer of 2002.

Upgrading and new construction

Upgrades and new construction are under way in the tank farms to prepare for retrieving waste and delivering it to the planned vitrification plant. A portion of this work includes refurbishment of tank-farm process pits, which contain valves, pumps and other equipment used to transfer radioactive waste in and out of the tanks. Four of these pits were upgraded in fiscal year 2001, with 32 more scheduled beginning in fiscal year 2002.

The pits are opened only when necessary to reduce the risk of spreading contamination to the environment and employees, and because it is very costly to do so. Over the decades since they were built, some deterioration has occurred. CHG is applying polyurea, a substance similar to a spray-on truck bed liner, to make process pit upgrades safer, easier and less costly. Polyurea provides a liner that is easy to decontaminate, resists abrasion and will stretch with any settling of the concrete, thus serving as secondary containment to protect the environment.

Other ongoing and recently completed construction work includes a new valve pit being built in AZ Tank Farm, a new valve manifold and coverblocks for a process pit in AW Tank Farm, installation of 10,000 feet of waste transfer pipeline, and replacement of the SY Tank Farm annulus exhauster.

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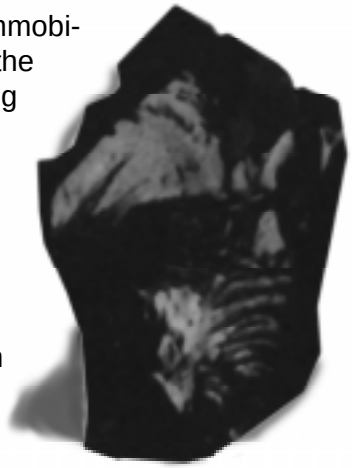
Hanford Group, Inc.

Vitrification:
Immobilizing radioactive waste in glass



Vitrification is a proven technology to immobilize radioactive waste and isolate it from the environment. In the process, glass-making materials such as silica are added to the waste. The mixture is then heated to 2,100 degrees Fahrenheit in an electric melter. The result is an exceptionally sturdy and stable form of glass.

Vitrification has been proven to work on radioactive waste at other Department of Energy sites and in other countries, most notably in England and France. At West Valley, N.Y., vitrification is being used to immobilize radioactive wastes left over from a commercial nuclear fuel reprocessing plant. The technology has also been used for several years at DOE's Savannah River Site in South Carolina.

Before it is vitrified, the waste must be pretreated to separate the high-level radioactive waste from the low-activity waste. Once the high-level and low-activity wastes are separated, filtered and chemically altered, silica and other glass-forming materials are added to form a slurry.

The waste slurry is sent to separate vitrification plants for the high-level and low-activity wastes. The slurry is fed into melters where it is heated by passing electricity through it. This is known as joule heating.

Low-activity waste can be processed much faster than high-level waste. Vitrifying low-activity waste takes about two-and-a-half days, while the high-level waste mixture must remain in the melter for more than six- and-a-half days.

Once the waste is completely dissolved in the molten glass, the glass is poured into large stainless steel canisters. The canisters must cool for a few days before being welded shut and decontaminated.

High-level waste canisters will be stored in Hanford's existing Canister Storage Building until they are eventually shipped to a federal geologic repository for permanent underground disposal. Low-activity waste canisters will be buried in concrete-lined trenches at a Hanford waste disposal facility well away from the Columbia River. ✦

Preparing for tank waste treatment

Vit plant infrastructure ready

The infrastructure that will provide electricity, water and roads for the vitrification plant is complete. The project features an electrical substation and 230-kilovolt transmission lines to supply the vitrification melters, which will operate continuously at 2,100 degrees Fahrenheit.

Three miles of pipeline that will deliver water for vitrification processes and for drinking and firefighting have been installed. A separate 2.5-mile piping system will transport liquid effluent byproducts to existing treatment and disposal facilities on the Hanford Site.

The intersection at Route 4 South and Canton Avenue in the 200 East Area was widened and reinforced to accommodate heavy construction traffic, and streetlights were added. A new road also encircles the 65-acre area where Bechtel National will build the Waste Treatment Plant.

CHG and its subcontractors completed the infrastructure project more than a year ahead of schedule and $9 million under budget.

On his first visit to Hanford earlier this month, Secretary of Energy Spencer Abraham, left, views the Hanford tank farms with Fran DeLozier, president of CH2M HILL Hanford Group, and Harry Boston, manager of the Office of River Protection.

Preparing for disposal of treated tank waste

CHG will also be responsible for storage of the highly radioactive, but more easily managed, glass logs until permanent disposal facilities are available. High-level waste glass, containing more than 99 percent of the radioactivity in the tanks, will be stored in the Hanford Site's Canister Storage Building until a permanent repository is established.

CHG and ORP are preparing to apply for a permit to retrofit two existing vaults in the building to provide storage capacity for 880 canisters of high-level waste. Preparations will include adding storage tubes and ventilation systems, and adding or modifying handling equipment and a receiving area.

Low-activity waste glass will be disposed of in subsurface trenches in the 200 East Area between PUREX and the steam plant. Initial design efforts have provided a concept of the trenches and an estimate of the cost and schedule involved.

Plans call for building one double-lined trench for the first phase of cleanup, with supporting infrastructure for a total of six trenches. Each trench would be almost the length of three football fields, nearly 90 yards wide and 33 feet deep. Leak detection and runoff collection systems would be contained in the double liner. Each trench would have the capacity to hold 13,500 containers of low-activity waste glass.

Mobilization for Waste Treatment Plant Project begins

Limited construction activities on the Waste Treatment Plant site were started in early October. During this limited construction period, excavation is just the first of many tasks to be completed, including concrete work, installation of underground utilities and erection of modular office space. Work on the underground utilities will begin in early December.

Construction of the Waste Treatment Plant, the world's largest plant of its kind, was mobilized in late September. By the time the first structural concrete on the plant's three major nuclear facilities is placed next year, 10 percent of the overall construction will have been completed. Some 18,849 cubic yards of concrete will have been placed, 157,717 feet of piping installed and 995,489 feet of electrical cable pulled.

The Waste Treatment Plant's three major facilities — pretreatment, high-level waste vitrification and low-activity waste vitrification — along with a variety of operations and maintenance buildings, analytical laboratories, utility services and administrative buildings make up the $4 billion project.

The pretreatment facility will take the tank waste feed and separate it into two separate streams: low-activity radioactive waste and high-level radioactive waste.

The low-activity waste vitrification facility will have three melters, and the high-level waste vitrification facility features a single melter.

Processes, equipment and facilities must be designed to operate at significantly increased production rates when compared to current U.S. and international facilities. Applied research and technology programs are under way to support the increased efficiency of the plants. The work must all be done on an aggressive schedule to meet Tri-Party Agreement commitments. Construction will begin in 2002, with operations scheduled for late 2007. The facilities will be in full operation and ready to turn over to an operations contractor by 2011.

By 2018, a minimum of 10 percent of the waste, representing 25 percent of the radioactivity in the tank waste, will be vitrified.

To meet this schedule, Waste Treatment Plant Project team members have set ambitious goals for every aspect of the project, including planning, permitting,

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Mobilization for Waste Treatment Plant Project begins, cont.

construction and commissioning — all the while maintaining a commitment to safety and a zero-accident philosophy.

The sheer size of the project is a challenge, according to Project Manager Ron Naventi, senior vice president of Bechtel National, Inc.

"If you look at the quantity of materials we need for this project — concrete, structural steel, piping and electrical cable — it's akin to building a two-unit nuclear power plant station."

The workforce will peak at about 4,300 people in 2004. Once the Waste Treatment Plant is fully operational, staff levels will settle at about 600 employees.

"Our success will also be measured on how safely, efficiently and cost-effectively the plant operates," said Naventi. "As we move closer to construction, we are focusing on minimizing the total installed cost and maximizing the return on investment to DOE and the taxpayers."

There are four initiatives in place to minimize cost and maximize the return on investment:

- Evolving the design with the target of saving $300 million in the project cost and saving $500 million of the life-cycle cost

- Using a quality control plan called Six Sigma to provide process improvements to save $100 million in capital costs

- Devising plant optimizations to improve life-cycle operations and accelerate completion of the mission

- Delivering the best available, proven technology.

When fully operational in 2011, the Waste Treatment Plant will have but one mission: to finally solve Hanford's tank waste problem by immobilizing the wastes in a sturdy glass that will remain stable and impervious to the environment while its radioactivity dissipates over a period ranging from hundreds to thousands of years. ✦

U.S. Senator Patty Murray and Congressman Doc Hastings review plans for construction of the Waste Treatment Plant with ORP Manager Harry Boston, right.