Frequently Asked Questions: Nuclear Safety/Hanford

What is the Nuclear Safety/Hanford program?

The Oregon Department of Energy's (ODOE) Hanford program oversees the federal government cleanup of the Hanford nuclear site. ODOE considers Oregon residents and Oregon's natural resources, such as the Columbia River, when trying to influence major cleanup decisions.

Where is Hanford and why was it built?

The 586-square mile Hanford site is located in the southeastern part of Washington state, north of Richland, Wash. and 30 miles north of the Oregon-Washington border. During World War II, the federal government relocated residents who lived near the area to build facilities that would produce plutonium for an atomic bomb. From 1944 to 1989, the primary mission for Hanford was to produce plutonium for America's nuclear weapons program.

Why is cleanup at Hanford necessary?

Plutonium production created large amounts of radioactive and chemically hazardous waste. The most dangerous radioactive waste was stored in large underground tanks, while massive amounts of liquid and solid waste were disposed of into the soil and groundwater environments at Hanford. At that time, it was assumed that the disposal of most of the waste would be permanent. However, the spread of contamination from the liquid waste disposal and the need to remove solid waste near the Columbia River and elsewhere necessitated the need for the waste to be removed.

In 1989 the work at Hanford transitioned from plutonium production to environmental cleanup of chemical and radioactive contamination, which continues today and likely for the next several decades. The Hanford cleanup program is the largest environmental cleanup project in the world.

The Hanford site is located in Washington, so why is Oregon involved in the cleanup?

Radioactive contamination poses a potential long-term threat to the Columbia River and species such as salmon and steelhead; therefore, Oregon's primary role at Hanford is to ensure that cleanup decisions are protective of the river, which flows through 50 miles of the Hanford site.

Additionally, radioactive waste generated during cleanup is transported from Hanford, through Oregon, to a disposal site in New Mexico. There are also other shipments of radioactive waste transported to and from Hanford. ODOE works to ensure that these shipments are conducted safely and in compliance with State laws. In addition, a fire, explosion, or other accident involving Hanford's contaminated facilities or underground waste storage tanks could cause an airborne release of radioactive materials. ODOE collaborates regularly with Umatilla and Morrow counties on testing emergency management plans to assure prompt response in case of a crisis or emergency.

Oregonians regularly engage in Hanford matters. Large numbers of people often attend public hearings and meetings, held in various cities throughout Oregon, to weigh in on Hanford cleanup proposals. Oregon also has a 20-member Oregon Hanford Cleanup Board, which offers recommendations and

advice on Hanford cleanup to the U. S. Department of Energy (USDOE) and its regulators; Oregon's governor, legislature and ODOE.

Why is the Hanford cleanup taking so long?

There are many reasons. The primary reason is the unprecedented extent of environmental contamination that occurred at Hanford from the production of plutonium and the difficulty in cleaning up these waste. There are 800 separate waste sites along the Columbia River and another 800 on Hanford's central plateau. There are hundreds of contaminated facilities that need demolition. Workers often deal with high levels of radioactivity or chemical contamination that requires them to use remote-handled equipment or robotics. Sometimes they must be completely covered with protective suits and breathing apparatus for additional worker protection. Combining these restrictions with complicated procedures greatly adds to the time necessary to complete the work.

In some cases, the waste is unique to Hanford, and the methods and equipment necessary to deal with the waste has to be created before cleanup can occur. Some of the work at Hanford is among the most complex environmental cleanup occurring in the world.

For example, it was necessary to develop, design and test new equipment and procedures before workers could remove irradiated nuclear fuel stored underwater in two basins—a quarter mile from the Columbia River—at the K-East and K-West reactors. Although the fuel was not designed to be stored for an extended length of time, it was stored there for more than 20 years. The fuel eventually corroded, creating a layer of radioactive sludge at the bottom of the basins. In 1994, USDOE identified the K-Basins as an urgent priority, because even a moderate earthquake could damage the basins and cause water to drain. Once exposed to air, the fuel could ignite, releasing a plume of radioactive materials into the air. Therefore, USDOE decided that the best solution would be to pack the 105,000 uranium fuel rods and fragments into water filled canisters; move them out of the basin; dry the fuel; repackage it; and move it away from the river to an interim storage facility.

It took six years to design and construct equipment that could collect and sort the fuel underwater, as well as a vacuum drying facility; storage containers; and a building to store the repackaged fuel. Specific procedures were also developed and rehearsed. Adding to the time required to do the work, visibility problems regularly hampered collecting the fuel because the fine sludge would cloud the water and force workers to wait for the water to clear. In October 2004, workers moved the last of the fuel elements from the two basins and consolidated the sludge into one of the two basins where it awaits treatment and final disposal.

Hanford's lengthy clean up time can also be attributed to the volume of work. Workers have spent the past decade or so digging up millions of tons of contaminated soil along the Columbia River and hauling it to a lined, engineered disposal site several miles from the river.

The following reasons also contribute to a lengthy cleanup:

- Cleanup is tremendously expensive (see answer below "How much is cleanup going to cost?").
- Environmental laws require identifying how much and what kind of contamination is present and the threat posed by the contamination. Environmental laws also require specifying several cleanup alternatives to manage contaminants at a specific location; developing alternatives to

assess risks, effectiveness and costs; providing regulators and the public with an opportunity to weigh in; and selecting and implementing a preferred alternative. In many cases, these critical steps, which can sometimes take a few years to complete, must happen before waste sites or contaminated buildings can be cleaned.

- There have been several false starts and missteps along the way which hampered progress. For example, several efforts to design and construct large tank waste treatment facilities were later cancelled, and one project to immobilize much of Hanford's tank waste through use of grout was also abandoned.

How much is cleanup going to cost? Why is it so expensive?

The volume of waste and the complexity of cleanup, including the handling of hazardous and radioactive waste at Hanford, makes cleanup expensive. For example, ensuring worker safety and preventing the spread of contamination with relatively straightforward activities such as drilling a well and analyzing samples is tens or even hundreds of times more expensive than this same activity on an uncontaminated site.

Currently, Hanford cleanup has cost nearly $35 billion, with remaining costs expected to require an additional $65 billion. The annual budget for Hanford is about $2 billion, which includes funding for approximately 11,000 workers. Budget targets and congressional allocations artificially constrain the annual budget. During the past two years, Hanford received an additional $2 billion from the American Recovery and Reinvestment Act (ARRA), and Hanford workers demonstrated that considerable additional progress can be made when additional funds are provided.

What is the plan for Hanford's tank waste?

The most hazardous of the liquid wastes — generated during plutonium production — were stored in underground storage tanks. Additional tanks were built as storage tanks began to fill. Hanford currently has 177 underground waste storage tanks which hold about 53 million gallons of highly radioactive waste.

USDOE is building a Waste Treatment Plant, a massive complex of waste treatment facilities. These facilities will immobilize the waste, permanently, through a process called vitrification. Glass-forming materials are added to the waste under heat to form molten radioactive glass. The molten material would then be poured into stainless steel containers to cool and harden into glass. The waste will still be radioactive, but no longer mobile or have an ability to easily spread into the environment. Treating the tank wastes is considered one of the most urgent, but expensive and difficult tasks at Hanford. It is believed that at least 67 of the tanks have leaked or released nearly one million gallons of highly radioactive waste into the soil. The tanks are beyond their life expectancy. Although sound for now, they will be more fragile with less ability to contain waste as they continue to age.

Once the treatment plant is completed, Hanford's tank waste will first be processed through a complex pre-treatment facility that separates the most highly radioactive elements (such as cesium) from the rest of the waste. The highly radioactive waste, which makes up a small percentage of the waste volume, will be sent to a high-level vitrification facility. Once turned to glass, waste would be moved to a national deep geologic disposal facility. However, the United States currently does not have such a facility (see below, for question related to Yucca Mountain); therefore, USDOE has to store the vitrified waste indefinitely at the Hanford site.

The less radioactive portion of the waste — which by volume will be the majority of the tank waste — would also be processed through some immobilization treatment. USDOE is also constructing a vitrification facility for the low activity waste, although this facility will not have sufficient capacity to treat all of the waste by the 2047 deadline. The USDOE is exploring other technology options for immobilizing waste. If USDOE does not find an alternative, an additional low-activity vitrification facility may need to be built.

Vitrification is a proven technology that is being used elsewhere in the United States and in Europe. The chemical complexity and massive quantity of waste at Hanford make its facilities larger and more complex than any existing facilities. Construction on the treatment plant began in 2002, but start-up operations are not slated to begin until 2019 and reach full operations until 2022. It is then anticipated to take 25 years to vitrify all of Hanford's tank waste and finish the work by 2047.

What are the risks posed by Hanford?

Current risks are low. Radiation and chemical exposure to site workers is regulated by federal and state laws, although there have been a number of serious worker exposures during the cleanup. Because access to the site is restricted, day-to-day risk to the public is extremely low.

Future Hanford risks could include contact with previously disposed chemicals and radioactive materials through groundwater. For Oregonians, exposure could come from a dilute amount of chemical or radioactive material that flowed downstream via the Columbia River. Extensive monitoring indicates that the risk is minimal today. On the other hand, it is concern that a large amount of contaminants are moving slowly through the soil column and groundwater at Hanford, and an even larger amount of contaminants could reach the river in decades or centuries into the future. There are potential risks for people living downwind from Hanford – including Oregonians – from an accidental release of radioactive material into the air, transported by wind. ODOE works closely with other state, county and federal agencies to plan and rehearse responses to this very unlikely event.

What is the risk to people who utilize the river for windsurfing, irrigation or as drinking water? Are there chemicals and radioactive waste from Hanford in the water? How safe is the water?

There are low concentrations of chemical contaminants in the Columbia River from Hanford and other sources, such as farmers' fields, paper mills, natural sources, radioactive materials from Hanford, and past nuclear weapons tests. These low levels of contaminants have not caused a need for restricting use or recreation in the river. Health and environmental organizations regularly sample and test the Columbia River and issue health advisories if there are concerns. A small amount of chemical and radioactive material from Hanford does drain into the river, but are quickly diluted and are not detectable beyond the immediate entry area.
Information on water quality within the river can be found on the Web from the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency.

What's been accomplished so far from the cleanup?

There has been considerable progress, especially in the past decade. However, we're not nearly as far along in the cleanup as anyone would have anticipated when the process started in 1989.

It was hard to see much progress during the first decade or so of cleanup, but in hindsight, a lot was done during that period that allowed it to move forward. Much of the early focus was spent dealing with urgent risk issues – risks that had to be resolved before much of the cleanup could move forward. These risks included a potential for a fire or explosion in one of Hanford's underground waste storage tanks, as chemical processes within the waste generated flammable concentrations of hydrogen and other gases. Certain types of chemicals in other tanks also posed a possible risk of fire or explosion. An explosion or fire inside a tank could cause the dome to collapse and afford an outlet for radioactive materials into the environment.

In January 1991, Congress created a *Watch List* of tanks that required special safety precautions. Sixty of Hanford's underground waste storage tanks were placed on the list – many for more than one safety-related issue. By the time the *Watch List* was closed in August 2001, the tank safety issues were resolved.

To minimize the risk of further tank leaks, free liquids were moved from Hanford's older single-shell tanks to 28 newer double-shell tanks. That was completed in 2004. Seven of the tanks have now been substantially emptied of all their wastes.

Hanford needed new treatment facilities for liquid effluent waste, for handling and packaging solid waste, and a disposal facility for the more than 20 million tons of contaminated soil and building debris that would be generated during the cleanup. It took time for the facilities to be designed, sited, and constructed.

The 1990s could be considered "getting ready for Hanford cleanup," and the years from 2000 up until today viewed as "major Hanford cleanup."

Notable other cleanup achievements include:

- More than 2,300 tons of corroding irradiated nuclear fuel stored in two leak-prone storage basins just a quarter mile from the Columbia River packaged, dried, and moved to a safer storage facility away from the river.
- More than 13 tons of plutonium and plutonium-bearing materials treated and stabilized for interim storage, and then shipped off-site. These materials posed risks to Hanford workers and the facility where they were stored. The Plutonium Finishing Plant was considered one of the highest risk facilities on site. With the plutonium stabilized and removed from Hanford, decommissioning and demolition of the finishing plant is in progress.
- Five of Hanford's nine plutonium production reactors were cocooned and placed into safe long-term storage. This will allow radiation within the reactor blocks to safely decay (greatly reducing the radioactivity) before they are torn down decades from now.
- More than 11 million tons of contaminated soil dug up from along the Columbia River and hauled to an engineered disposal facility in the center of Hanford. Prior to being removed, these wastes posed a threat to the river.
- Groundwater pump-and-treat systems installed in some areas and expanded treatment capability is being constructed. Hanford's groundwater is widely contaminated. The pump-and-treat systems, where contaminated groundwater is pumped to a treatment facility to remove contaminants, will initially help prevent contaminants from reaching the Columbia River and ultimately clean up the contaminated groundwater.
- Hundreds of contaminated buildings torn down.

- More than 530 truckloads of transuranic waste shipped to a disposal facility in New Mexico. Transuranic waste is predominantly protective clothing and building debris that is contaminated with small amounts of plutonium. Because it will be hazardous for thousands of years, it is buried deep underground to keep it away from people and the environment.

Surface cleanup is expected to be completed along the Columbia River corridor by 2015. Groundwater treatment systems along the river will operate well into the future.

I've read that the Yucca Mountain nuclear waste disposal project for Hanford's most radioactive waste was cancelled. What will be done with that waste?

Hanford waste intended for disposal at Yucca Mountain (Nevada) will be stored at Hanford. Irradiated nuclear reactor fuel is already in storage at Hanford, and the state expects this storage facility will be safe and appropriate for decades to come.

Federal law requires that the irradiated nuclear fuel and the vitrified high-level waste be disposed in a deep geologic facility. The radioactive portion of Hanford's highly radioactive tank waste is intended to be immobilized through a process called vitrification and the vitrified waste will need storing indefinitely until there is an alternative to Yucca Mountain. A continual delay in constructing a deep geologic disposal facility will require the building of additional storage facilities, adding to Hanford's clean-up costs.

How can I get regular information about future Hanford meetings and events, and groups involved in the Hanford cleanup?

The U.S. Department of Energy has a calendar of events available on its website. The calendar includes notices of public meetings and public comment periods, and other items of interest. The Hanford website also posts notices and information on items of interest on its main website page, and on the following social media sites:

- Hanford Facebook
- Hanford Twitter
- Hanford YouTube

A number of citizen groups stay abreast of the Hanford cleanup process. Most are represented on the Hanford Advisory Board (HAB), a federally chartered board that offers advice on Hanford cleanup to the U.S. Department of Energy and its two regulators: State of Washington and the U.S. Environmental Protection Agency. The HAB is a 32-member board, comprised of representatives from the State of Oregon, Native American tribes, local governments, the Hanford workforce, and citizen groups.
The State of Washington's Department of Ecology, Nuclear Waste Program maintains a website with a calendar of events and opportunities to comment on proposed actions affecting Hanford. Ecology also maintains a general Hanford cleanup information line (1-800-321-2008), and an e-mail inbox: Hanford@ecy.wa.gov.