Tank Waste Treatment News

Volume 2, Issues 2 & 3

Providing the Washington State Department of Ecology's views on Hanford's Waste Treatment Plant

In this double issue

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DEPARTMENT OF ECOLOGY
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Why it matters

The 586-square-mile Hanford Nuclear Site is located in south-central Washington along the **Columbia River**. Hanford's mission included defense-related nuclear research, development, and weapons production activities from 1943 to 1987. During that time, Hanford operated a **plutonium**-production complex with nine nuclear reactors and associated processing facilities.

Today at Hanford, 177 **underground storage tank**s hold a total of 56 million gallons of dangerous, **mixed waste**. Some of these tanks have leaked, contributing to more than 70 square miles of contaminated **groundwater** currently under Hanford. This contaminated groundwater threatens the Columbia River and all life that depends on it.

Under the direction of the Tri-Party Agreement and the Consent Decree, U.S. Department of Energy and its contractor Bechtel National, Inc., are constructing the Tank **Waste Treatment and Immobilization Plant** (WTP) to prepare waste for long-term underground disposal. WTP will split **tank waste** into **high-level waste** (HLW) and **low-activity waste** (LAW), and turn it into glass form using **vitrification**.

Ecology's **Dangerous Waste Permit** guides WTP construction and operation with the goal of a safe, environmentally protective, functional facility that can treat tank waste for 40 years. Ensuring this is one of Washington State's highest priorities at Hanford.

Potential wear & tear in WTP piping, tanks causes concern

The U.S. Department of Energy (USDOE) and their contractor Bechtel National, Inc., are building the **Waste Treatment Plant** (WTP, also called the Vit Plant) at Hanford. WTP will treat radioactive and chemical (**mixed**) **waste**. The waste is currently in 177 **underground storage tank**s that are degrading. New information shows that the single-shell tanks are taking on rainwater and that one or more of the double-shell tanks may have significant integrity issues.

Since the early 2000s, the Washington State Department of Ecology and other independent review teams have raised concerns about the ability of WTP's tanks and piping to withstand erosion and corrosion from processing nuclear waste over the expected 40-year life of the facility.

Recently, erosion and corrosion issues at WTP have come to light again. As part of our dangerous waste permitting process, Ecology reviews estimated wear rates for WTP's metal equipment. Our engineers and permit writers seek to answer all questions about the viability of systems before we approve WTP design and construction plans. Recent USDOE and Betchel evaluations have again brought up the concern that some of WTP's stainless-steel piping, waste-processing tanks, and **pulse jet mixer**s may wear out too soon.

With 80 percent of WTP's design complete, Ecology is surprised and frustrated that USDOE and Bechtel have not resolved serious technical issues that were identified 10 years ago. Ecology has acted at least ten times, expressing concerns and requiring USDOE and Bechtel to address erosion and corrosion issues with our **Dangerous Waste Permit** (see "Erosion & corrosion at WTP: A Timeline" on page 3). Yet WTP's start date, and worse, its overall ability to function safely and efficiently, continue to be questioned.

The longer Hanford's 56 million gallons of **mixed waste** is stored in outdated underground tanks, the risk to people and the environment increases. Ecology expects USDOE and Bechtel to design WTP so that every piece of metal equipment that cannot be replaced will outlast the necessary 40 years of waste processing.

"With 80 percent of WTP's design complete, Ecology is surprised and frustrated that USDOE and Bechtel have not resolved serious technical issues that were identified 10 years ago. Ecology has acted at least ten times, expressing concerns and requiring USDOE and Bechtel to address erosion and corrosion issues with our Dangerous Waste Permit."

How erosion and corrosion affect WTP

In this context, *erosion* is wear and tear on WTP's stainless-steel piping and tanks from abrasive waste.

Corrosion degrades metal over time due to chemical reactions with moisture. This can cause metal to pit or crack. (See Washington Administrative Code 173-303-090(6) for more information.)

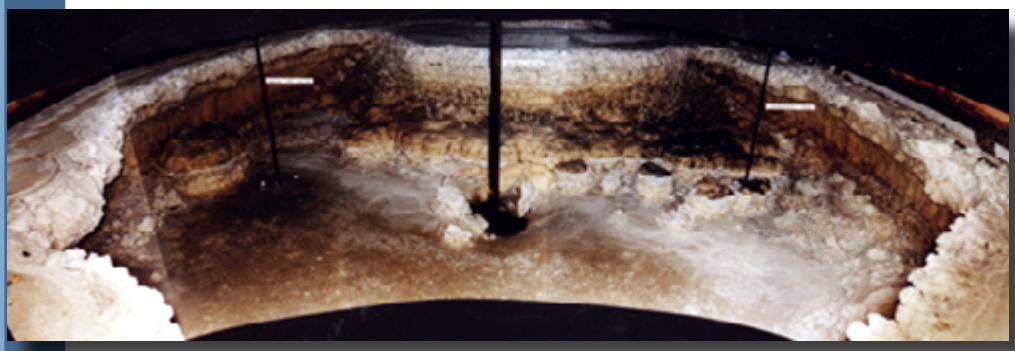
WTP's Pretreatment (PT) Facility will process liquid waste containing abrasive, solid particles from Hanford's 177 **underground storage tank**s. During **pretreatment**, the solids will be sent through **ultrafiltration**. This process will channel the larger particles that remain after pretreatment into the **High-Level Waste** (HLW) Facility for **vitrification** and disposal in a **deep geologic repository**. The liquid portion will contain most of the chemicals, be processed in the **Low-Activity Waste** (LAW) Facility, and disposed at the Integrated Disposal Facility.

Some of the equipment at risk of damage from erosion and corrosion is in **black cell**s, areas that will be sealed after receiving waste due to high levels of radioactivity. Because black cells will be closed to human access when WTP operates, observation of the equipment inside will be limited, and maintenance will be nearly impossible.

In WTP's black cells, tanks processing waste with high quantities of particles will have **pulse jet mixer**s. Pulse jet mixers suck up and expel waste forcefully to keep it mixed. This keeps particles (for example, **plutonium**) from settling out and explosive gases (hydrogen is of most concern) from building up in the tanks. But these particles are very abrasive to tank bottoms and mixer nozzles. Although pulse jet mixers are designed to be maintenance-free because no one can enter black cells after WTP is operating, the mixing increases erosion to tank bottoms.

Many tanks with **pulse jet mixer**s have wear plates for protection from erosion. A *wear plate* is a metal sheet welded to the rounded tank bottom. The risk is that if not enough wear allowance (metal thickness) is planned into the design, the tank bottoms will wear through before treatment is complete, spilling waste onto **black cell** floors. This could end the black cells' function of waste processing, making them subject to expensive cleanup that could be avoided if we make informed choices now.

If equipment in a black cell fails, WTP will limp along, at best, or come to a complete halt.



Above: Radioactive and chemical waste inside one of Hanford's 177 **underground storage tanks**. The saltcake (crust on the top and sides of the tank) has to be dissolved with liquid waste (a process called *sluicing*) before it can be treated at Hanford's **Waste Treatment Plant**. Under the saltcake is a layer of **slurry** containing abrasive, solid particles.

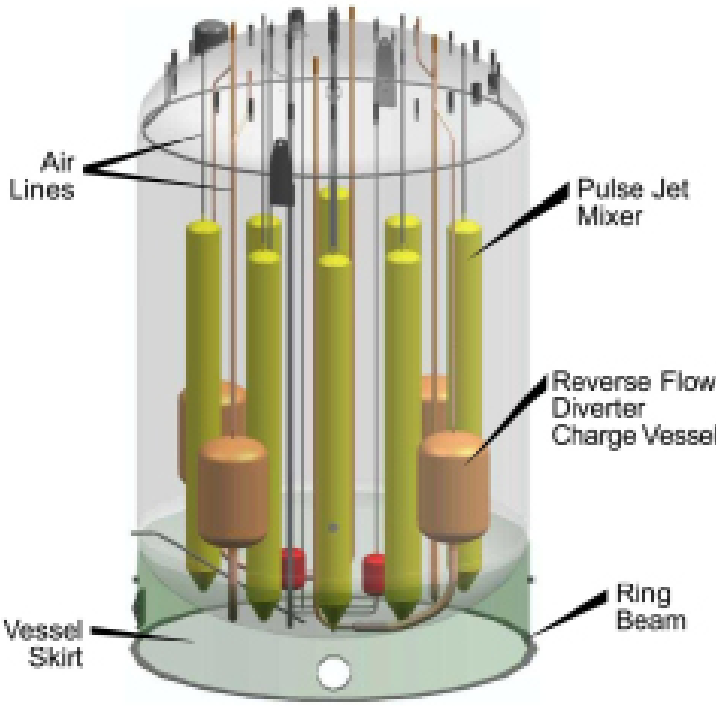
Moving forward

Ecology will continue to work with USDOE and Bechtel to resolve erosion and corrosion issues in WTP piping, tanks, and **pulse jet mixer**s.

Until testing verifies that Bechtel's erosion and corrosion calculations are correct, we have put holds on installing 11 tanks with pulse jet mixers.

We are meeting regularly with USDOE and Bechtel to discuss design submittals that could be affected by erosion or corrosion issues. We have also asked USDOE to review all the WTP design that's already in the **Dangerous Waste Permit** for WTP, if it pertains to erosion and corrosion issues.

In addition to the Defense Nuclear Facilities Safety Board and Ecology design reviews, USDOE experts from the Pacific Northwest National Laboratory, Savannah River National Laboratory, and National Energy Technology Laboratory also contribute.



Above: The view inside a WTP tank with **pulse jet mixer**s. WTP design currently includes 38 tanks with pulse jet mixers, and they are not all alike. In fact, there are 22 different pulse jet mixer designs used at WTP, depending upon the type of tank and its function.

USDOE is responding to ongoing WTP issues by planning a series of tests and building a new full-size tank with pulse jet mixers to test the mixing process. Ecology is hopeful that this new test facility will help USDOE get a better handle on some of WTP's corrosion and mixing issues (including erosion).

In the next issue of TWTN, we'll take readers on a photo tour of the existing test facility. **TWTN**

Erosion & corrosion at WTP: A timeline

2000

The U.S. Department of Energy (USDOE) awarded the contract to design and construct the **Waste Treatment Plant** (WTP) to Bechtel.

2002

In October, Ecology issued the **Dangerous Waste Permit** for USDOE and Bechtel to construct WTP. This permit is continually updated as Bechtel designs new components.

In the early stages of permitting, Ecology reviewed the initial design for the structural components of the buildings and the general design for the tanks, piping, and other treatment components. In the first permit issuance, Ecology required designs of waste-containing equipment to be reviewed by an independent, professional engineer. As the design became more complete for specific tanks, Bechtel and USDOE submitted the information for Ecology to review and add to the permit.

Ecology's WTP permit includes conditions that USDOE and Bechtel must follow as they design and build WTP. These permit conditions require independent corrosion evaluations and adequate metal thickness and strength based on those evaluations for the following WTP equipment:

- Containment systems (including piping and leak-collecting components).
- Tanks.
- Any other metal equipment that contacts soil or water.

In November, the Defense Nuclear Facilities Safety Board (DNFSB) reviewed WTP design. Regarding

erosion and corrosion in **pretreatment** (PT) and **high-level waste** (HLW) piping, they reported that USDOE and Bechtel had increased pipe thickness by 0.125 inch, but that their calculations only considered wear and tear in straight pipes and not bends or elbows. The DNFSB required USDOE to respond in 60 days with a plan to address their concerns.

The DNFSB also found that Bechtel's "calculations lacked technical quality." Bechtel reviewed their own calculations, finding "that all calculations contained some errors, with an average of 40 errors per calculation." To improve quality, Bechtel increased their review process internally and added external reviews. This satisfied the DNFSB's concerns, but they reminded USDOE that its oversight would have to remain vigilant to ensure future quality.

2003

In January, USDOE responded to the DNFSB, reporting they had hired the equivalent of 28 full-time positions to review and oversee WTP design and safety issues, including calculation quality. To address erosion and corrosion issues, USDOE planned to assess the character of Hanford's **tank waste** and to re-evaluate the wear calculations.

In March, the Secretary of Energy sent the DNFSB a letter, agreeing that WTP's metal wear rates and federal oversight are extremely important aspects of WTP safety and functionality. The Secretary reported that Bechtel calculates wear rates and USDOE assesses them, noting that this process had not been "formally documented in a single readily available format." The process was to be formalized and available for review by March 31. At this time, USDOE also planned to review "WTP system erosion, corrosion, and material selection." (*Material selection* refers to choosing the type of metal to build WTP piping and tanks.)

Above: Ecology employees inspecting work on Hanford's **Waste Treatment Plant** to ensure that construction activities follow the designs approved in the **Dangerous Waste Permit**.

2004

In March, the DNFSB sent a letter to USDOE after reviewing a USDOE report on **black cell** design. In that report, USDOE made five recommendations and listed 30 unresolved items. They found that Bechtel's selection of metals for WTP piping and tanks was not defensible, and they asked Bechtel to "reassess … erosion wear rates to determine whether they are adequate." The DNFSB sent a letter of concern because "materials selection and erosion/corrosion allowances are critical to meeting the black cell design objective of 100 percent reliability during the 40-year life" of WTP.

In May, USDOE responded to the DNFSB's black cell concerns, "judg[ing] that the programmatic risk associated with continuation of the black cell vessel [tank] and piping design is acceptable." USDOE assessed Bechtel's selection of metals for WTP piping and tanks and how it would stand up to corrosion from three types of chemicals and the expected pH levels of the waste. Their findings showed concentrations were not high enough to cause metal equipment to fail.

In this letter, USDOE claimed the erosion and corrosion issues at WTP would be closed by July 30.

By that time, USDOE was to verify Bechtel's:

- Evaluations of the erosive power of Hanford's **tank waste**.
- Estimates of piping and tank erosion from waste particles to ensure they were representative of the tank waste.
- Corrosion evaluations and whether they had been updated to account for erosion.

Based on their findings, USDOE would then "review the need for modifications to the design required to accommodate changes in erosion allowances, if any."

In early July, Ecology issued two Notices of Non-Compliance about erosion and corrosion at WTP to USDOE and Bechtel.

The first is documented in a letter sent on July 1, that was sent after an inspection in late May. Ecology staff observed workers fabricating tanks without ½-inch-thick by 20-inch-diameter wear plates on the bottoms for erosion protection from **pulse jet mixer**s. Bechtel had independently approved design changes deleting the wear plates from those tanks. Our letter to USDOE and Bechtel stated that their "decision to eliminate wear plates reflects unwarranted confidence in the accuracy of predictions based on studies that are not completely applicable. This potentially places WTP operating life at risk due to failure to include adequate design margin associated with uncertainty and variability."

Erosion & corrosion at WTP... *Continued on page 6*

Low-Activity Waste Facility receives new equipment

Left: Two tank agitators awaiting installation in the **Low-Activity Waste** (LAW) Facility. These agitators will mix LAW in the processing tanks to aid sampling and suspend solids.

Unlike the **mixed waste** piped into the **Pretreatment** (PT) Facility from the underground tanks and the resulting **high-level waste** (HLW) stream, LAW will be less dense and viscous. Therefore, the tanks in the LAW Facility don't need **pulse jet mixer**s like the PT and HLW tanks.

Right: A LAW **offgas** exhauster. Exhausters are large fans that pull and channel offgas through a treatment system to ensure it is filtered properly. They serve an important safety function for the air quality of the facility and the surrounding environment.

Left: A carbon bed adsorber for the LAW Facility. The purpose of carbon bed adsorbers is to remove mercury, iodine, and acid gases from offgas. They help ensure that air emissions from the LAW Facility meet environmental standards and protect people and the environment. **TWTN**

Erosion & corrosion at WTP... *Continued from page 4*

There were two main issues from Ecology's point of view:

- Bechtel deleted some wear plates from WTP design without informing Ecology, submitting a proposed design revision, and requesting a permit change.
- Questions still remained about whether the tanks would last 40 years without wear plates.

Ecology required USDOE and Bechtel to install the wear plates by August 31, 2004, as was agreed to in the permitted design, or to submit a permit change proving that wear plates were not needed. We also asked them to identify other tanks with **pulse jet mixer**s from which they proposed to delete wear plates.

On July 2, Ecology issued a second Notice of Non-Compliance concerning corrosion in piping. USDOE and Bechtel had started work on piping in WTP's tank system, but their design did not meet permit requirements. In addition, the permit-required review by an independent, professional engineer had not included the piping stress calculations. (Corrosion can reduce a pipe's ability to withstand stress.) We required Bechtel to submit a justification for their piping design and to re-analyze their calculations for a specific line of piping to include corrosion.

> **"Ecology strongly recommends conducting WTP-specific laboratory testing for erosion/corrosion on tank components exposed to [pulse jet mixers]. The purpose of this would be to reduce uncertainty and provide a strong technical basis for [Bechtel's] erosion estimates."**
> *– Letter to USDOE, September 2004*

By mid-July, USDOE and Bechtel responded to the Notice of Non-Compliance about wear plates, denying that they were breaking the terms of the WTP permit because the tanks weren't actually installed. They also asked for an extension in their deadline to meet our requirements.

Following this and later interactions about wear plates with USDOE and Bechtel, Ecology started reviewing Bechtel's wear rates for many WTP tanks and doing additional calculations based on alternative interpretations of the cited laboratory data. We concluded that we could not justify their calculations and resulting estimated wear rates. We were not convinced the test data they had relied on represented WTP conditions or that they had incorporated enough margin for error or uncertainty. This brought us to the conclusion that Bechtel would have to either perform WTP-specific erosion testing or substantially increase metal thickness to account for uncertainty.

In August, USDOE responded to Ecology's Notice of Non-Compliance about piping corrosion after requesting an extension in July to meet our requirements. As we requested, they submitted a justification for their piping design, but argued that an independent, professional engineer review was not required for piping stress calculations.

In September, Ecology responded to USDOE about the wear plate Notice of Non-Compliance, strongly recommending "WTP-specific laboratory testing for erosion/corrosion on tank components exposed to [pulse jet mixers]. The purpose of this would be to reduce uncertainty and provide a strong technical basis for [Bechtel's] erosion estimates." We also considered adding a permit condition requiring ultrasonic examinations of **black cell**s when WTP is operating.

Also in September, the DNFSB reviewed new information from USDOE regarding erosion in tanks that would feed waste into WTP's melters. (For more on melters, see "Supplemental waste treatment solution clear as glass" in TWTN, Vol. 1, Issue 2.) Bechtel had found greater wear rates than first expected in mixing equipment within these tanks, and their calculations did not address wear on the mixers. (To be clear, these mixers are not located in black cells and can be replaced.)The DNFSB suggested that testing would be needed to fully understand mixing equipment wear. Bechtel said they would consider it. The DNFSB also pointed out that Bechtel had not yet fully considered the impact of glass formers being added to the waste. USDOE said they would evaluate the effects of glass formers.

In October, USDOE requested another extension in the deadline to submit a plan for addressing issues related to black cells identified in Ecology's Notice of Non-Compliance about wear plates.

2005

In January, Ecology sent USDOE a letter resolving the Notice of Non-Compliance about piping corrosion. We accepted Bechtel's justification of their piping design upon their completion of some outstanding actions. However, Ecology still felt our concerns about the lack of independent, professional engineer review of piping stress calculations were valid. To solve this, we drafted specific permit conditions requiring independent, professional engineer review of metal wear rates.

In February, USDOE responded to the DNFSB's September 2004 erosion concerns. They agreed to install some of the wear plates and an erosion-resistant coating to affected in-tank waste mixing equipment. USDOE cited computer modeling of fluids from the company that manufactured the mixing equipment to prove that erosion would not cause the tanks or mixers to fail. USDOE admitted that the company's results did not account for glass formers in the liquid waste.

In October, the DNFSB sent USDOE a letter summarizing their remaining issues with WTP design.

Above: Complicated stainless-steel piping is assembled in a module, and then the module is lowered into place in the **Pretreatment** Facility.

Back in March 2004, the Board identified issues associated with waste mixing equipment in **black cell**s. They now felt Bechtel had "developed a sufficient understanding of the requirements for mixing … fluids [containing particles]." The DNFSB reinforced the importance of USDOE's careful review of final designs, but thought Bechtel could "develop a design that meets existing safety requirements upon completion of remaining research activities and ongoing engineering work."

In December, USDOE directed Bechtel to fully review WTP design and its ability to safely process waste.

2006

In March, USDOE's Office of Environmental Management (EM) published a report identifying 28 WTP issues the Hanford USDOE office and Bechtel needed to resolve. This report was prepared by the External Flowsheet Review Team, a panel of national experts who reviewed WTP's capability to successfully process Hanford's **tank waste**. Their report classified erosion as a systemic issue that must be fixed.

USDOE-EM also noted, as Ecology did in 2004, that the estimated wear rates Bechtel used to determine metal thickness in tanks and piping weren't verified by lab testing with simulants representing Hanford's waste. The calculations used assumptions based on a few waste samples from Hanford's tanks that were slated for treatment first. But the composition of the waste in Hanford's 177 tanks varies greatly from tank to tank.

In June, Ecology sent USDOE and Bechtel a letter disapproving their metal wear rates for several tanks with **pulse jet mixer**s. USDOE and Bechtel had not provided any evidence that an independent, professional engineer had evaluated the wear rates, which is required by WTP permit conditions. In addition, Ecology staff did not agree that the wear rates were adequate. At this time, we asked them to either increase the metal thickness or to prove that their calculations were correct by doing WTP-specific erosion testing.

Ecology's main concerns stemmed from issues that had lingered since mid-2004:

- Uncertainties in Bechtel's erosion estimates for WTP's metal equipment, especially the bottoms of tanks with pulse jet mixers, due to a lack of WTP-specific testing.
- The lack of a plan for inspecting tank-wall thickness in black cells after WTP starts operating.

In August, USDOE sent Ecology a letter responding to our disapproval of their metal wear rates. They said they could not select one of the options we proposed for resolving erosion issues because the External Flowsheet Review Team was finalizing a plan to address erosion issues based on the findings from their March 2006 report. They said this plan required independent reviews of Bechtel's erosion estimates and a reassessment of the particle size and hardness of Hanford's tank waste. USDOE agreed to send Ecology the plan for review and approval in February 2007.

Ecology held a public comment period (2+2 Melter Configuration) for changes to the WTP permit from October 9, 2006, to January 5, 2007. One of Ecology's proposed changes was a new condition (III.10.E.2.d.) limiting further work on six **pretreatment** tanks with pulse jet mixers. The condition stated the hold would be released when Ecology agreed that the erosion estimates were accurate.

2007

In January, USDOE sent Ecology a letter with their comments on the proposed changes to the WTP permit. Both USDOE and Bechtel were "concerned that the changes proposed by Ecology … to stop fabrication on

six [tanks] … [would] not result in significantly greater protection of human health and the environment, but would likely impact the project's schedule because of the changes that would be necessary to current plans … to comply with the proposed permit conditions."

In February, USDOE sent Ecology a second letter responding to our June 2006 disapproval of the wear rates they submitted for tanks with **pulse jet mixer**s. Instead of increasing the thickness of the metal, they opted to do erosion testing.

In March, Ecology responded to USDOE via letter, requesting a copy of the test plan and waste simulant recipe for review. USDOE planned to complete the testing by April 2007 to maintain their project schedule, but we encouraged them to "take adequate time to plan and carry out these tests so that the results may be applied with confidence to the WTP [permit] conditions."

In October, Ecology sent USDOE a letter because we had decided to finalize the permit changes proposed in October 2006. USDOE appealed our decision.

2008

Through negotiations during the appeal resolution process that occurred throughout 2008, Ecology expanded the WTP permit condition (III.10.E.2.d.) that limited further work on six PT tanks with pulse jet mixers. We revised that condition and added two more (III.10.E.2.d.i. and III.10.E.2.d.ii.). Until Ecology approved wear rates for the entire WTP tank system, the new conditions required USDOE and Bechtel to:

- Maintain construction access to the inside of tanks with pulse jet mixers that were already installed.
- Hold installation of 11 tanks with pulse jet mixers.
- Hold fabrication and assembly of six tanks with pulse jet mixers.

In June, USDOE sent Ecology a letter, requesting that the holds on some of the tanks with pulse jet mixers be released. They wanted to close off construction access to two tanks in the HLW melter **offgas** system because it was slowing other construction activities. In addition, they wanted Ecology to allow fabrication of the six PT tanks we put on hold. USDOE reasoned that they would lose priority with the manufacturer if their order wasn't submitted by July, and that the erosion testing would be complete in late July before the manufacturer began working on the tanks in late 2008. They assured us, "In the unlikely event that the final report shows that additional erosion protection is required, the installation of wear plates or surface hardening can occur at any time prior to the installation of the six [tanks]."

In July, Ecology sent a letter to USDOE agreeing to allow work to progress on WTP tanks specified in their June letter because we were satisfied with their plan for resolving erosion issues in those tanks. The hold release was based on Bechtel's commitment to roughly double the erosion estimate after completing tests to address issues in the External Flowsheet Review Team's report. However, this release was contingent upon Ecology and independent, professional engineer approval of their revised calculations.

In October, USDOE closed the tank erosion issue USDOE-EM identified in March 2006. However, USDOE's closure report (Correspondence Control Number 167395) reflected uncertainty surrounding the tests done, noting that not enough was known about the expected particle sizes, densities, hardness, and abrasiveness of **tank waste**. Their report also stated that erosion analyses had focused on fluid flowing through pipes, not fluid being forced at high velocity out of a pulse jet mixer into tank bottoms. USDOE admitted, "As a result, it is not possible to preclude premature failure of [tanks] with [pulse jet mixers] due to erosion based on these unverified calculations." It is unclear why the issue was "closed" when it remains unsolved and the closure report reflects uncertainty.

2009

In December, Bechtel issued a report with the results of erosion testing they did to address the External Flowsheet Review Team's 2006 findings. Ecology was involved in planning the erosion testing, selecting waste simulants, and the actual testing. The testing provided limits for WTP's pulse jet mixer velocity and the average particle size and **slurry** concentration that WTP can handle.

2010

In January, the DNFSB requested that USDOE submit a report in 60 days regarding issues related to WTP's pulse jet mixers. Among other requirements, the report should outline factors affecting erosion, such as particle size and hardness, for WTP's piping, tanks, and pulse jet mixers. These factors should be set using data from testing a full-size model tank mixing liquid waste with particles in it.

In late February, USDOE requested an additional 60 days to prepare the mixer report for the DNFSB.

In May, USDOE responded to the DNFSB's concerns, reporting the results of five mixing-tank tests. They proposed changes, such as adding additional mixers and ways to clean out and inspect tank bottoms. Although erosion and corrosion were not directly addressed, changes to the waste delivery instructions for the tank farms added responsibilities like ensuring the waste did not contain large quantities of particles.

USDOE committed to further testing as necessary, but did not provide a specific plan or schedule.

In June, Ecology expressed concerns about Bechtel's design for tanks that will decontaminate sealed canisters of **vitrified** HLW. These titanium decontamination tanks will contain an acidic solution to remove radioactivity on the outsides of waste canisters. Ecology will approve installation of HLW decontamination tanks when Bechtel and USDOE resolve the following issues:

- Bechtel does not have technical justification and supporting data to defend their corrosion evaluation for the decontamination tanks.
- Bechtel did not consider corrosion of the heating and cooling coils inside the decontamination tanks. Their response to our question about technical justification for this was, "The corrosion evaluation has been revised to include a coil allowance of 0.0 inches."

In August, we responded that this answer was not acceptable because Bechtel's reasoning was, "[Titanium] appears to be an acceptable alloy, although there is no published data, or known unpublished data, on the topic. Based on an examination of the chemical and electrochemical behavior of titanium alloys and [the acidic solutions used for decontamination], no problem appears to exist."

In December, the DNFSB issued Recommendation 2010-2, *Pulse Jet Mixing at WTP*, after reviewing the revised WTP design documents and holding public hearings. Among other things, the DNFSB recommended laboratory testing on a full-scale model tank with **pulse jet mixer**s using a simulant representing the worst of Hanford's **tank waste**.

In October, the U.S. District Court approved a judicial consent decree negotiated and signed by USDOE and the State of Washington that set up a new, enforceable schedule for treating Hanford's tank waste. Included in the new schedule are some specific WTP deadlines:

- Treatment of tank waste beginning in 2019 with full operations in 2022.
- Completing treatment of tank waste in 2047.

2011

In February, USDOE accepted DNFSB Recommendation 2010-2, *Pulse Jet Mixing at WTP*.

In May, Ecology, USDOE, and Bechtel met to discuss a new plan for permitting WTP tanks not yet installed. In June, USDOE sent Ecology a letter summarizing the strategy. The agreement requires Bechtel to provide Ecology erosion and corrosion calculations for review before we approve any revisions to mixing components or the tank installation schedule.

In August, the *Tri-City Herald* reported that some USDOE scientists working on WTP disagreed with tank installation progressing despite unresolved issues, including erosion.

Left: A stainless-steel, waste-processing tank in the **Pretreatment** Facility.

Below: Stainless-steel jet pumps that channel air to **pulse jet mixers**.

On November 10, USDOE submitted a plan to address DNFSB Recommendation 2012-2. In their plan, USDOE agreed to conduct "large-scale testing with representative simulants," and committed to addressing the identified safety and operational issues. USDOE decided to re-evaluate the design of all WTP tanks and make corrections as needed.

On November 16, Ecology sent USDOE and Bechtel a letter approving the WTP design package that included the HLW decontamination tanks that we expressed concerns about in June 2010. However, "Bechtel … removed the corrosion evaluation and agreed to submit a revised [version] at a later date. Ecology must approve the revised corrosion evaluation prior to installation of the HLW [decontamination tanks]."

On November 22, USDOE sent Ecology a letter (11-WTP-430) about the metal selected for some of WTP's tanks. USDOE reviewed Bechtel's corrosion evaluations and the materials selected for WTP tanks, and found that 10 tanks were made of materials that may not withstand operating conditions. Bechtel's corrosion calculations were flawed because they did not consider the combined effects of temperature and corrosive liquids that also contain abrasive (erosive) particles.

Eight of the tanks in question are in the PT Facility, and two are in the HLW Facility. Of these, only one of the PT tanks and both of the HLW tanks are not already installed. If changes need to be made to the seven that are installed, they will have to be cut open.

2012

In January, the DNFSB shared with USDOE the results of their nine-month review of Bechtel's wear rates. The major findings were:

- Wear rates for WTP piping, tanks, and **pulse jet mixer**s are based on tests using simulants that do not compare to **tank waste**. So the assumptions used to predict whether the tanks and piping would last 40 years were not representative.
- Bechtel and USDOE have claimed, but not proven, their wear rates are protective. In some cases, the DNFSB found some of the estimated rates to be the opposite. Because of the flawed assumptions in the wear rates, experimental testing of WTP's pulse jet mixers produced flawed results.
- Bechtel and USDOE have not set up controls to ensure that equipment in **black cell**s runs safely.

The DNFSB gave USDOE 45 days to produce a report and brief them on the plan for resolving these issues.

On May 4, USDOE met with Ecology and the Washington Attorney General's Office to announce possible schedule delays due to ongoing technical issues at WTP, including erosion and corrosion.

On June 26, a USDOE scientist released a "differing professional opinion" report touching on the same issues that Ecology is also reviewing.

Ecology believes WTP's erosion and corrosion issues are fixable. We will work with USDOE and Bechtel to ensure the permitted design adequate and protective. We expect USDOE to fulfill their legal obligation to build and operate a plant that will treat Hanford's **tank waste** safely, effectively, and on schedule. **TWTN**

Glossary

Black cell: Area in WTP that will handle or process radioactive and chemical waste. When WTP is operating, the black cells will be sealed and inaccessible to humans due to high amounts of radiation. Because the equipment in these areas will have no moving parts, they will require no maintenance. The equipment in the black cells is designed to last 40 years, the lifetime of the WTP.

Columbia River: A 1,214-mile river that begins in British Columbia, Canada, flows down through Eastern Washington and heads west, forming the border between Washington and Oregon, before emptying into the Pacific Ocean. It is the largest river in the Pacific Northwest, and approximately 50 miles of it flow through Hanford.

Dangerous Waste Permit: A document outlining requirements for the treatment, storage, or disposal of dangerous waste at a specific location with the goal of protecting people and the environment. The requirements are based on Washington State's Dangerous Waste Regulations (Washington Administrative Code 173-303).

Deep geologic repository: A long-term nuclear waste disposal site excavated underground, below 980 feet, in a stable geologic environment.

Groundwater: Water below the ground surface in a zone that is completely saturated.

High-level waste: Material resulting from the reprocessing of spent nuclear fuel. This includes liquid produced during reprocessing and solids derived from this liquid waste that contain fission products in sufficient concentrations and other highly radioactive material that, by law, requires permanent isolation.

Low-activity waste: Waste that remains after as much radioactivity as is technically and economically practical has been separated from **high-level waste**. When immobilized in glass (**vitrified**), it may be disposed as low-level radioactive waste in a near-surface facility at Hanford.

Mixed waste: **High-level waste** mixed with dangerous chemicals.

Offgas: A gaseous radioactive and hazardous byproduct of tank waste treatment.

Pretreatment: The first process in treating Hanford's tank waste, which separates **low-activity** and **high-level waste** for **vitrification**.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. Plutonium-239 is the radioactive isotope used in nuclear weapons.

Pulse jet mixer: An air-driven device with no moving parts that suspends solid particles in liquid waste. It works like a large turkey baster, repeatedly sucking in

waste and then expelling it back out, to keep particles from settling.

Slurry: A liquid containing solid particles. The consistency varies anywhere from being like a milkshake to chunky peanut butter.

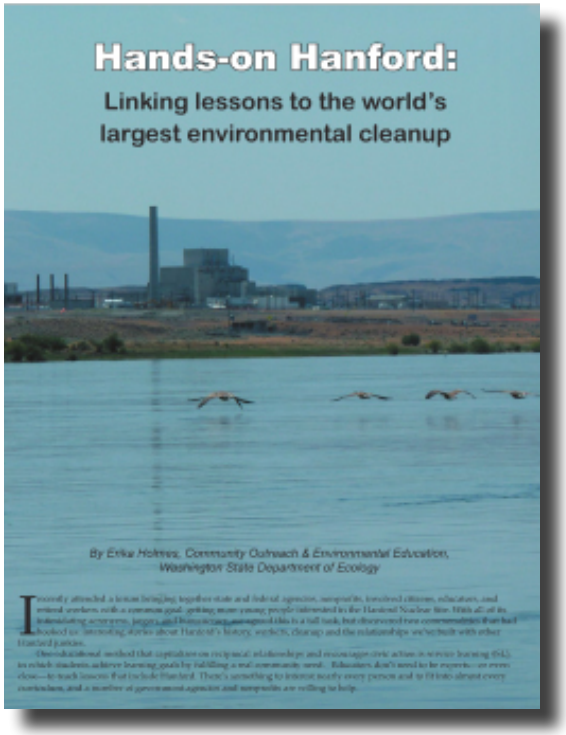
Tank waste: **Mixed waste** stored in Hanford's 177 **underground storage tank**s that was the byproduct of **plutonium** processing.

Ultrafiltration: Filtering solids from liquid using semi-permeable tubes. During ultrafiltration, the hydrostatic pressure of recirculating pumps is used to force liquid across the tube walls. Solids and semi-solids are left behind, while liquids pass through the filter. In the **Pretreatment** Facility at WTP, ultrafiltration will separate solids greater than 0.3 microns from tank waste.

Underground storage tank: A tank that is entirely below the surface of and covered by the ground. At Hanford, two types of underground storage tanks have capacities ranging from 50,000 to one million gallons. The **single-shell tank**s have one steel liner encased in concrete and are do not comply with State environmental laws. The **double-shell tank**s have two steel liners in concrete and are compliant because they can detect and contain leaks.

Vitrification: A method used to immobilize waste (radioactive, hazardous, and **mixed**). This involves mixing glass formers and waste and melting the mixture into a glass form that cools into a solid. This process stops waste from leaching into soil and groundwater.

Waste Treatment and Immobilization Plant (WTP): Facility designed and built to thermally treat and immobilize (**vitrify**) tank waste at Hanford.



Environmental education journal features Ecology's Hanford outreach efforts

Late last year, the environmental education journal *Clearing* called for articles for their annual compendium issue. With the majority of readers in, and content focused on, the Pacific Northwest, it's a great opportunity to share ways local teachers can bring Hanford into their lessons.

The article submitted by Ecology covers some of the projects we have done with college students and some shorter classroom activities with younger students. It also overviews Hanford history, the cleanup effort, and Hanford-related classroom resources.

To read "Hands-on Hanford: Linking lessons to the world's largest environmental cleanup," see page 24 in the *Clearing Compendium*.

Then, email Hanford@ecy.wa.gov or call 800-321-2008 to start planning a classroom presentation or activity with Ecology's Nuclear Waste Program! **TWTN**

Public Comment Period Hanford Dangerous Waste Permit

May 1 – October 22, 2012

Voice your opinions on Ecology's permit that regulates Hanford cleanup!

Send comments or questions to:
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3100 Port of Benton Blvd.
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More information

Join Ecology's Hanford Education & Outreach Network

Follow these links to our Facebook page, email list, and ECOconnect blog. All three tools are moderated (spam free!), and we encourage participants to share and discuss Hanford information, resources, and events.

If you need this document in a format for the visually impaired, call the Nuclear Waste Program at 509-372-7950. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.