

# Third Quarterly Cost Report

Industry bracing for 2020 (p. 24)

# **REALITY CHECK**

FOCUS SHARPENS ON PROGRESS AND RISKS AHEAD FOR FEDERAL HANFORD SITE'S EPIC \$17-BILLION NUCLEAR WASTE CLEANUP PROJECT (P. 16)

DOD PUBLICATION

# **CONFRONTING THE PAST**

17 YEARS IN THE MAKING, A KEY PART OF A NOVEL APPROACH TO CLEAN UP THE HANFORD SITE'S LEGACY NUCLEAR WEAPONS WASTE NEARS COMPLETION. BUT BIGGER ISSUES REMAIN TO BE SOLVED BY TIM NEWCOMB AT DOE HANFORD, WITH DEBRA K. RUBIN

CAUTION

RADIOACTIVE MATERIAL AREA RADIOLOGICAL BUFFER AREA

Entry Requirements:













he relics of the nation's World War II and Cold War past spread across 580 sq miles of a desert plateau in southeastern Washington state in the form of decaying buildings and storage tanks that sustained plutonium production from 1943 to 1987. For more than three decades at the massive Hanford site near Richland, Wash., the U.S. Energy Dept. has tasked employees and multiple contractors to assess and clean up the daunting environmental legacy of

making America's nuclear weapons. Billions of dollars have been spent, but billions more are needed.

Now, one of the largest pieces of the cleanup program nears a milestone after 17 years and \$17 billion of construction: startup of the first phase of a new production complex to transform much of Hanford's 56 million gallons of longstored radioactive waste—a by-product of years of weaponsmaking—into inert glass. Nearly 3,000 on-site employees are attached to the project, including 1,500 trades workers. But as it pushes to meet court-imposed mandates, the project and its innovative technology still face big technical and funding uncertainties and stakeholder skepticism.

The Hanford Tank Waste Treatment and Immobilization Plant, dubbed Vit Plant, was conceived nearly two decades ago to pump radioactive waste from 177 aging underground tanks, 60 of which have leaked to the subsurface. Using vitrification technology, the pumped waste will be heated to 2,100° F and blended with glass-forming materials. The molten mixture will be poured into stainless steel canisters to cool and solidify, protecting humans and the environment from its radioactivity as it dissipates over hundreds to thousands of years. The technology has worked elsewhere—in France, Japan, Russia and the U.K., and has been used to treat 40 million gallons of waste at DOE's Savannah River site in South Carolina—but never at this scale, nor for Hanford's complex waste mix that includes up to 1,800 other hazardous chemicals.

"One of the last major challenges left, if not the last major challenge left, is to get the waste out of those tanks and turned into stable forms where we will store the waste," says Erik Olds, DOE deputy project integration manager at Hanford. The plant's plan and construction has been led since 2002 by Bechtel National Inc. The work

**LONG JOURNEY** Aging underground nuclear waste tanks dating to the 1940s (top) at the U.S. Energy Dept.'s Hanford former weapons site in Washington leaked into groundwater. A \$17-billion production complex to turn treated waste into glass for long-term storage is under construction with some smaller facilities ready to test (center), but technology issues dog completion of one key plant for high-level waste (bottom).



spans 65 acres and includes four major components: a 12-story pretreatment facility to separate waste streams for treatment by radioactivity level; a smaller plant to vitrify low-activity wastes; a six-story structure measuring 440 ft by 275 ft to treat high-level waste streams; and an analytical laboratory. In all, Bechtel is now designing, constructing and commissioning the world's largest radioactive waste treatment plant.

But the project—based on a design in a 1997 environmental impact statement—has been plagued by delays, and its costs have also risen significantly. The current price tag remains a moving target more than a decade from full completion. Years and billions of dollars beyond the original scope, DOE has tamped down expectations as safety and quality assurance issues emerged in the high-level waste (HLW) treatment process, some raised by whistleblowers. Originally intending to treat all waste in a single stream, DOE in 2013 moved to create what is now called the Direct-Feed Low-Activity Waste (DFLAW) process, which will allow treatment of 90% of tank waste, considered low-activity, through a designated vitrification plant as engineers work out technical and design issues for high-level waste treatment.

Last month, Brian Vance, who heads DOE operations at Hanford, told the Washington Dept. of Ecology in a "notice of serious risk" that his agency "cannot project with certainty" when the high-level waste or



ACTIVITY Waste treatment complex facilities at Hanford include one to pretreat waste by level of radioactivity (top, left) on which work has stopped as technical issues are addressed, and one to treat low-level waste that must operate by 2023 (bottom, left). Liquids vessels, each 160 tons, are readied for installation (top, right) while workers finish interior construction on one building (bottom, right).

PROCESS

Waste in Hanford's single- and double-

shell tanks must be

pumped to treat-

ment facilities.



pretreatment plants will be completed. The state has some legal oversight over cleanup activity. A 2016 agreement with the state mandates Bechtel to demonstrate the ability of both facilities to work with radioactive waste by 2033 and reach full operation by 2036. "We're still reviewing the notice and its implications," said a state agency spokesman. The state has been in talks with DOE since spring, when its top environmental official asked for a "frank discussion" of project challenges. With a new process configured to separate waste streams, DOE said in a statement it "remains firmly committed to, and is on schedule to meet" a December 2023 target to treat low-activity waste.

# BRAPHIC COURTESY DOE

Even so, a congressionally mandated National Acad-

emies of Science draft report issued in mid-September raises concerns about the plant's ability to treat the large amount of low-level waste in time to meet the deadlines, based on existing design. The draft study noted options such as expanding the plant, which could push its cost to \$20 billion or higher, or cheaper treatments such as grouting or fluidized-bed steam reforming that would turn waste into a ceramic-like material. But it cautions that because the approaches have not been fully developed or tested, the "large attendant uncertainties" mean costs could be much higher. DOE and the state announced last month a new round of talks on cleanup strategies and deadlines, possibly through a

and are set to wrap up by next July.

# End in Sight

While work on the high-level and pretreatment facilities has been stopped since 2012 as question marks about the process remain, for the first time DOE is "laser-focused" on DFLAW process startup by 2023, Vance told attendees of a DOE cleanup workshop in September, according to industry publication Weapons Complex Monitor. "Once you turn it on, you operate 24/7, 365," he said.

professional mediator. They will start in November,

Says Valerie McCain, Bechtel principal vice president and Vit Plant project director.: "We are really at a stage we have never been at before. People can see the end is in sight."

The cleanup cost of the entire 580-sq-mile Hanford site in future ranges anywhere from \$323 billion to \$677 billion, based on changing estimates, with annual federal spending of about \$2.5 billion. About \$690 million of that money goes to the Vit Plant's DFLAW project each year. But Olds, who now manages it, says uncertain funding strains progress. The House of Representatives fiscal 2020 spending bill restores about \$381 million to the





LABORING More than 1,500 craft workers are part of an estimated 3,000-person workforce involved in building the Hanford waste vitrification complex.

overall Hanford site cleanup budget cut out of the Trump administration budget proposal, but still is \$37 million less than FY19 funding. The Senate version, still in committee, seeks a higher amount.

Rep. Dan Newhouse (R), who serves the district that includes Hanford and helped push up funding, says he constantly monitors the project and is confident in the DFLAW initiative. "The federal government has a legal and moral obligation to complete the cleanup, and we must ensure the significant resources going toward the effort," he says.

### Infrastructure

That effort is showing progress in terms of connecting the key plants, along with supporting facilities and systems, plus interconnecting piping, electrical and utilities support. Nearly 36%-64 of 180 total sys-

"It's extremely troubling if NNSA intends to proceed," he says.

The environmental groups, which include the Natural Resources

Defense Council and Oak Ridge Environmental and Peace Alliance,

challenged NNSA's 2016 revision to the facility's 2011 construction

plan for one large "big box" building to hold the entire facility. That

design was scrapped when its cost was estimated at more than

\$19 billion. The facility then was designed to have several smaller

component structures, with parts of the original plant refurbished,

PHOTO COURTESY DOE

# \$6.5B US URANIUM PLANT IS BIG, BUT SHARES LITTLE

t took years of debate and funding battles to move to modernize critical World War II-era uranium processing facilities at the U.S. Energy Dept.'s Y-12 complex in Oak Ridge, Tenn. Now, with construction completed on some phases of the multibillion-dollar project that has hard budget and schedule mandates, a Sept. 24 federal court decision could upend further work.

U.S. District Court Judge Pamela Reeves in Knoxville tossed out a 2016 plan by DOE's National Nuclear Security Administration-

the agency that maintains the weapons stockpile-to change its design for the Uranium Processing Facility (UPF) at the Y-12 complex, the





using a "build to budget" strategy. **NNSA** announced that no further National Environmental Policy Act analysis was needed.

PAST AND FUTURE World War II-era uranium processing plant at Tennessee DOE site (left) will have functions replaced by the \$6.5-billion new complex (right) underway, but some original building upgrading also is being done.

country's primary site for uranium operations. Her ruling calls for additional environmental analysis of a now \$6.5-billion project first approved by the Obama Administration in 2006 that must be finished by the end of 2025. DOE/NNSA officials acknowledged the project's need for added seismic risk analysis claimed in a 2017 lawsuit filed by three environmental groups, but "in the meantime, construction ... will proceed," the government said in a statement. Nick Lawton, attorney for the three plaintiffs who sought to stop construction until required environmental review is completed, said it is not clear what legal authority the agency has to continue work.

While originally budgeted at \$650 million, added equipment and major worker safety and material security upgrades for sustained and modernized uranium manufacturing pushed up the price, NNSA said in its amended 2016 record of decision. But Judge Reeves said NNSA must conduct further NEPA review, including, at a minimum, analysis of increased earthquake risk in the region, based on a new U.S. Geological Service warning. Reeves also said previous reviews of existing Y-12 site buildings by the Defense Nuclear Facilities Safety Board found structural deficiencies in using them in new nuclear weapons manufacture. She outlined 69

MAGES: NNS

tems—have successfully completed startup and testing and are being commissioned. Another 51% (92 systems) are in startup, and the final 13% (24 systems) are nearing construction turnover to startup. "It was a transformational year for us," McCain says.

The next major project milestone, the "loss of power test," is a critical activity needed to start the facility's two vitrification melters. Once the melters reach operating temperatures, they can never shut down. The 28-day test to determine that the plant has adequate backup power in an emergency situation is set for late 2020, ahead of the 2021 commissioning deadline and glass manufacturing in 2022. The Vit Plant control room already operates 24/7, and analytical lab staff work off site with the same equipment and procedures that will be used on site next year. Olds says about 11 million gallons of waste are set to be pumped to



**BUILDUP** Construction must complete by 2025, but NNSA would not say how a Sept. 24 U.S. court ruling ordering more analysis will affect ongoing work.

improper "categorical exclusions" by NNSA to environmental requirements. The most controversial of these is what her ruling terms an "electrorefining project" that converts impure uranium metals to a purified version using electrochemical technology "that has never been used at Y-12." According to Reeves' ruling, the proposed project "would require significant investment and take three years to build."

Plaintiffs have filed a Freedom of Information Act request to have the facility budget and schedule released. "I predict the budget is more than \$6.5 billion," says Ralph Hutchinson, Oak Ridge Environmental Peace Alliance coordinator, who says \$3 billion already has been spent on design. In 2018, then-UPC project director John Howanitz told a local group that staying on schedule and budget "will be challenging."

An NNSA spokesman declined to provide ENR with any details on the scope of the project or on its cost and schedule, including project progress. He also would not approve for release to ENR the facility. "To have actual discussions about operations ... on site is a great place to be," he says.

Hanford's tank farm, run by AECOM-led Washington River Protection Solutions, stages the waste and delivers it to a separation process tank. Engineering to send waste from one part of the site to another posed challenges, says Rick Holmes, general manager for Waste Treatment Completion Co., a joint venture of Bechtel and AECOM. Once waste moves into the Vit Plant purview, managed by Bechtel, it will be analyzed and processed into vitrified glass. Holmes says one hurdle in the turnover and handover phase is ensuring that equipment, some installed in 2002, meets current protocol standards. This process, he says, requires extensive testing and, at times, process alterations. The final step requires transporting glass to a 1-million-cumeter, \$25-million on-site disposal facility operated by

design and construction informaton the agency received from its EPC contractor/project manager, Consolidated Nuclear Security LLC, of which Bechtel National Inc. is majority partner and Leidos is a teaming partner, at ENR's request. CNS also operates the Y-12 site and NNSA's Pantex plant in Texas.

Based on NNSA online information and media reports, CNS will replace a set of deteriorating buildings called 9212 that were built in 1945, where enriched uranium is recycled from disassembled nuclear weapons for stockpile maintenance and to provide fuel for U.S. Navy submarines and aircraft carriers. More than 300,000 cu yd of soil were excavated from the site and replaced with about 132,000 cu yd of concrete and 42,000 cu yd of engineered backfill to build the foundation for three new site buildings that required 210 concrete placements and nine 3-ft-deep lifts. Local media say the project is the largest ever in Tennessee. A CNS spokeswoman said about 1,350 workers are on site, with reports predicting up to 2,200 at peak construction through 2022. The main processing building, which will handle high-risk materials, will be 240,000 sq ft and three stories high and cost \$4.7 billion. The first vertical wall was completed in May. Work continued over the summer to install the remaining 27 vertical wall sections for the building's first floor.

The shell of a 66,000-sq-ft mechanical and electrical support building was completed this summer for an estimated \$284 million. Steel columns, each 60 ft tall and weighing up to 12.5 tons, were also installed on the \$1.2-billion, 127,000-sq-ft salvage and accountability building that will handle low-risk material at the site. A 24,000-sq-ft, \$140-million support facilities building will store non-nuclear materials. Two of three areas that are part of the \$164-million refurbishment also are complete. The NNSA spokesman said there has been no decision by the U.S. Justice Dept. on an appeal to last month's ruling.

By Mary B. Powers



Hanford contractor CH2M Plateau Remediation Ltd. Creation of the DFLAW approach required adding both a new effluent management facility and the lowactivity waste (LAW) facility. The former will handle secondary waste liquid generated in treatment, and the latter is a 330-ft-long, 240-ft-wide and 90-ft-high concrete structure designed to mix waste with silica and other glass-forming materials before it reaches the two 300-ton melters.

At about 20 ft by 30 ft and 16 ft tall, the world's largest waste glass melters will create vitrified glass resting in containers 7 ft long and 4 ft in diameter, weighing more than 7 tons each. Holmes says a mixture recipe is generated for each waste batch by the lab in conjunction with DOE and Pacific Northwest National Laboratory experts. "Nothing I have ever done has prepared me for this," Holmes says. "The scale is a pretty significant leap. I am doing stuff nobody else is doing." With melters designed for an annual throughput of about 1.75 million to 2 million gallons of tank waste per year, each melter has a five-year operating life. A third melter will be on site before treatment begins. DFLAW has a 40-year design life.

While DOE says that previous outstanding technical and design questions on the DFLAW process have been answered and cleared by the state, the high-level waste process, by contrast, remains in design and it is unclear whether it, along with the pretreatment facility, will be finished. "I would be jumping ahead to give you a conclusion," Olds says.

Of nine main technical issues raised on the pretreatment structure, two remain unsolved. Compounding uncertainty, in June DOE proposed guidelines to reclassify some high-level waste as low-level—a move Hanford watchdog groups adamantly oppose and LONG TERM Treated low-level nuclear waste will be permanently stored at this Hanford disposal site. Washington Gov. Jay Inslee (D) termed "reckless." While supported by some local groups to speed cleanup and accelerate some Hanford redevelopment, the reclassification was banned in language added earlier this year to a House-passed spending bill. DOE officials at Hanford have said that they have not committed to any change.

DOE says a U.S. Army Corps of Engineers analysis of options and money scenarios to evaluate the likelihood of reaching key consent decree milestones for the HLW and pretreatment plants indicates there is a "low probability" it can do so "under the current funding profile." To meet this challenge, DOE has contracted with an independent firm to develop alternatives by late 2019 for future decisions.

### **Future Doubts**

Tom Carpenter, executive director of leading site watchdog group Hanford Challenge, says no part of the Vit Plant should operate short of a complete and independent inspection that validates and verifies nuclear treatment quality.

"DOE seems to be doing everything in its power to simply walk away from its legal and moral obligations to deal with Hanford's extraordinary radioactive waste inventories," he contends, related to the proposed waste reclassification. "I seriously doubt the HLW facility will ever operate for numerous reasons, and DOE will simply find that the waste is low-level, not high-level, dump concrete on the whole mess and call it good."

While Carpenter supports vitrifying tank waste, he has concerns with what he calls consistent design flaws, a lack of quality control and a "poor nuclear safety culture." Carpenter cites whistleblower lawsuits and reassignment of employees who raised safety concerns.

For DOE and Bechtel, the focus remains on the 90% of waste they know they can successfully treat via the DFLAW process."There have been quality issues in the past that slowed things, but those have been addressed," McCain says. "Having legacy issues behind us was a big burden off the project."

David Reeploeg, vice president of federal programs for local economic development group TRIDEC, is encouraged with the progress made in recent years, but says funding remains the "single biggest challenge." Not only does the project need hundreds of millions of dollars every year to meet milestones and agreements, he says it will be "critically important for DOE and its regulators to identify ways to reduce the long-term cost and schedule for Hanford cleanup," something that the Vit Plant's history has already shown won't be an easy task.