ORP, CHG team up with experts on leak detection

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Led by the Department of Energy Office of River Protection and CH2M HILL Hanford Group, a team of experts from Pacific Northwest National Laboratory, other DOE sites and national laboratories, universities and private companies are narrowing the field of new Hanford external tank leak-detection technologies.

The ability to detect and assess a potential leak more quickly will help reduce the risk to public health and the environment during efforts to retrieve millions of gallons of solid waste from Hanford's older tanks.

In the past, 67 of the 149 single-shell tanks have leaked or are assumed to have leaked approximately a million gallons of highly radioactive and hazardous waste into the soil. To reduce the risk of future leaks, the liquid portion of the waste in the older tanks is being pumped into newer, safer double-shell tanks. Now, ORP and CHG are preparing to retrieve the remaining solid waste so it can be turned into glass in a planned treatment facility on the Hanford Site.

Above: Pacific Northwest National Laboratory project manager Brent Barnett checks equipment inside an open-top mock tank in the 200 East Area. PNNL led demonstrations of six external tank-leak detection methods in August as part of an effort by the DOE Office of River Protection and tank-farm contractor CH2M HILL Hanford Group to identify a new detection system that can more quickly determine the size and location of leaks.

Retrieval efforts will involve using water to dissolve and transport waste from the tanks so it can be sent through pipes to double-shell tanks. To reduce the amount that a tank could leak during retrieval, what is needed is a method of detecting leaks around and below the entire 75-foot width of a tank, in addition to existing or planned in-tank detection methods.

Beyond boreholes

In the past, methods for detecting leaks outside the tanks have consisted primarily of lowering equipment into boreholes in the soil around the tanks. Radiation surveys can detect gamma-emitting radioactive contaminants in the soil, and neutron probes can detect moisture. The drawback in these methods is the fact that contamination in the soil has to be within a few feet of the boreholes for reliable detection.

In January, experts from across the country met at Hanford to narrow a new field of 20 possible leak-detection methods to six leading-edge technologies that have the greatest likelihood of success under Hanford Site conditions.

"We are reaching out to the best and the brightest people in this field to help us improve our ability to detect leaks around tanks," said Rick Raymond, vice president of projects for CH2M HILL Hanford Group. "We're moving forward to reduce the risk by retrieving the remaining waste in Hanford's older tanks, and better methods of leak detection are important to our progress."

Demonstrations conducted

PNNL led the demonstration of the six technologies around a mock tank in the 200 East Area this past summer. The mock tank is the full width of the typical Hanford single-shell tank. It is open at the top, with half its 20-foot height buried 8 to 10 feet in the ground.

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The mock tank setup included a 5,000-gallon storage tank and a system of PVC (polyvinyl chloride) pipes to distribute a simulated tank leak liquid at various locations along the bottom or sides of the tank. The liquid was an environmentally friendly, non-radioactive saline solution, similar to tank waste in density, viscosity, ionic strength and electrical conductivity. The liquid has been safely used as a simulated tank waste solution in other Hanford vadose zone plume-tracking activities.

The goal of the demonstrations was to identify more sensitive, reliable and cost-effective leak-detection methods. The new technologies will use computer modeling to analyze the data so operators can more quickly determine the size and location of leaks. That is a major advantage over existing point-source measurement techniques that provide several smaller "snapshots" at a single point and require waiting for a leak to move to a borehole before it is detected.

A report evaluating the six leak-detection methods demonstrated will be issued this fall.

Officials also hope to determine whether or not they can use the existing system of steel-cased boreholes around Hanford's single-shell tanks for the new leak-detection system. The boreholes were drilled over the decades to support past tank leak-detection and soil-sampling efforts. There is little space for new boreholes because of the existing infrastructure of contaminated pipes and other equipment buried in the ground around the tanks. ✦

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Left: Lawrence Berkeley National Laboratory's Susan Hubbard lowers radar equipment into a borehole to make an image of a simulated tank leak. Several PVC- and steel-cased boreholes were installed around the mock tank. To simulate a tank leak, an environmentally safe, non-radioactive saline solution was introduced into the soil.

The leak-detection technologies

Six methods for detecting leaks in the soil around Hanford tanks were demonstrated at a mock tank in the 200 East Area this past summer. Several PVC- and steel-cased boreholes were installed around the mock tank, and leak-detection equipment was deployed, which included lowering equipment into the boreholes.

The six leak-detection methods are of four basic types:

- **Tracer gas method** — Also called Partitioning Interwell Tracer Tests, this method involves pumping air into a borehole and through the soil under the tank. Gas tracers that dissolve in waste are injected into the airstream, extracted at a borehole on the other side of the tank, and analyzed using gas chromatography. This method is a proven technology and has been used in the environmental remediation industry to detect and measure contamination in the soil.
- **Electrical methods** — Three electrical methods were also demonstrated. Two methods charge the ground with electricity and use detectors to sense how the current moves through the soil. Current passes through moisture more quickly. A third operates much like a metal detector, using a coil of wire to create a magnetic field that interacts with the leak.
- **Borehole seismic method** — To make an image of a leak, this method uses sound reflecting off the target — in this case the high-density, simulated tank waste. The method also provides information on site geology, including soil types and soil-layering features.
- **Radar method** — This leak-detection method is similar to the borehole seismic method, except that radio waves are used to produce an image of the leak.

The demonstrations were led by PNNL, with support from the University of Texas at Austin, Duke Engineering Services, Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory and HydroGEOPHYSICS, Inc. ✦