

# Washington Group International

DELMIA simulation tools empower cleanup of nuclear waste



## Overview



### ■ Challenge

*The US Department of Energy needed training tools to simulate toxic chemical removal at the worlds largest treatment plant for nuclear waste.*

### ■ Solution

*As principal subcontractor to Bechtel, Washington Group International is using DELMIA ENVISION to build life-like, real-time simulations for training in remotely controlled robotics—and zero-error methods.*

### ■ Benefits

*Based on the high cost and long downtime required for repairs in contaminated areas, return on investment (ROI) in simulators is projected at between 50:1 and 100:1.*

“ENVISION is very powerful. We are confident it is going to meet the needs of the WTP operations personnel as a great productivity tool. It satisfies the need for utilization of the plant because training operators is critical and costly. They will learn how to access and remove devices and jumpers without any collisions.”

Kent Ozkardesh  
WTP Simulator Project Manager  
Washington Group International

### Largest U.S. Environmental Cleanup

Washington Group International (WGI) is a leading US engineering, construction and management company. WGI has partnered with Bechtel International Inc. on the Hanford Reservation environmental cleanup project commissioned by the US Department of Energy.

Washington State’s Hanford Reservation was a major component of the Manhattan Project that helped end World War II and the Cold War. Now Hanford is the largest environmental cleanup in U.S. history – costs are projected at several billion dollars over 40 years.

The U.S. Department of Energy (DOE) estimates that preventing further contamination and then cleaning up the site will take until about 2030. Though remote, the Hanford site is on the Columbia River, the main source of water for several million people in Washington and Oregon.

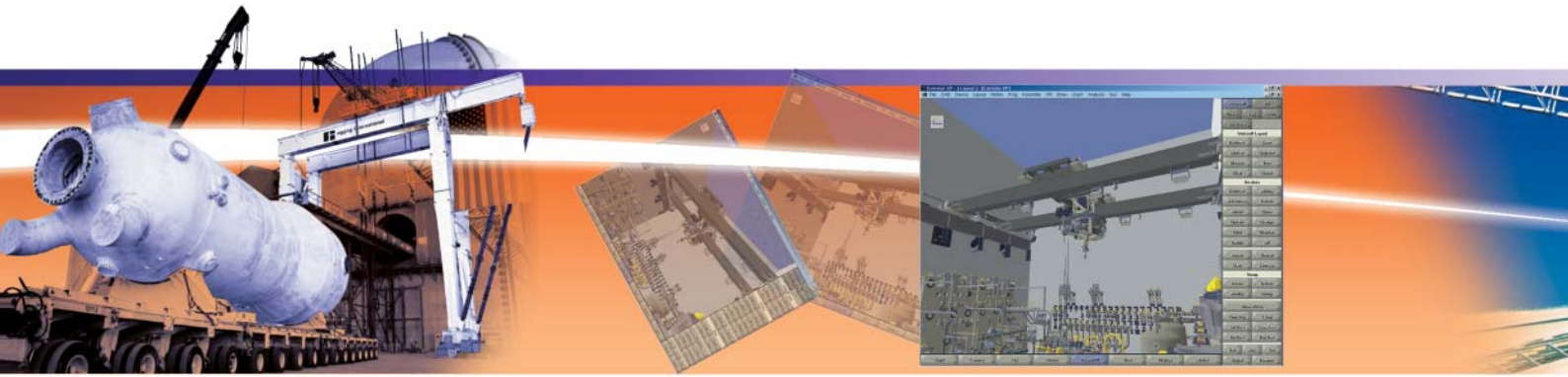
The Hanford Waste Treatment and Immobilization Plant (WTP) treats chemically hazardous liquids, sludges and solids, much of which is also highly radioactive. Hanford’s wastes – 53 million gallons – are stored in 177 underground steel-lined concrete tanks, some dating back to the 1940s.

Hanford’s three nuclear reactors and their processing facilities were shut down in the 1970s. Left behind were 1,700 separate waste sites, according to the DOE, and 500 contaminated facilities. A multi-year project, WTP will be the world’s largest radiochemical treatment facility, the DOE and Bechtel say.

### Safety Is Critical

To ensure uncompromising safety at WTP, and that the plant will start the cleanup at high productivity, Bechtel International Inc. and Washington Group International have partnered to develop five training simulators for operators.



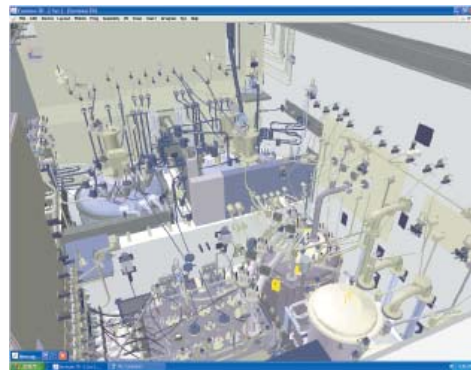


“ENVISION lets us work side by side with the WTP engineers on the design the WTP, instead of developing something and throwing it over the wall. Without that continuous feedback, the users would have to spend a year tweaking it to work properly.”

Kent Ozkardesh  
WTP Simulator Project Manager  
Washington Group International

“Our training simulator focus is on zero errors and on making sure we have people with the right skills,” said Dave Mueller, training specialist and simulator lead for Washington Group. He is pushing simulation capabilities for size, speed, realism and simultaneous video input.

The prime contractor, Bechtel National, Inc., will have performance fees associated with the number of canisters of waste it produces. For this reason, there will be a high productivity incentive on operator skill and efficiency.



Simulation model created with DELMIA for the high-level waste melter in Waste Treatment and Immobilization Plant (WTP) under construction at the U.S. Department of Energy’s Hanford, WA, site by Bechtel. Image courtesy of Washington Group.

### Simulation Productivity and Collision Avoidance

Working with DELMIA’s ENVISION software, Kent Ozkardesh, Simulator Project Manager, is building two simulators for Hanford WTP crane operator training and three more for the WTP’s distributed control systems (DCS) that manage the process side of the facility.

The three crane operator simulators will be used to train operations personnel in the pretreatment facility and the high-level radioactive waste facilities. The Hanford WTP will have 145 different chemical processes and 17 material handling (MH) systems to maintain and operate. The MH systems consist of overhead bridge cranes with trolleys, robotic manipulators, hoists and a variety of tools known as robot end-effectors. Eight of the 17 cranes can be operated simultaneously.

WTP has five processing areas, known as canyons because their reinforced concrete walls, 35 to 50 feet high, are lined with tanks and piping several layers deep. The pretreatment “canyon” will be about 600 feet long.

### 114 TV Cameras for Eyes

WTP crane control operators will run the plant remotely with joysticks and pushbuttons. For eyes the operators will have 114 remotely controlled TV cameras mounted throughout the WTP, on the overhead cranes and on the robotic manipulators.

Operators must be able to see, so the simulators must handle the simultaneous output of any four of the 114 camera views—and they must achieve a rate of 30 frame updates per camera per second. Every camera view, angle, zoom, pan and tilt must be modeled.

Hanford WTP crane operator simulators need high-end video performance to provide the virtual reality of the physical



plant responses. Right out of the box, ENVISION supports the key training features needed with Freeze, Resume, Snapshot, and Restore. They are essential for repetitive scenarios and operator training review sessions.

represented. Specifications also require that the simulators give correct logic responses to hardwired interlocks and any detected collisions.

“People are always going to make errors as part of the learning process. We want the operators to make ALL their mistakes on the simulators in a safe environment with no real-world consequences.”

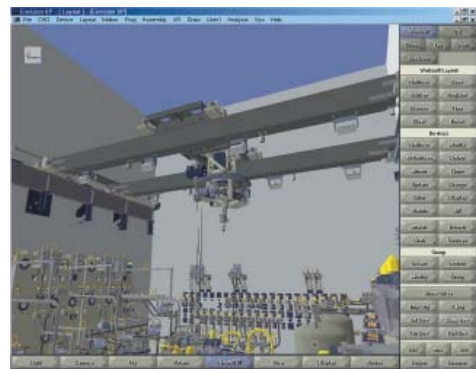
Dave Mueller, Simulator Lead  
Washington Group International

Linking each of these devices to its programmable logic controller (PLC), to the overall plant control system, and to the operators’ consoles plus hard-wired interlocks “takes a total of about 20,000 input/output (I/O) points,” Ozkardesh noted. “That is four times the I/O that would be in a typical refinery.”

Two key I/O processing requirements:

- Processing 200 points per second between the MH systems and the operators’ control consoles.
- Responding exactly as if the signals were real.

“Otherwise, the simulations are of not much more value than an animated cartoon,” Ozkardesh said.



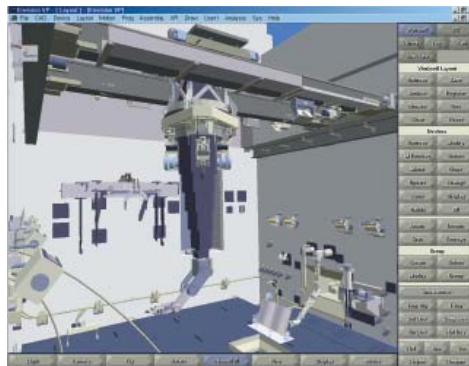
Model of one of 17 overhead cranes in the Waste Treatment and Immobilization Plant (WTP) under construction at the U.S. Department of Energy’s Hanford, WA, site by Bechtel. Image courtesy of Washington Group.

“These simulators will allow operators to develop skills and error-free performance habits without the risk and schedule impact associated with the use of actual plant equipment,” added Mueller.

### Fully Realistic Kinematics

Some 1,000 discrete devices are being modeled in the WTP crane operator simulators. Operators will manipulate them with real-time feedback between the plant control system and the crane operator control consoles.

Everything that moves will have fully realistic kinematics. Every degree of adjustment, rate of change and mechanical stiffness will be



Robotic manipulator mounted on trolley beneath overhead crane in Waste Treatment and Immobilization Plant (WTP) under construction at the U.S. Department of Energy’s Hanford, WA, site by Bechtel. Image courtesy of Washington Group.

## Robustness, Accuracy and Flexibility

“Despite the project’s enormous size and almost overwhelming complexity, no potential limitations of ENVISION have been reached,” Ozkardesh said. “Accuracy is demonstrated in ENVISION’s ability to model the entire WTP in the simulators—millions of cubic feet—to one-sixteenth of an inch or less.”

“We use the ENVISION Graphical Simulation Language (GSL) for device interlocks, device behavior and potential malfunctions. Its power lets us model the field logic of the thousands of PLCs in the plant,” he continued.



Crane operator’s control panel with six joysticks to be used in the Waste Treatment and Immobilization Plant (WTP) under construction at the U.S. Department of Energy’s Hanford, WA, site by Bechtel. Image courtesy of Washington Group.

## Getting to the Final Process, Vitrification

The product of the Hanford WTP will be chemically inert glass “logs” of radioactive wastes that will be isolated for thousands of years, until the radiation declines to harmless levels.

After chemical processing, the wastes will be combined with silica at 1,000 degrees centigrade, cooled and welded into stainless steel canisters. Ultimately several hundred thousand canisters will be shipped to permanent storage facilities.

“The simulators will provide the ideal environment to develop and ensure efficient and safe WTP operations by the control rooms,” Ozkardesh concluded.

“Despite the project’s enormous size and almost overwhelming complexity, no potential limitations of ENVISION have been reached.”

Kent Ozkardesh  
WTP Simulator Project Manager  
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