The West Valley Demonstration Project size-reduced the Process Mechanical Cell cranes with an oxy gasoline torch and plans to use the technology in future decontamination and decommissioning applications at the site.

Getting "Fired" Up

Size-Reduction with an Oxy Gasoline Torch

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The West Valley Demonstration Project (WVDP) was established to manage liquid high-level radioactive waste at the site of the former and only commercial spent nuclear fuel reprocessing facility to have operated in the United States. The reprocessing plant was constructed in 1966 and subsequently operated by Nuclear Fuel Services (NFS). Operations ceased in 1972 after approximately 700 tons of spent nuclear fuel was reprocessed, resulting in about 600 000 gallons of liquid high-level radioactive waste left in underground storage tanks.

In 1980, Congress passed the WVDP Act, authorizing the U.S. Department of Energy to conduct a nuclear waste management demonstration project at West Valley.

The PMC was used in former reprocessing operations to mechanically size reduce the irradiated fuel and prepare it for chemical processing. The newly installed crane system will allow cleanup of this material from the PMC.

A D&D operator sprays a fixative coating on the failed crane equipment planned for size-reduction at West Valley. The coating helps to minimize airborne contamination.

Since 1982, the DOE and its partners—the New York State Energy Research and Development Authority and the prime contractor, West Valley Nuclear Services (WVNS)—have demonstrated that the high-level waste can be safely and successfully placed into a vitrified waste form that provides long-term stability in the environment. Since 1996, the WVDP has produced 258 canisters of vitrified HLW glass, which are being stored in an on-site facility until a federal repository is available to receive the waste.

The PMC Cranes

The WVDP has now turned its focus to decontaminating certain portions of the facility that were used by NFS during reprocessing operations prior to the DOE's assuming control of the site. Much of the work must be conducted remotely due to the high levels of radioactivity and contamination present in the facility's shield-

Even with changes to the room ventilation, the thermal effects of the cutting were overcoming the normal direction of the airflow from the enclosure to the crane room.

D&D operators don flame-retardant suits and prepare to insert the 13-ft torch through the rolling hatch and down into the crane room below for cutting.

ed hot cells. Remote operations present a challenge for operators who rely on mechanical equipment to accomplish them. Because many of the facilities at the WVDP have not been used since the early 1970s, overhead cranes and other equipment in the hot cells require repair or replacement before the decontamination work can begin.

This was the case in the Process Mechanical Cell (PMC), where two cranes and a bridge-mounted power manipulator were inoperable. The PMC was used in former reprocessing operations to mechanically size reduce the irradiated fuel and prepare it for chemical processing. It was in this cell that the ends of the fuel assemblies were cut off and the fuel was sheared. Operations in the PMC were supported by the cranes and power manipulator that traveled on rails near the top of the PMC. If the cranes or power manipulator required maintenance, they were transferred into the adjacent PMC crane room for repair.

The PMC is a reinforced concrete structure that measures 52 feet long, 12 ft wide, and 25 ft high. The cell has 5.5-ft-thick shield walls and a 6-ft-thick ceiling. The floor is covered with Type 304L stainless steel, which also extends up the walls to a height of approximately 20 ft. The concrete walls above the stainless steel are coated with a carboline-based paint. General dose rates in the cell are estimated at 100 roentgens per hour, with hot spots of up to 2000 R/h.

Cleanup of the PMC will involve sorting, segregating, vacuuming, packaging, and storing debris and loose contamination to place the PMC into a safer storage configuration for future facility decommissioning. Removal of equipment and piping in the cell will be performed as necessary to ensure access to the debris and loose contamination.

The first step in decontaminating the PMC was the refurbishment of four 15-ton shielded viewing windows. (See "How to 'Do' Windows: Refurbishment of Shield Windows at the West Valley Demonstration Project," *Radwaste Solutions,* Jan./Feb. 2001, p. 37). The four windows were restored to optical clarity in 1999 to facilitate future decontamination operations and to accomplish the next step in the decontamination process: removal of the cell's two cranes and power manipulator and installation of a new single bridge having both a crane and power manipulator.

The Crane Removal Challenges

Access to the crane room was very limited and dose rates in the room were approximately 50 mR/h. The original airlock was no longer usable. Personnel access consisted of entering a hot cell located below the crane room and going up a ladder through a 4- × 4-ft hatch in the floor of the crane room. To remove the failed equipment, the large concrete hatches in the

The oxy gasoline torch at work on the failed cranes.

crane room roof had to be removed.

A new enclosure was designed and constructed over the existing crane room roof to (a) ensure contamination control during the removal of the failed equipment, (b) provide an area for maintenance of the new crane and power manipulator, and (c) provide a pathway for equipment and wastes into and out of the cell. Operations personnel removed three 10-ton concrete roof hatches that were $6 \times 11 \times 2$ ft thick. The remaining 25-ton hatch was relocated and a motorized rolling hatch installed over the opening. The rolling hatch provided ventilation control between the cells and allowed ready access to the equipment by personnel working above the crane room.

> *The WVDP conducted extensive internal safety reviews of the oxy gasoline process to ensure that the technology would be safely used for this particular application.*

The cranes being removed measured 16 ft rail to rail and 9 ft wide; each weighed approximately 7 tons. The two main girders on the cranes were constructed of two carbon-steel W14x38 beams welded together with the 3-inch rail for the trolley welded to the top. The original plan for removal of the failed cranes was to wrap the cranes in herculite, remove them from the crane room and enclosure in one piece, and place them in a waste container staged outside on the ground. Initial radiological data on the cranes showed high contamination and dose rates of 30 to 80 mR/h, with hot spots of up to 650 mR/h. With the high contamination levels, the possible spread of contamination during removal became much more likely, and the original plans were modified to package the cranes within the enclosure. Further, space constraints in the enclosure required the use of smaller waste containers, making size-reduction of the cranes necessary.

A "Cutting Edge" Technology

With size-reduction of the cranes now a necessity, the high dose rates presented an additional operational challenge: to protect the field personnel during cutting operations. The initial dose estimate based on "hands-on" mechanical size reduction was 1600 person-millirem. In keeping with the WVDP's policy of ensuring personnel exposure is as low as reasonably achievable, WVDP performed an evaluation of various cutting technologies. The oxy gasoline cutting technology was found through a technology-sharing program with the Fernald Environmental Management Project (FEMP), under the auspices of the DOE's Accelerated Site Technology Deployment Program. This program provides an avenue for DOE sites to deploy commercially available technology in new ways in order to accelerate schedules and reduce costs. The technology had been used at DOE's FEMP, the Idaho National Engineering and Environmental Laboratory, and Hanford Site.

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The oxy gasoline cutting technology uses gasoline as its fuel source instead of the typical acetylene-fueled cutting torch. The liquid gasoline is pressurized and fed to a mixer at the head of the torch. Oxygen is supplied from a cylinder through a separate line in the torch assembly to the mixer and combines with the gasoline. The resulting fuel mixture travels to the tip of the torch where it is lit. After a few seconds of preheating, the tip of the torch becomes warm enough to vaporize the gasoline at the tip. The rapid expansion results in a high-velocity stream of vapor that fuels the cutting flame.

The oxy gasoline technology has many advantages compared to the oxyacetylene torch: It cuts faster (13 minutes versus 27 min on tests using a 2-in. plate); uses less fuel and is thereby more economical; makes a cleaner, more oxidized cut producing little or no molten steel; is lightweight; cuts well through varying steel thicknesses; and is able to bridge gaps in the material to be cut that the oxyacetylene torch can't. One disadvantage that was recognized, but not relevant to the West Valley project, was that the oxy gasoline technology is not effective in cutting stainless steel. The cranes at the WVDP were made of carbon steel and, therefore, good candidates for the oxy gasoline technology.

The oxy gasoline technology also offers several safety features: The gasoline stays in liquid form until it reaches the tip of the torch, minimizing back-flash potential; liquid gasoline is safer than acetylene from a reactivity standpoint and also because there is no pressurized cylinder to handle; because vaporization of the fuel takes place at the very tip of the torch, the majority of the tip stays cool; since the gasoline stays in liquid form in the lines, it is easier to find leaks; less sparking and popping is experienced with oxy gasoline versus oxyacetylene; and it is UL tested. The WVDP conducted extensive internal safety reviews of the oxy gasoline process to ensure that the technology would be safely used for this particular application.

Planning the Work

The WVDP adapted the oxy gasoline technology for use in the PMC crane size-reduction project. The modified plan for size-reduction of the cranes was to cut each of them into four pieces: through each of the two main bridge girders and each of the end trucks. Working directly with the torch vendor, the WVDP had a first-of-its-kind, 13-ft-long cutting torch fabricated. This specially designed torch would allow the operations personnel to stand in the enclosure located above the crane room and lower the torch through the opening created by the rolling hatch to size reduce the crane. Keeping personnel out of the immediate area of the crane would greatly reduce the radiation exposure to personnel.

Before using the oxy gasoline torch in the crane room, the WVDP fabricated and constructed a full-scale mockup of the crane girder. The mockup provided a means to train the operations personnel who would use the torch in the field and to refine the tools and techniques to be used. With the operation mapped out during the mockup process, radiation exposure to personnel would be reduced even further.

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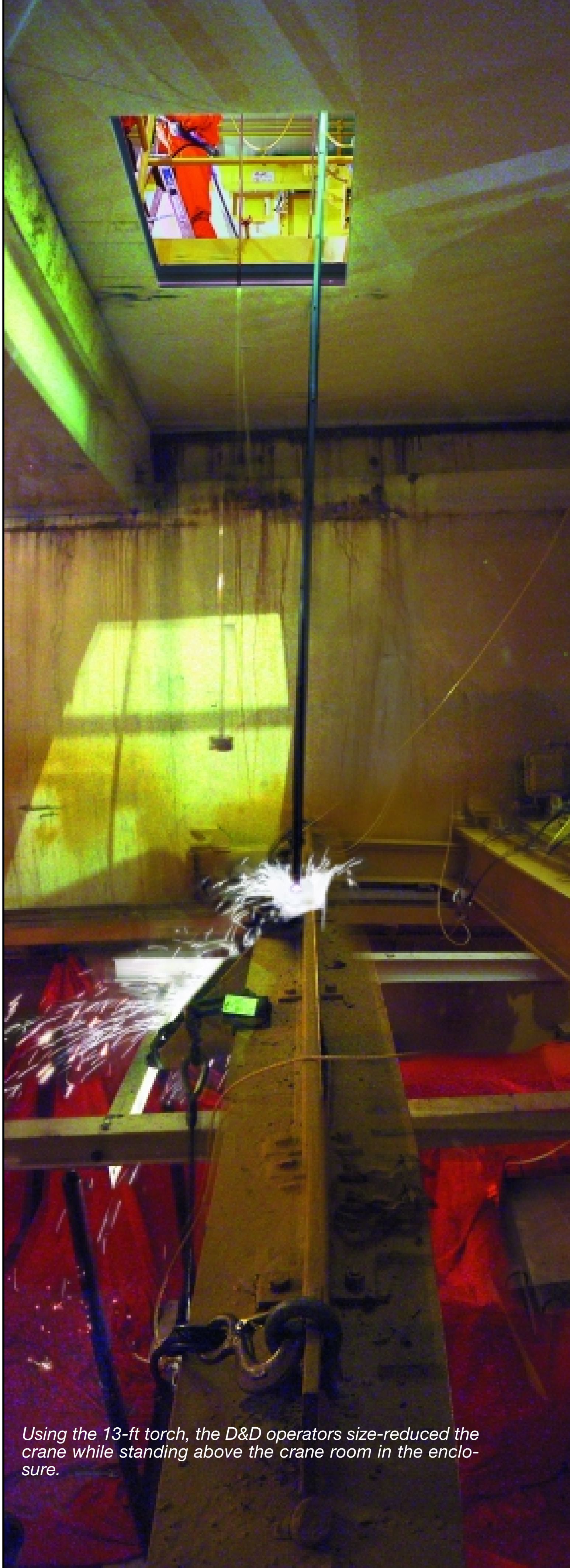
To provide added operator safety, the WVDP used remote indicating dosimetry. This commercially available equipment allowed radiological control staff to monitor worker exposure to radiation in real time. Dosimeters worn by the operations team were monitored via a computer hookup outside the enclosure and were capable of sounding an alarm if either the workers' dose rates or accumulated dose for the project were exceeded.

After successfully testing the torch use in the mockup process, operators made manned entries into the crane room to perform a series of preparatory tasks prior to the start of size-reduction. As an added measure to control the spread of contamination, a strippable coating was sprayed on the cranes and other miscellaneous pieces of equipment. The strippable coating served two purposes: First, the contamination was immediately fixed. Second, because the coating is strippable, it could be removed in the future to effect decontamination. Following application of the fixative, operators removed combustible material from the crane room and cut the crane festoons, cables, and stainless steel drive shafts. As the hoist and gear boxes still contained oils, they were removed and containerized separately for further processing.

A flame-retardant tarp was installed to cover the floor, and slag catch pans were installed under the cut points on the girders. Metal shields were installed under the crane end trucks and over the rails to protect the rails from the



Using the 13-ft torch, the D&D operators size-reduced the crane while standing above the crane room in the enclosure.

Following size-reduction, the crane pieces were lifted out of the crane room for placement in the waste container.

heat of the torch. To support the crane after it had been cut, support stands were installed on both sides of the cut areas. To eliminate the need for operations personnel to enter the crane room after the crane had been cut, the center of gravity of each piece was determined and removal rigging was installed. To add a third viewing angle for the operations personnel, a remote video camera was installed in the crane room. With this additional camera, all sides of the crane girders could be observed.

Prior to the use of the oxy gasoline torch, the WVDP performed an initial check of the ventilation system to ensure proper airflow from the PMC crane room enclosure into the PMC crane room. A commercially available fogging unit, similar to that used in theatrical productions, was used to dispense a fog in the enclosure. Operators then observed the fog to ensure the flow was from the enclosure, through the rolling hatch, and down into the crane room. The initial test showed a very turbulent, swirling airflow in the enclosure, which was then drawn down into the crane room where additional turbulent flow was observed. Minor modifications were made to better direct the air inlet duct in the enclosure and create a more laminar flow. In addition, the shield door between the crane room and the PMC was opened slightly to help increase the draw of air.

A commercially available fogging unit, similar to that used in theatrical productions, was used to dispense a fog in the enclosure.

As an additional protective measure for the operators, a continuous air monitor was placed in the enclosure to continuously sample the air in the area where the operators would be standing to check for any increase in airborne contamination levels during torch operation.

Working the Plan

Once the preliminary work was completed, the equipment required to complete the size-reduction was staged in the enclosure. Oxygen bottles and the gasoline tank were placed outside of the enclosure and supply lines were fed into the enclosure through its airlock. Operations personnel were suited in flame-retardant anticontamination

A mobile crane was used to lift out the waste containers from the enclosure for placement in storage and eventual disposal.

The waste container filled with the size-reduced crane is lowered to the ground for movement to a waste storage area at the WVDP.

clothing to complete the work. Operators lit the 13-ft torch in the enclosure and inserted it down through the rolling hatch into the crane room below the enclosure.

After an increase in the airborne contamination levels was observed during initial cutting operations, the cutting was stopped and the problem was evaluated. Even with the previously mentioned changes to the room ventilation, it appeared the thermal effects of the cutting were overcoming the normal direction of the airflow from the enclosure to the crane room. To increase the airflow velocity and prevent contamination spread into the enclosure, the size of the opening in the rolling hatch was reduced by placing clear Plexiglas™ over a portion of the opening. The clear Plexiglas had the added benefit of allowing the operators to continue to observe the torch during the cutting operation.

Following these additional ventilation control measures, cutting resumed. The two main girders were successfully cut, as were the two end trucks. Additional spray-on fixative was then applied to fix any loose contamination generated during the cutting operation. Using long-handled tools, the operations personnel attached the preinstalled rigging to the enclosure crane hook and removed the cut up crane pieces, placing them in the waste containers staged in the enclosure. Once the containers had been filled, a mobile crane was brought onsite to remove the enclosure roof hatch, and the containers were lifted out of the enclosure and placed in storage for eventual disposal.

With the first crane safely and successfully size-reduced and packaged over a seven-week period, the project team conducted a lessons learned meeting to determine how to improve the process for size-reduction and removal of the second crane. By factoring in the lessons learned and the reduced setup time, the team reduced the time to complete the removal of the second crane to two weeks. The entire project was completed between December 2000 and February 2001.

Looking Forward

The successful use of the oxy gasoline torch in this application paved the way for its use in future decontamination and decommissioning applications at West Valley. The torch is not the tool for every size-reduction job, but it has been added to the WVDP's D&D toolbox for use in the remainder of cleanup operations. ■

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Installing the new crane in the PMC. Workers are tied off for safety.