

DECONTAMINATION OF EXTRACTION CELL-2 AT THE WEST VALLEY DEMONSTRATION PROJECT

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ABSTRACT

The West Valley Demonstration Project (WVDP) is a radioactive waste cleanup project being conducted by the U.S. Department of Energy (DOE) in West Valley, New York. The WVDP is located at the site of the only commercial spent nuclear fuel reprocessing facility ever operated in the U.S. The facility was used to reprocess spent fuel from 1966 until 1972. Cleanup operations at the WVDP were initiated in 1982. West Valley Nuclear Services Company (WVNSCO) is the site contractor for the WVDP. The New York State Energy Research and Development Authority owns the site property and is a project partner in the WVDP.

In recent years, cleanup operations at the WVDP have focused on decontaminating shielded cells in the reprocessing facility. Extraction Cell-2 (XC-2), a highly contaminated, high-dose, high-risk area, is one of these cells. The second of three multilevel cells designed to separate uranium (U) and plutonium (Pu) material from liquid process streams, XC-2 measures about 6.4m (21-ft) long by 6m (20-ft) wide by 17m (57-ft) high. Shortly after the cessation of reprocessing operations, several flushes were carried out in XC-2 to prepare it for modification. Once these partial decontamination flushes were completed, the cell was closed for entry.

WVNSCO began decontaminating XC-2 to significantly reduce the level of radiological hazard and risk posed by the presence of contaminated equipment, piping, support structures, and residual debris remaining in the cell. To meet objectives set for accomplishing this, a detailed technical approach was developed to take out approximately 2743m (9,000-ft) of piping, 35 tanks and vessels, related components, and support structures from XC-2. This paper describes how this decontamination work was planned and safely completed.

Discussions presented include summary descriptions of preliminary work done to prepare for entering XC-2; approaches taken to reduce general dose rates during initial entries; and techniques used to remove piping and equipment by level until the cell was completely cleared. Additionally, discussions are provided on innovative approaches used to complete the project safely. These include discussions on integrating As Low As Reasonably Achievable (ALARA) dose practices into work planning; using innovative cutting techniques to safely size-reduce multilevel vessels in XC-2; and augmenting worker safety by deploying a Spider® Basket as moveable work platform. A summary discussion also is provided on how incorporating lessons learned from other decontamination projects contributed to the safe and successful decontamination of XC-2.

INTRODUCTION

Constructed more than 40 years ago, the reprocessing facility at the WVDP housed an integrated system designed to recover U and Pu material from spent nuclear fuel used in commercial reactors. As operated, the system employed a distinct mechanical process to prepare spent fuel assemblies for chemical processing by chopping and leaching solid fuel. Liquid process streams thus produced by were fed through shielded cells where various stages of U and Pu material extraction, separation, and product purification took place.

The key phases of system operations, both mechanical and chemical, were conducted in a series of operationally interconnected cells positioned at different elevations within the reprocessing facility's main five-story, reinforced concrete structure. Designed to be operated remotely, each cell in the main structure was physically isolated from the other cells by shield walls, floors, and ceilings up to 5-ft thick. All were built and oriented according to a specific process function. The material-handling and mechanical preparation of solid fuel took place in two cells positioned within the facility's lower core area. From this core area, chopped fuel was directed up to a centrally located cell equipped with chemical dissolvers used to produce a liquid process stream. As it was produced, the liquid process stream was directed through three adjacent, multilevel cells where U and Pu extraction and separation cycles took place, XC-1, XC-2 and XC-3.

Comparable in size and shape to the two extraction cells it is located between, XC-2 was constructed as a 6.4m (21-ft) long by 6m (20-ft) wide by 17m (57-ft) high, concrete shaft containing a structural-steel support tower. A series of work platforms and service ladders were built into this tower at intervals measuring 33m (108-ft), 37m (121-ft) and 41m (133-ft) above the cell's stainless-steel lined concrete floor at the 30.5m (100-ft) elevation. Extending from floor level upward, an array of 35 stainless-steel tanks and vessels, 2743m (9000-ft) of associated piping, and related components used to operate the U and Pu extraction and separation cycles were anchored between platform elevations with structural steel supports. Access for conducting contact maintenance via the work platforms was provided through a 15cm (6-inch) thick steel shield door at ground level. Access for moving equipment and materials into or out of XC-2 was provided through a 0.69m² (7.5ft²) service hatch installed between the ceiling of XC-2 and a 25m (81-ft) long by 12.5m (41-ft) wide by 5m (17-ft) high concrete-block room at the top floor of the plant building, the Extraction Chemical Room (XCR).

Configured to preserve criticality safety, process vessels anchored to the support tower in XC-2 varied in size from four small 20cm (8-inch) high, 5cm (2-inch) diameter vessels weighing about 2kg (5-lbs) each, to four narrow processing columns measuring up to 13m (43-ft) high and weighing more than 1542kg (3400-lbs) each. Accompanying feed and hold tanks set between the work platforms varied in size from a 2.7m (9-ft) high, .91m (3-ft) diameter tank that weighed about 1452kg (3200-lbs), to a 3m (10-ft) high, 1.8m (6-ft) diameter tank that weighed about 2041kg (4500-lbs). These equipment items, associated system piping, and related components remained as originally configured when the cell was closed for entry. A computer generated interior view of XC-2 illustrating this configuration is shown in Figure 1.

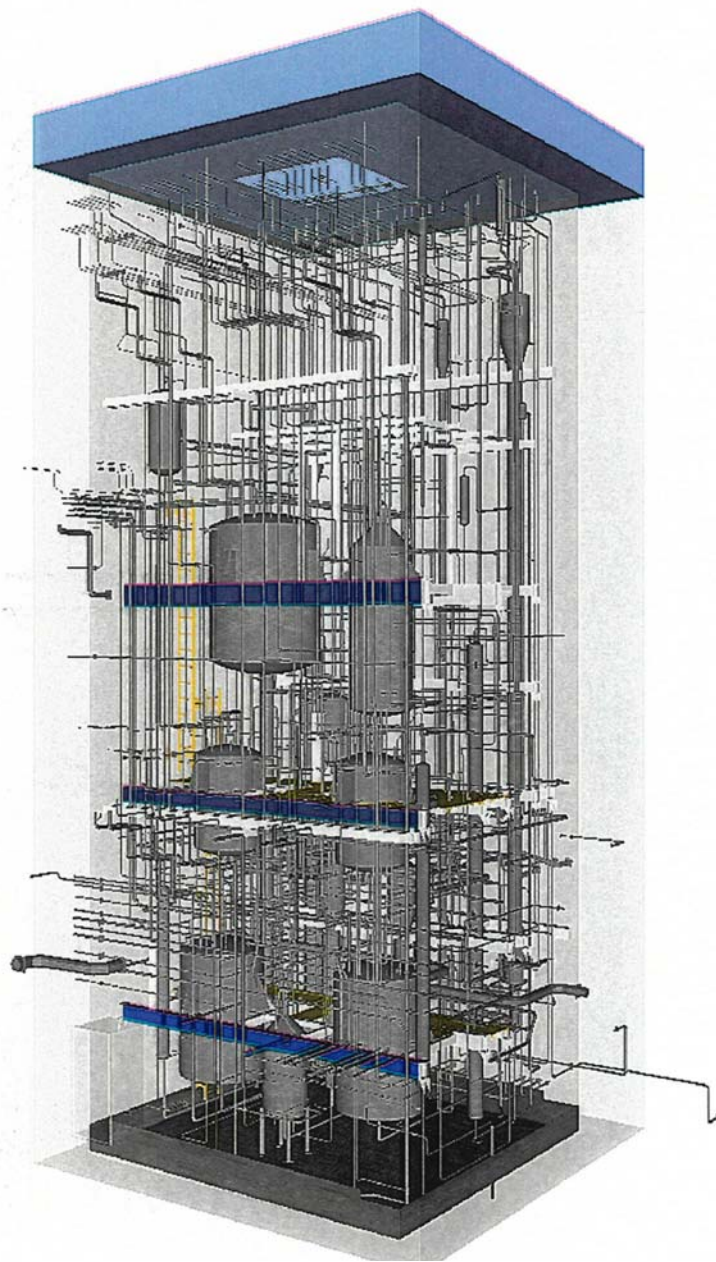


Fig. 1. Interior view of XC-2 before decontamination

DECONTAMINATION APPROACH

Radiological contamination in XC-2 resulted from U and Pu separation and extraction operations conducted in the cell. Most of this contamination consisted of a residual mixture of alpha, beta and gamma emitting radioisotopes (including plutonium, uranium, cesium, strontium, and transuranics) that remained in process piping, tanks, vessels, and miscellaneous components. A lesser volume of in-cell contamination took the form of floor debris and residue from process spills, routine process losses, and decontamination solutions cycled through the cell between reprocessing campaigns.

The central challenge for decontaminating XC-2 involved carrying out large scale decontamination and dismantlement work from a physically isolated, fully equipped, highly contaminated, multilevel cell both safely and efficiently. This was accomplished by conducting a comprehensive engineering review of historical records, and by analyzing decontamination work previously conducted in areas like XC-2. Information gathered through this preliminary review process was then used to establish the technical baseline for developing an increasingly detailed approach for working in XC-2. Specifically, information assessed during the preliminary review process was used to:

- Confirm the location and configuration of tanks, vessels, piping, miscellaneous components, and support structures in XC-2;
- Develop reference tools for planning and conducting in-cell work, including an interactive 3D computer model of the cell; and
- Establish methods for safely detaching, removing, and packaging contaminated tanks, vessels, piping, structural supports, and miscellaneous waste materials found in XC-2.

Using these tasks as a starting point, potential removal activities were considered from radiological, operational, waste characterization, and waste management perspectives to formulate the overall technical approach for decontaminating XC-2. This involved preparing to enter XC-2, making initial entries, and conducting waste removal and packaging operations. Key aspects of planning and conducting this work are described as follows.

Preparing for Entry

Decontaminating XC-2 was undertaken to achieve a marked reduction in radiological risks and hazards associated with the cell by removing contaminated piping and equipment from it. Work scope planning to accomplish this involved assessing the overall design of XC-2 and considering its condition within the context of decontamination work previously carried out in two similarly constructed and contaminated cells: XC-3, the multilevel cell adjacent to XC-2, and the Product Purification Cell-South (PPC-S), the multilevel cell next to XC-3. During the planning process, particular attention was given to identifying equipment and techniques needed to carry out in-cell decontamination work safely, and on integrating recently used best-practices into strategies for maintaining rigorous safety and contamination controls during decontamination work.

Among the first techniques considered were those related to establishing containment and work areas in and around XC-2. With the advantage of having an existing shield door and a shielded service hatch to use as functioning access points, planning efforts focused on increasing the degree of contamination control provided by containment structures already in place around these locations.

Contamination control for the area surrounding the shield door was increased by expanding the dimensions of the existing containment tent, and by employing a design feature used to set up a functioning containment area for the PPC-S. This involved installing an interior vinyl wall inside the containment tent to isolate the personnel entry from the interior equipment staging area. Contamination control in the area surrounding the shielded service hatch was increased by installing a new containment structure in the XCR. As installed, the structure included two airlocks equipped with interior walls, a set of double doors designed to act as an isolation barrier between packaging and staging areas in the XCR, and a zippered roof flap positioned between a staging pad inside the containment area and a ceiling hatch leading to the roof above the XCR.

Beyond increasing the number of physical barriers between work areas, arrangements also were made to increase ventilation capacity in XC-2 (i.e., air flow and exchange). This was accomplished by configuring and installing three portable ventilation units to provide independent (stand alone) ventilation for the cell. Additionally, as work got underway to remove and refurbish the service hatch between XC-2 and the XCR, plans were made to fabricate a new replacement cover for the hatch. This new cover used a bi-fold door concept as its central component. Set horizontally within a metal frame, the orientation of the custom made bi-fold door made it possible to quickly isolate the cell from the containment area by simply lowering the door closed after completing in-cell work. This ability to seal the containment area from XC-2, combined with detailed housekeeping practices, helped to maintain rigorous contamination control throughout decontamination work.

In addition to upgrading existing facilities and structures in the XCR, several specific measures were taken to increase worker safety during removal operations. Like the other hatches in the XCR, the hatch for XC-2 covered an opening designed to facilitate equipment installation and removal. The distance from the top of this floor-level opening to the cell's uppermost platform measures about 9m (30-ft). To use it as a functional point of entry, it was therefore necessary to develop a means of conveying personnel through the opening to the platform (or other elevations in the cell).

After assessing the potential for using a moveable work platform to transport personnel into XC-2 from the XCR, the decision was made to deploy a Spider® ST-18 Electric Powered Work Cage as the conveyance device. Constructed as self-contained suspended scaffold, the Spider® ST-18 Work Cage (or Spider® Basket) consists of a 91cm by 91cm (3-ft by 3-ft) work deck enclosed by a safety cage, with the motor and winch used to power the unit mounted below the work deck.

Used throughout the commercial construction industry to perform elevated work on buildings, water towers, and structures like nuclear reactor domes, Spider® Baskets meet current OSHA regulations governing the use of scaffolds and suspended scaffolds, 29 CFR 1926.451 and 1926.452.⁽¹⁾ With a lightweight, compact design, Spider® Baskets can be easily transported and set up for use in tight spaces. By connecting a standard unit to a single point (such as a beam), a Spider® Basket can be operated like an elevator, making it possible to lower and retract the device as needed to perform work at various elevations. These features, combined with the ability to use it with a newly refurbished gantry crane in the XCR, made it ideally suited for conducting entries into XC-2.

To provide requisite fall protection during entries made in the Spider® Basket, a combination fall arrest and retrieval system was selected as the form of occupational protective equipment (OPE) to be used. To provide equally rigorous occupational radiation protection for working in a cell with high airborne contamination levels, a combination supplied air respirator/multi-layered suit-up known as the "Bubblesuit" was selected as the form of Personnel Protective Equipment (PPE) to be used.

Demonstrated to be highly effective during the recently completed decontamination of the PPC-S, this suit-up consists of multiple layers of protective clothing (i.e., anti-contamination clothing, cloth coveralls, shoe covers, gloves, cap, booties, rubbers, and vinyl coveralls), a supplied air respirator, cloth hood, and a supplied air hood. As worn during entry, the complete suit-up included a two-way radio (i.e., ear piece and transmitter) and a breathing zone air sampler (BZAS) used to monitor breathing air between the supplied air respirator and the supplied air hood.

Training to prepare personnel for making entries into XC-2 included an extensive review of radiological and safety concerns associated with wearing Bubblesuits. Additionally, personnel received training in the safe operation of a Spider® Basket. After confirming that personnel were qualified to operate a Spider® Basket, the actual device to be used was set-up in an open area of the XCR. Here work crews practiced getting into or out of the Spider® Basket wearing a full suit-up. These supplemental practice sessions gave work crews the opportunity to refine techniques for using the Spider® Basket before making the first entry into XC-2 from the XCR. (A view of a work crew in full suit-up preparing to make an entry in the Spider® Basket is shown in Figure 2.)



Fig. 2. Preparing to enter XC-2 in the the Spider® Basket

Dose Reduction and Contamination Control

Reviews of radiological data prepared during the mid-1980's indicated levels of gamma radiation on the floor of XC-2 ranging from 50mR/hr to more than 200mR/hr near identified hot spots. Dose rate measurements taken during a scoping entry made in January 2002 via the ground-level containment area indicated that gamma radiation levels in XC-2 varied from about 30mR/hr along the floor of the cell to more than 300mR/hr at points measured near major process vessels. Consequently, a central objective for conducting initial entries into XC-2 was to bring measurable dose rates within a range determined to be as-low-as-reasonably-achievable (ALARA) for conducting removal activities from ground level on a regularly scheduled basis. This was accomplished by entering XC-2 via the containment area at ground level, clearing debris off the cell floor, and alternately applying and removing strippable coatings from cleared surfaces. By removing floor debris and consecutively applying and removing strippable coatings from the cell floor and adjacent surfaces, the general area dose rate in XC-2 was brought below 10mR/hr, with measurable hot spots reduced to 50mR/hr or less.

As decontamination of the floor and adjacent surfaces was being completed, arrangements were made to begin the process of identifying, sampling, and draining lines of piping in preparation for carrying out the next stage of decontamination operations, piping, and equipment removal. The approach and techniques employed to sample and prepare piping for removal were based on those used to accomplish similar work conducted in the recently decontaminated PPC-S. Starting at ground level, the 3-D model developed as an interactive reference for conducting decontamination operations was used to inspect and confirm the location of specific lines of pipe and points to be sampled for identified lines. After verifying the position of sample points by level and exact location, lists were drawn up and used with isometric views generated with the 3-D modeling software to complete detailed instructions for conducting sampling work.

In preparation for making entries to collect samples, pre-job briefings were structured to include a review of in-cell isometrics and sample-point lists with engineering staff. These reviews gave personnel the opportunity to familiarize themselves with the layout of a specific area, as well as the equipment needed and procedures to be followed while collecting samples.

Entries to gather samples in XC-2 via the ground level containment area were made by observing the same operational sequence as that used to enter and decontaminate the floor of the cell. This sequence included preliminary steps for confirming ventilation airflow, maintaining contamination control, and visually inspecting the designated work area to ensure that appropriate safety measures were in place before entering the cell. Once these steps were completed, engineering staff, in two-way communication with personnel entering the cell, guided them to specific sample points while referencing monitors displaying the 3-D model of XC-2 and the view provided by in-cell cameras. After obtaining the requisite number of samples from a specified location, any perforations made to collect the samples were spliced or capped with plugs to maintain negative pressure needed to ensure contamination control. Additionally, cleanup activities were carried out in the containment area at the conclusion of each entry to ensure that contamination levels remained within prescribed limits (i.e., < 2000 dpm alpha/100cm², $< 10,000$ beta/gamma/100cm²) before conducting subsequent entries through this access point.

Removal Techniques

Like work done in the PPC-S, decontaminating XC-2 involved cutting and removing contaminated piping and equipment from multiple locations inside a narrow, multilevel cell with limited clearances between work areas. Although partial flushing done after reprocessing operations ended reduced contamination levels in XC-2 piping and equipment, it remained contaminated with process residuals generated when the cell was used to operate the Pu and U solvent extraction cycle. Accounting for this, various techniques used to control the spread of contamination during cutting work done in the PPC-S were integrated into detailed work instructions for accomplishing the cutting and removal work in XC-2.

Following entry and exit protocols established for making initial entries into XC-2, basic contamination control for conducting cutting and removal work was provided by applying fixatives to surfaces before initiating this work. Similarly, the potential for dislodging and releasing internal contamination while preparing to cut into a line of pipe or piece of equipment was diminished by using the interactive 3D-model of the cell as a visual reference tool for planning and conducting in-cell work.

The technique of conducting “virtual” visual inspections with the interactive 3D-model made it possible for personnel to become familiar with the location and condition of a specific line of pipe (or piece of equipment) before making entries. Combined with using in-cell cameras, this also made it possible for personnel engaged in two-way communications with personnel working in XC-2 to guide them with greater accuracy as they proceeded with in-cell cutting and material-handling activities. This improved the identification of potential hazards and supported the development of more effective radiological and safety controls as in-cell work progressed.

The strategy for preventing the release of contaminated liquids from XC-2 piping during cutting work involved the use of custom-machined assemblies known as “tell-tale” devices. Simply constructed and contoured to fit over the outer diameter of a pipe (or vessel), these devices were used to safely vent, sample, and drain a line or vessel before cutting. The strategy for preventing the release of contaminated solids involved using the opening created by applying the tell-tale to physically examine the internal contents of a line or vessel to be cut. This was accomplished by inserting a swab into the opening, and using it to detect the presence of residual solids accumulated in the line. Beyond functioning as a line probe, the swab also served as a sample used to establish the internal contamination level for the section of line to be cut. Based on preliminary sample (counting) results, provisions were made to continue with cutting by using localized ventilation or by injecting fixatives into the line to prevent the release of internal contamination during cutting. Employing these screening techniques before proceeding with cutting activities strengthened ALARA objectives set for the project as in-cell work advanced from basic cutting and material-handling activities to more complex work involving the detachment, rigging, and removal of large tanks and vessels.

Specifically structured to maintain rigorous safety and radiological controls throughout decontamination operations, the overall approach taken to conducting removal work in XC-2 involved taking contaminated piping and equipment out by level to create the space needed to detach, rig, move large tanks and vessels out through the service hatch leading up to the XCR containment structure. In keeping with established ALARA objectives, removal activities concentrated on taking out piping, smaller vessels, and support structures starting at floor level and working upwards to clear space and lower in-cell dose rates before initiating removal work at higher elevations. To maintain ALARA efficiencies, priority was given to removing piping and smaller vessels by dose rate rather than strictly by location. Cutting and removal work continued at ground level until it was no longer possible to continue removal activities without exceeding ALARA efficiency rates. When this point was reached, attention shifted to preparing for the

removal of large tanks and vessels by clearing piping and support structures from the ceiling down to the uppermost work platform in the cell (the 41m platform level).

Like the techniques employed during pipe removal, techniques used to remove contaminated equipment from XC-2 were structured to prevent the spread of contamination by making use of various controls, equipment, and confinement barriers set up to support removal operations. Control measures and flowpaths used to remove specific pieces of equipment were based on equipment size and position within the cell. Small pieces of equipment near the top of XC-2 were taken out by using techniques similar to those used to remove piping and support structures via the XCR containment area. When possible, large pieces of equipment were removed intact by coating exterior surfaces with fixatives before initiating lifting activities; lowering protective sleeving over equipment brought through the service hatch; and moving sleeved equipment items to the staging area used to prepare equipment for release along established flowpaths leading out of the XCR.

When equipment dimensions precluded using this approach to take it out intact, an alternative method was used to size-reduce equipment in-cell before taking it out through the service hatch and packaging for release in the XCR containment area. Size-reduction was accomplished by injecting stabilizing materials into equipment at identified cut points, allowing the injected material to cure, and then proceeding to make cuts with an appropriately sized power saw (either a WACHS® or portaband saw).

Depending on equipment design and internal components, one of three distinct injection techniques was used. For equipment containing loose components (such as raschig rings) a dual-material injection technique was used. This involved making an epoxy-filled foam “sandwich” at the cut point to contain internal contamination and create a smooth surface for the power saw to be used (i.e., a WACHS® saw). For equipment containing contaminated components (such as deck plates), a simple injection technique was used (either a polyurethane foam or sprayable fixative). Using these injection techniques provided the degree of control needed to limit the release of loose internal contamination during cutting. It also supported ALARA objectives by making it possible to consolidate work activities being carried out by level in the cell. Additionally, segmenting equipment into predetermined lengths allowed equipment to be packaged into waste containers easily transferred out of the XCR.

Work Practices

The interior dimensions of XC-2, combined with the size, volume, and arrangement of contaminated piping, equipment, and support structures inside the cell, heightened the need to maintain and continuously enhance safe working conditions as decontamination activities progressed from creating in-cell workspace to conducting more complex removal tasks. Accurately identifying and assessing potential hazards throughout the decontamination process was therefore critical to ensuring that each entry made into XC-2 was carried out safely.

Recognizing the complexities inherent in preparing to and working in a highly contaminated, high risk area like XC-2, a dedicated effort was made at the start of decontamination project planning to take detailed technical information about XC-2, organize it, and use it to create interactive tools and techniques for continuously assessing in-cell conditions. Following precedents set for evaluating and monitoring in-cell conditions in the PPC-S, arrangements were made to create a 3D computer model for XC-2.

Designed to function as a virtual tool, using the 3D computer model as a reference at the start of decontamination operations made it possible to inspect areas inside XC-2 that were otherwise obstructed

from view. Having the power to closely examine specific pieces of equipment without physically entering XC-2 allowed engineering staff to prepare precise work instructions for carrying out in-cell activities. It also allowed personnel involved in making entries to “see” potential hazards ahead of time, giving them and engineering staff greater opportunity to identify, develop, and implement effective strategies for conducting increasingly demanding work tasks.

Beyond expanding the ability to confirm and incorporate new information into work plans on a routine basis, using interactive tools like the 3D model encouraged personnel to work together in devising safe and effective techniques for carrying out complex, high risk activities like size-reducing and dismantling multilevel processing columns in XC-2. Extending upward to distances ranging from 8.5m (28-ft) to 13m (43-ft) above the cell floor, removing this equipment was complicated by the fact that the each item was filled with contaminated internal components like stainless steel baffles, plates, or packing used to direct or otherwise influence the flow of reprocessing solutions upwards or down through the equipment. Finding a way to safely segment this equipment into smaller, more manageable sections was essential to completing the decontamination of XC-2.

Building on experience gained through the progressive cutting and removal of contaminated piping, personnel devised a series of mock-up tests to demonstrate the effectiveness of potential stabilization and cutting techniques in a non-radioactive setting. Accomplishing this involved creating several test columns by filling predetermined lengths of large diameter pipe with packing materials like those found in the columns targeted for removal. Testing began by injecting a two-component polyurethane foam sealant into a test column to fill void space in the column before cutting. After allowing the foam to cure, personnel fastened a WACHS® guillotine saw onto the test column to make a single cut through the stabilized column, as would be the case during actual in-cell cutting. As determined during preliminary rounds of testing, the faceted cutting surface formed by the presence of the packing material inside the test column prevented the blade of the WACHS® saw from making a clean cut through it. This led to an evaluation of various kinds of epoxy materials with sealing capabilities sufficient to lock the packing into place around a cut-line. Further testing involving the injection of a two-part epoxy into test columns demonstrated its effectiveness in sealing the packing into place before cutting. However, the potential for the epoxy to migrate past the cut-line after injection made it necessary to form some type of solid buffer below the cut-line to prevent this from happening. Continued mock-up testing resulted in the development of the dual-injection technique. Using this technique effectively transformed the internal contents of a column into a solid monolith that made it possible for personnel to segment columns by making single cuts with a WACHS® or a portaband saw. (A view of the cutting surface created by using the dual-injection technique is shown in Figure 3.)



Fig. 3. Mock-up piece showing cutting surface created by epoxy-foam -injection

To maximize ALARA-related benefits associated with stabilizing the internal equipment surfaces via sealant injection, removal activities involving in-cell cutting were coordinated with the progressive removal of piping and structural supports. This allowed personnel to consolidate activities so multiple removal tasks could be performed by making a single entry. Beginning at the uppermost platform level and working downward using the Spider Basket® to traverse the cell, taking this approach gave personnel the opportunity to do more work in less time, thus limiting the amount of fatigue experienced while conducting dismantlement work from in-cell platforms and scaffolding while wearing full-suit-ups.

Implementing Lessons Learned

Like similarly constructed, adjoining cells, initiating decontamination work in XC-2 was complicated by its interior configuration and status as a high-dose, high-contamination area that had not been entered for more than 30 years. To meet the central challenge of working in and around a highly contaminated, concrete shaft filled with a large volume of contaminated piping and equipment weighing as much as 3 metric tons (6700-lbs), planning efforts focused on assessing XC-2 within the context of previously conducted decontamination projects to identify equipment needed and best-practices to be used during decontamination work.

Specifically, reviewing lessons-learned from the recently completed decontamination of the PPC-S supported the development and use of multiple techniques for maintaining safe working conditions including: installing multiple barriers between work areas; using fixatives to reduce dose and stabilize surfaces; deploying a movable platform as a means of conveyance; and using a 3D computer modeling to augment in-cell viewing capabilities. It also supported the coordinated development of effective strategies for continuously monitoring and assessing in-cell conditions, between engineering staff and personnel involved in conducting entries.

CONCLUSIONS

When decontamination of the XC-2 began, the cell contained approximately 2743m (9000-ft) of contaminated piping, and 35 contaminated tanks and vessels positioned within a structural steel tower set inside a 17m high concrete shaft. Developing an effective technical approach for decontaminating and dismantling XC-2 was accomplished by organizing, coordinating, and integrating information and lessons learned from previous decontamination projects into detailed plans for conducting work in XC-2. Continuous evaluation of hazards associated with conducting in-cell work during each stage of project planning and execution led to the development of various tools and techniques for conducting decontaminating work safely. These included:

- Establishing multiple segregated areas for conducting removal operations;
- Controlling the release of internal pipe and vessel contamination during size-reduction and removal work by applying and injecting fixatives before cutting;
- Continuously monitoring and evaluating in-cell conditions as entries were being conducted; and
- Using a Spider® Basket as a movable work platform during the performance of removal work.

In-cell operations began with dose-reduction and debris removal activities conducted via a newly refurbished ground level containment area. Dose reduction was followed by pipe removal. Pipe removal activities were conducted until sufficient space had been cleared to begin equipment removal. When this point was reached, work scope shifted to concentrate on removing contaminated piping and equipment via a newly constructed containment area above XC-2.

At the conclusion of XC-2 removal activities, the structural steel framework, equipment connected to it, and piping associated with the operation of in-cell equipment had been taken out of the cell, packaged into identified waste containers, and prepared for transfer to a designated on-site storage facility. Removal activities were followed by applying fixatives to the ceiling, walls, and floor surfaces to minimize the spread of any residual contamination remaining on in-cell surfaces, and visually inspecting interior surfaces to establish final conditions in XC-2.

The complete range of safety and contamination controls and techniques used to keep worker exposures to levels ALARA during XC-2 decontamination work ensured stringent radiation protection during each stage of decontamination operations. The effectiveness of the techniques used is reflected in the measured dose rate of approximately 11.9 rem out of the assigned ALARA budget of 20.8 rem for conducting work in XC-2.

REFERENCES

1. Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction, Subpart 451, Scaffolds, 11/2004; Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction, Subpart 452, Additional requirements applicable to specific types of scaffolds, 11/2004.