

**CLEANUP OF THE HEAD END CELLS AND THE REFURBISHMENT OF SHIELD
WINDOWS AT THE WEST VALLEY DEMONSTRATION PROJECT**

John Drake

U. S. Department of Energy - West Valley Demonstration Project

Ken Schneider, Mike Fizzano
West Valley Nuclear Services Co.

Chuck Kalkwarf
Hot Cells Services Corporation

ABSTRACT

With the completion of the first phase of high-level radioactive waste (HLW) processing at the West Valley Demonstration Project, efforts are being shifted to begin the decontamination and decommissioning (D&D) of the old fuel reprocessing plant. The initial D&D efforts are being focused on the Head End Cells. These are the cells in the plant associated with the shearing of the spent nuclear fuel and storing and handling the sheared fuel prior to chemical dissolution. There are significant challenges associated with the cleanup of these cells as all of the work must be done remotely and the majority of the equipment in these cells is no longer operational. One of the first efforts to begin this cleanup operation was to gain visual access to the Process Mechanical Cell (PMC) and its associated Crane Room by refurbishment of three of the shielding windows. This refurbishment effort required the removal of two 5 ft wide x 5 ft high x 5 ft 6 in. thick, 15-ton window assemblies from the PMC shield wall, installation of temporary shielding, disassembly and refurbishment of the shield glass, and reinstallation of the window. The refurbishment of the PMC Crane Room shield window involved the conversion of an old zinc bromide window to an oil-filled lead glass window.

This paper will discuss the significant challenges associated with the cleanup of the Head End Cells, with primary focus on the recently completed refurbishment of the three shield windows.

BACKGROUND

The West Valley Demonstration Project is an environmental management project located 35 miles south of Buffalo, New York, at the site of a former nuclear fuel reprocessing plant. The site is owned by New York State. The U.S. Department of Energy (DOE) is conducting the Project in cooperation with the New York State Energy Research and Development Authority. The management and operations contractor is West Valley Nuclear Services Co., a division of Westinghouse Electric Company.

In 1962, the Davison Chemical Company established Nuclear Fuel Services, Inc. (NFS) to construct the first commercial nuclear fuel reprocessing plant in the United States at the Western New York Nuclear Service Center. NFS leased the land from the state. Construction was completed in February 1966 and fuel reprocessing began in April. NFS operated from 1966 to 1972, reprocessing about 640 metric tons of spent nuclear fuel to recover usable uranium and plutonium.

WM'00 Conference, February 27 – March 2, 2000, Tucson, AZ

The plant was shut down in 1972 for modifications to meet new regulatory requirements. At that time NFS estimated that the modifications would cost \$15 million and take only two years to complete. Four years later, in April 1976, NFS announced that the modifications would cost \$600 million. NFS notified the State of New York that it would be surrendering responsibility for all wastes at the site to the state. Two months later, NFS announced it was withdrawing from the nuclear fuel reprocessing business, citing rising costs and uncertain regulatory requirements.

Following a 1978 U.S. Department of Energy study, the West Valley Demonstration Project Act was signed into law. In 1982, DOE and Westinghouse/West Valley Nuclear Services Company, the management and operating contractor, assumed operational control of the approximately 200-acre reprocessing facility site. In 1996, after a five-year nonradioactive test run, radioactive processing began. The first phase of vitrification operations was completed on June 9, 1998.

With the completion of the first phase of vitrification, the Project has begun to shift its focus to begin the decontamination and decommissioning (D&D) of the old fuel reprocessing plant, with initial efforts focusing on the Head End Cells.

DESCRIPTION OF THE HEAD END CELLS

The Head End Cells (HEC); which primarily include the Process Mechanical Cell and its Crane Room, the General Purpose Cell and its Crane Room, and the Scrap Removal Room; were used to mechanically process and handle irradiated nuclear fuel assemblies. The HEC include the following cells and rooms:

Process Mechanical Cell	(PMC)
Process Mechanical Cell Crane Room	(PMCR)
General Purpose Cell	(GPC)
GPC Crane Room	(GCR)
GCR Extension	(GCRX)
Miniature Cell	(MC)
Scrap Removal Room	(SRR)
Manipulator Repair Room	(MRR)

The PMC was used to mechanically size-reduce irradiated fuel so it could be chemically processed in another part of the plant. Fuel assemblies stored in the Fuel Receiving and Storage Facility were transferred to the PMC where a high-speed abrasive cut-off saw was used to remove fuel assembly end fittings after which a hydraulic ram was used to push the contained fuel elements into a shear feed magazine. The loaded shear feed magazine was transferred to a hydraulic shear that cut the elements into 0.50 to 2.0 inch lengths that fell down a chute into the chopped fuel baskets in the GPC.

The sheared fuel from the PMC shear would fall down a chute into the GPC where it would be collected in baskets designed for use in the dissolvers in the CPC. Cranes housed in the GCR and CPC would be used to transfer the filled baskets to the CPC where the irradiated fuel would be dissolved with nitric acid. Once dissolution was complete the baskets containing the leached hulls would be transferred back to the GPC where the hulls would be remotely inspected and packaged in 30-gallon steel drums. The filled drums would be transferred to the SRR where they

WM'00 Conference, February 27 – March 2, 2000, Tucson, AZ

would be loaded onto a shielded truck and transported to the on-site Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA) for burial. Some of the leached hulls were transferred from the GPC through the PMC to the Analytical Labs where the effectiveness of the dissolution process was assessed. After they were examined in the Analytical Labs the leached hulls were transferred back through the PMC to the GPC for packaging and eventual disposal in the NDA. The MC, which is located adjacent to the east end of the GPC, was not used by NFS to support the spent fuel reprocessing operation. If a GPC crane or PaR (power manipulator) required maintenance it was transferred into the adjacent GCR where repairs were effected. The GCRX is a small room connected to the west end of the GCR. The GCRX was designed to store one or both of the GPC bridge cranes while work was performed in the GCR thereby reducing exposure to personnel performing the work.

Operations in the PMC were supported by two cranes and a bridge-mounted power manipulator (PaR) that traveled on rails near the top of the PMC. If the cranes or PaR required maintenance they were transferred into the adjacent PMCR where repairs were effected. The MRR, which is located beneath the PMCR, was used to repair the arm of the PaR, which extended through a hatch in the floor of the PMCR.

After operations were suspended in 1972, there was still a significant amount of debris remaining in the cells that consisted of fuel and saw fines, activated fuel assembly hardware, unprocessed fuel assembly sections, and contaminated handling equipment, as well as radioactive wastes from the Analytical Laboratory areas

General dose rates in the PMC and GPC vary from a general field of 100 to 300 R/hr up to 2000 R/hr hot spots. Due to these high radiation fields and the high levels of contamination, all of the cleanup operations will have to be performed remotely.

Planning for the cleanup of these cell began in September 1998. The initial focus was on getting the infrastructure in place to begin cleanup of the PMC and the PMCR. After an initial review of the existing equipment in the PMC and the PMCR, it was determined that neither of the two cranes or the bridge-mounted manipulator system were operational and they would have to be replaced. In addition, only one of the four through-the-wall manipulators was operational. The only visual access to the cell was from a video camera installed in the cell in 1996. To aid in the planning and the actual cleanup operations, additional visual access was needed.

SHIELDING WINDOW REFURBISHMENT

To gain this additional visual access to the PMC and the PMCR, three of the seven shielding windows were refurbished. Two of these windows were located in the west wall of the PMC. These windows had become cloudy over time and no longer provided useful clarity. The third window, located in the PMCR, was a zinc bromide window that was partially converted to an oil-filled lead glass window.

Method of Optical Degradation

The shielding windows have not been serviced for many years. The main reasons for degradation are: 1) moisture build-up within the window cavity that may have been caused by loss of seals and/or rupture of the bellows, and 2) ionizing radiation degradation.

Exposure of the optical oil to moisture in the air can produce a cloudy build-up of paraffin suspended in the oil, and a heavy gray film on the surface of the glass.

Mineral oil can become degraded by exposure to radiation and light. Radiation reacts with the moisture (oxygen) in the oil to produce peroxides and acids. The peroxides and acids attack the lead packing in the window to produce a cloudy suspension or organic lead salts and lead carbonate. The lead salts and the lead carbonate then become deposited on the glass as a white precipitate and adhere with the degraded oil to etch the glass surface.

Oil & Oxygen > Exposed to Radiation = Peroxides & Acids

Peroxides & Acids & Lead = Cloudy Oil Sludge = Etched Glass

To restore the optical clarity of the windows in the PMC, the glass is removed from the windows, ground, polished, then reinstalled. The removal and reinstallation of such large windows provided the real challenge to the job.

Method of Window Refurbishment

Each of the shielding window assemblies in the PMC consist of a large steel weldment filled with concrete and/or cast iron shot (Figure 1). Within the window cavity are four large pieces of nonbrowning glass weighing from 800 to 1500 lbs. Hot side and cold side cover glasses are sealed to the window weldment and contain approximately 180 gallons of mineral oil that couples together the glass surface within the window cavity.

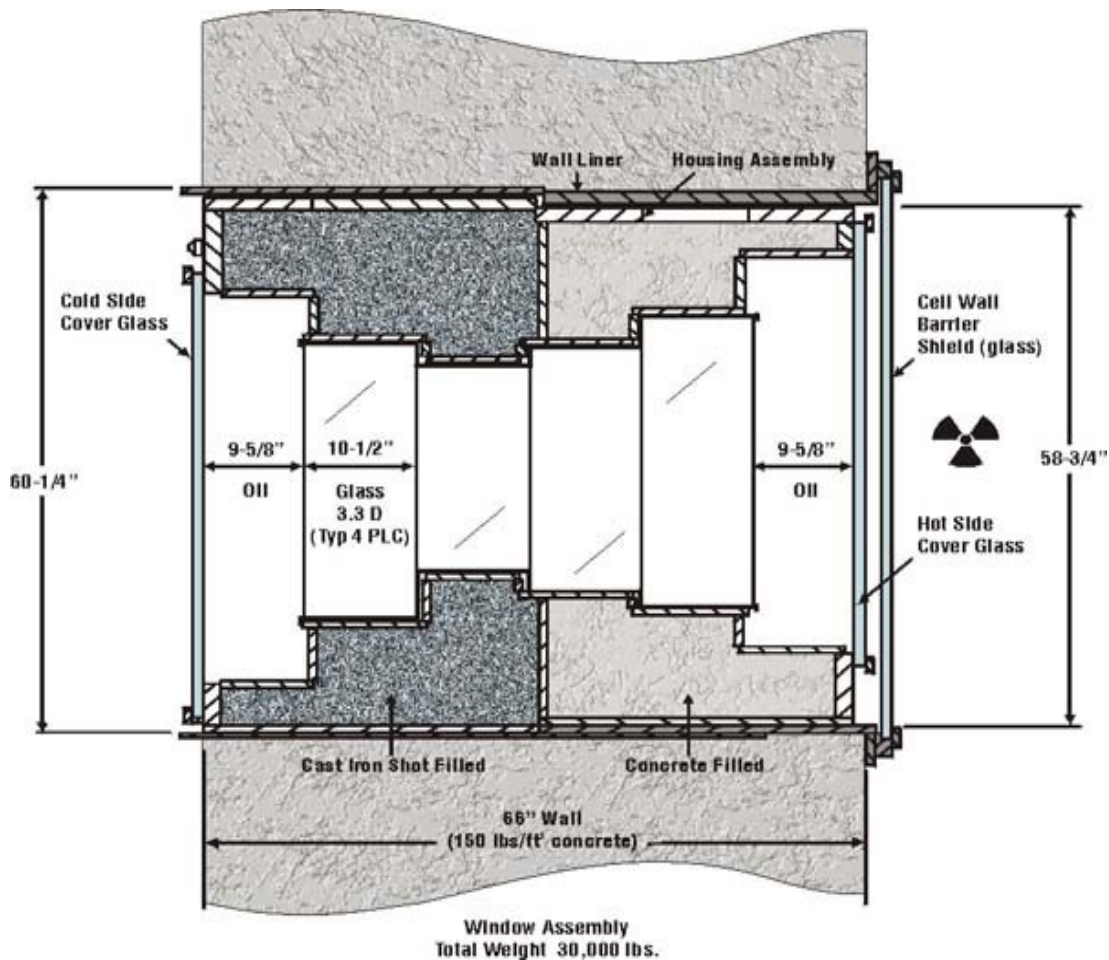


Figure 1. Shield Window Assembly

To refurbish the glass in each of the window assemblies, the entire window assembly had to be removed from the liner in the cells wall. This provided a number of significant challenges: 1) dose rates in the cell varied between 100 R/hr to 2000 R/hr, 2) there was a significant contamination risk, and 3) the floor in the Operating Aisle could not support the weight of the window assembly.

Prior to the actual removal of the window assembly, the mineral oil was drained and the cold side cover glass and the first two pieces of shielding glass were removed. This allowed the two pieces of shielding glass to be shipped back to the Hot Cells Services facility in Kent, Washington to be polished while preparations were being made to pull the window assembly.

To help distribute the 15-ton weight of the window assembly and to facilitate its removal, an extraction table was installed in the aisle way (Figure 2). The extraction table spanned the aisle and helped to distribute the weight of the window assembly across the aisle and down to the pile foundation of the building. The extraction table consisted of a series of W10x39 structural beams with 1/2 in. thick steel plates bolted on top to make a flat surface onto which to pull the window.

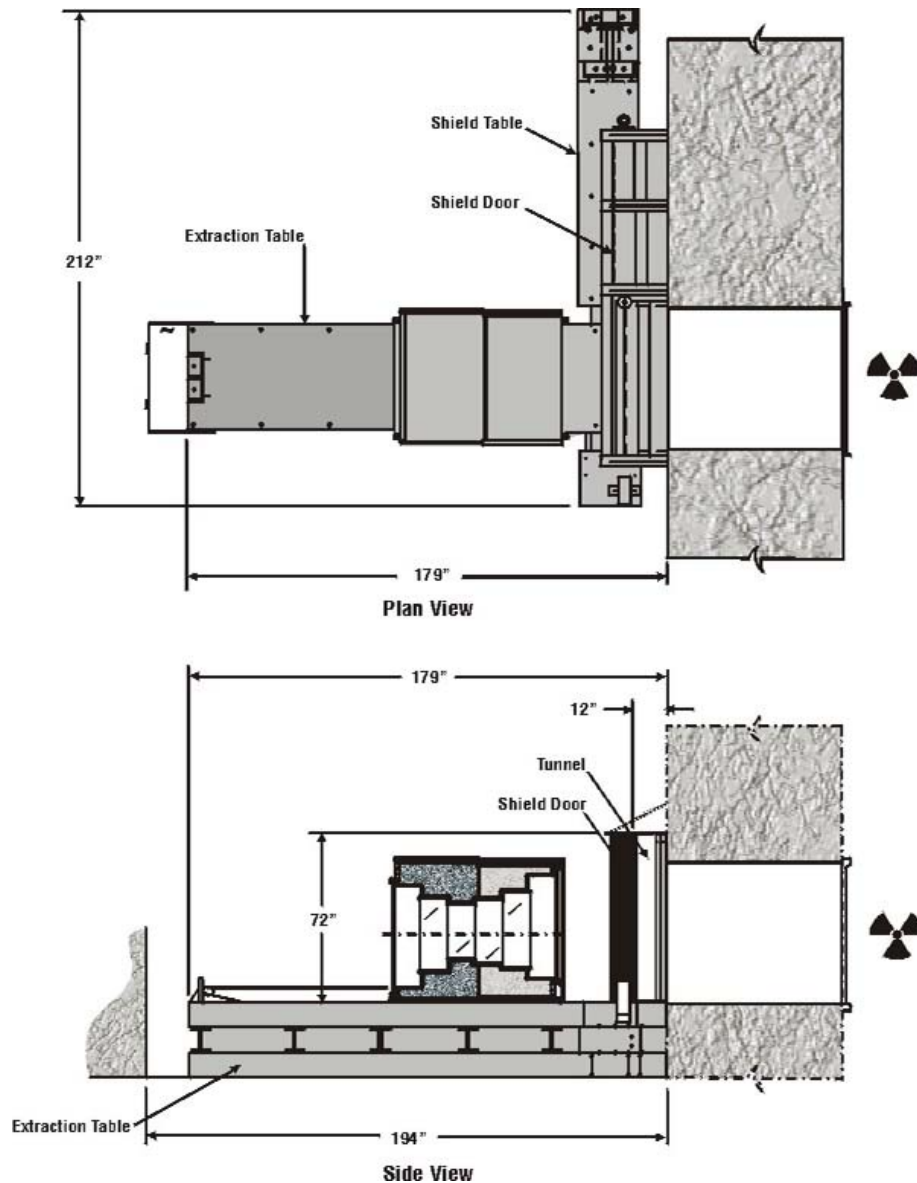


Figure 2. Window Extraction Setup

While the shield window was out of the window cavity, temporary shielding was needed to protect the workers while they refurbished the window assembly. To provide this shielding, a 6-inch-thick steel tunnel was constructed around the window opening. This provided radiation shielding from diagonal shine when the window was removed. In addition, a separate shield table was constructed to the side of the window to hold the shield door. The shield door consisted of eight 6 ft by 6 ft by 1 in. thick steel plates bolted together. Once the window assembly was removed from the wall, the shield door was slid into place.

The extraction table, shield table, and shield plates were designed and fabricated by Hot Cells Services in their facility in Kent, Washington. The only access to the Operating Aisle near the shielding windows was through a 4 ft by 8 ft personnel door. This required that all of the steel be brought into the building piece by piece and assembled in place. To ensure fit up of all of the

WM'00 Conference, February 27 – March 2, 2000, Tucson, AZ

pieces, the extraction table, shield table, and shield plates were assembled at the Hot Cells Services Facility. Following assembly, a trial run of the movement of the shield plates was successfully performed. The system was then disassembled and shipped to the WVDP.

Once the extraction table, shield table, and shield door were installed in the Operating Aisle, a 22 ft x 14 ft x 12 ft high containment tent was installed. This containment tent would provide the necessary contamination control should airborne contamination be encountered during the refurbishment of the window. After making some final preparations and isolating certain areas of the plant due to expected radiation shine, the window assembly was removed and the shield door slid into place. Dose rates in the window opening with the window removed varied from 10R at the top of the window opening to 1R at the bottom. After the shield door was slid into place, the window assembly and tent were decontaminated and the containment tent was released. The hot side cover glass and the remaining two pieces of shield glass were removed. The two pieces of refurbished shielding glass were installed and the cover glasses reinstalled. Once the window assembly was reassembled, a leak test was performed and the assembly was filled with mineral oil. Following the final inspections, the shield door was pulled back out of the way and the window assembly pushed back into the window liner using 5-ton hydraulic jacks. The elapsed time from actual window removal to window reinstallation took approximately 20 days for the first window and approximately 16 days for the second.

The third shield window to be refurbished was the PMCR window. This was a zinc bromide window that was converted to an oil-filled lead glass window. In 1998, Hot Cells Services found a need for zinc bromide at another DOE facility. Recognizing that WVNS had several zinc bromide windows that were no longer usable due to the degradation of the zinc bromide, Hot Cells Services contacted WVNS. Zinc bromide is a hazardous material and this provided WVNS with a method to dispose of this material and then convert the window to an oil-filled lead glass window. WVNS contracted with Hot Cells Services to drain the zinc bromide from the PMCR window. Once the zinc bromide was drained from the window, the window cavity had to be completely refurbished. This involved removal of the cold side cover glass and sandblasting the window cavity to remove all the old paint. Once the cavity had been sandblasted, the cover glass was reinstalled and the window cavity was flushed with hydrochloric acid. The acid was used to leach out residual zinc bromide from the window cavity. After the acid flush, the window cavity was again sandblasted and painted. Following the painting, two pieces of lead-shielding glass were installed, the cover glass was reinstalled, and the window was filled with oil.

TEAMWORK, THE KEY TO SUCCESS

All of the Hot Cells Services procedures necessary to complete the work were submitted to WVNS for review and approval prior to the commencement of the work. A hazard analysis of each procedure was performed that allowed the project lead engineer to determine which WVNS organizations needed to review the procedure. Only after this review was successfully completed and the work procedures approved, was work allowed to begin.

Due to the complexity and hazards associated with the job, a cross-functional team, consisting of Engineering, Construction, D&D Operations, Radiation Controls, Industrial Hygiene and Safety,

WM'00 Conference, February 27 – March 2, 2000, Tucson, AZ

and Hot Cells Services, was formed. Engineering had overall project responsibility. Hot Cells Services provided their expertise on the refurbishment of the window assemblies. D&D Operations provided their expertise on contamination control and decontamination techniques. Radiation Protection brought their expertise on radiological controls, and Industrial Hygiene and Safety brought their expertise on industrial safety. Construction was brought in to provide the day-to-day coordination of the work between the various groups. This allowed the project lead engineer to focus on the “paper” side of the process and ensure all necessary procedures were in place. This also allowed Engineering to spend less time on the day-to-day activities and to stay 2 to 3 steps ahead of the field, thereby ensuring the equipment was delivered and the procedures were in place for the next evolutions.

To ensure continuity during the window refurbishment work, two Radiation Protection technicians were switched from their normal rotation and assigned full time to the project. D&D Operations also ensured the same personnel were used through the 7-month project. This not only ensured continuity among personnel, but allowed the people in the field to work together to develop the synergy necessary to successfully perform the refurbishment work.

After the first window was completed, an off-site “lessons learned” session was held with all the personnel involved. This served as a forum to review the job and document the things that could be improved and the things that went well. The improvements from the “lessons learned” were incorporated into the refurbishment of the second window and were instrumental in that window being completed in 20 percent less time than the first window.

SUMMARY

The refurbishment of these three windows has provided valuable visual access to these two cells and has allowed the WVDP to better plan the approaches for decontamination and decommissioning of these cells. As a result of the success of this window refurbishment work, the WVDP elected to refurbish two additional windows in the PMC. This refurbishment work should be completed in early 2000. This project will also serve as a model for future D&D work on the site where outside contractors are brought in for their specific expertise and teamed up with the WVNS D&D Operations and Radiation Protection personnel to share their expertise and knowledge of the plant.