Structured Planning and Preparation Leads to Safe Open-Air Demolition of Contaminated Facility – 14520

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ABSTRACT

In December 2012, the U.S. Department of Energy, CH2MHILL Babcock &Wilcox, LLC (CHBWV) and American DND initiated demolition of the 01-14 Building at the West Valley Demonstration Project (WVDP). The six-month open air mechanical demolition of the four-story, 204 square meter (2,200 square foot) structure marked the first instance of open-air demolition of a radiological building at the WVDP. Integrated and effective project management during all aspects of the project ensured successful project completion that met all safety, environmental and radiological control objectives while demonstrating the proof of concept for open air demolition of radiological facilities at the site. A number of best practices and lessons learned were generated as a result of 01-14 Building demolition, all of which have future applicability at the WVDP and similar sites that are planning for the demolition of aging nuclear facilities.

Photo 1 - The 01-14 Building, prior to the start of demolition

Background

The 01-14 Building was a 18.3 meters (60 feet) tall steel, reinforced concrete, and concrete masonry block structure constructed at the WVDP in the 1970s as part of a modernization effort undertaken by nuclear fuel reprocessing operator Nuclear Fuels Services. It was constructed adjacent to the site's Main Plant Process Building and housed new acid recovery equipment for use in commercial fuel reprocessing. (See Photo 1) Nuclear Fuels Services was in shutdown mode for facility modifications at the time of 01-14 Building construction and since fuel reprocessing never resumed at the site, the building's acid recovery system was never activated.

The U.S. Department of Energy (DOE) assumed control of the site in 1980 to conduct the West Valley Demonstration Project, with a primary goal of solidifying liquid high-level radioactive waste that had resulted from reprocessing and was stored in the site's underground waste tanks. The 01-14 Building was used for a number of radioactive processes during the DOE pre-vitrification and vitrification era, beginning with cement solidification of lower activity liquid waste from the site's high-level waste tanks and the vitrification off gas system. A number of major components remained in the building prior to demolition that fed complex systems that were interwoven with systems in other facilities. Major components included reheaters, catalytic reactors, heat

exchangers, HVAC blowers, filter housing, a waste dispensing vessel and system piping. Waste streams that passed through the facility during the 01-14 Building's operational history included uranyl nitrate hexahydrate, sludge wash solutions, PUREX and THOREX supernatant and sodium bearing wastewater.

DOE awarded a 7-year contract for facility disposition as part of Phase 1 Decommissioning to CH2MHILL B&W West Valley, LLC (CHBWV) in August 2011. Approximately 50 radiological and industrial structures are scheduled for demolition and disposal under the contract, including the 01-14 Building, the Main Plant Process Building and the Vitrification Facility.

Since August 2011, CHBWV has removed over a dozen facilities and foundations from the WVDP site premises. The 01-14 Building was the first radiological structure demolished under the current contract. It allowed CHBWV an opportunity to demonstrate safe, successful open-air radiological demolition, served to identify best practices and lessons learned, and provided the basis for future large-scale radioactive demolition activities at the site.

01-14 BUILDING DEMOLITION

Major Considerations

The 01-14 Building was constructed adjacent to the Main Plant Process Building (MPPB) at the WVDP. Internal contamination in piping, vessels and equipment, close proximity to the highly contaminated MPPB, a dedicated ventilation stack that approached the reach capacity of demolition equipment, guy wires from the Main Plant Process Building ventilation stack that stretched over the top of the 01-14 Building, connections to the nearby Utility Room and co-location next to the site's water tower contributed to making physical demolition a complex effort.

Preventing unintended releases of radiological and hazardous constituents that were within the 01-14 Building were major considerations during demolition planning. Specific attention was given to ensuring there were no adverse impacts to employees, nearby residents or the environment as a result of the demolition of the building. Radiological and hazardous materials were evaluated during facility characterization and on an ongoing basis during demolition to facilitate planning and progress-based decisions related to specific building components. To ensure accepted practices were applied, CHBWV used NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance to develop a consistent approach for planning, performing, and assessing building surfaces to meet established dose or risk-based criteria.

Regulatory compliance was an equally important consideration in planning for 01-14 Building demolition. The project served as a "proof of concept" demonstration for the WVDP and the state of New York - the ability to validate full compliance during mechanical open-air demolition would establish a precedent for future radiological demolitions at the site.

The availability of field personnel with experience in mechanical demolition of radiological buildings was another consideration for the 01-14 Building demolition project. Available onsite resources included an experienced demolition Project Manager; experienced health, safety and environmental personnel; proficient heavy equipment operators; experienced demolition planners

and knowledgeable radiological control technicians with questioning attitudes. Regular and productive interactions with support organizations such as regulatory strategy, waste generator services and engineering ensured total project integration during all aspects of 01-14 Building demolition. The project team was also augmented by a professional engineer disciplined in structural engineering.

Pre-demolition Preparations

Planning and preparation for 01-14 Building demolition began months in advance of the physical demolition. A cross-sectional group was involved in planning the 01-14 Building demolition, which included an extensive review of the building's structural, process, and instrument diagrams. Planning included the development of 3-dimensional sketches of the building and its internal components that were used to develop Work Instruction Packages (WIPs) for the various stages of demolition and to clearly identify areas of special concern. The sketches were modified and used throughout demolition to keep field personnel apprised of current conditions and for use in discussions with regulators and stakeholders.

Emphasis was placed on reducing the risk of airborne releases at the onset of demolition planning by involving Radiological Engineering in an evaluation of system piping and equipment in 01-14 Building, which was then used to construct dose models. Those models were used to determine which equipment and piping should be removed versus what could stay until structural demolition, based on finite criteria developed for specific alpha, beta, and gamma radiation and contamination levels.

A cell-by-cell evaluation was conducted, with utility and piping isolations and demolition preparations conducted in each individual area. Cell interfaces with other buildings were identified and terminated. More than one-half mile of contaminated piping was removed from the building, along with pumps, waste processing equipment, and high-efficiency particulate air (HEPA) filters. A number of contaminated components were also left in place and prepared for demolition with internal grout, expandable foam and a variety of contamination lock down agents.

Proactive and frequent agency interactions proved vital to gaining approval and buy-in of regulatory agencies; the site's owner, New York State Energy Research and Development Authority; and DOE. Discussions were initiated early in the deactivation process to keep agencies informed during the planning and to establish relationships that fostered a forum for open discussion of issues and concerns. Routine teleconferences and field visits continued through the duration of 01-14 Building demolition.

Job site configuration included planning for essential communications for the duration of demolition. This included locating job site trailers adjacent to the demolition area which remained in place for the duration of the project. These facilities served as a meeting location for daily pre-job conferences, provided office space for involved personnel and were used for equipment storage for radiological control technicians. The availability of at-location personnel reduced the time required to process paperwork and count real-time smear samples. In addition, most field personnel were equipped with two-way radios for use in the field to facilitate good communications.

The project structural engineer and demolition Project Manager were both heavily involved in the development of the demolition WIP. Their input was crucial in preparing the final

three-dimensional demolition sketches showing the various demolition phases and engineered limits of access openings required for retrieval of specific contaminated pieces of equipment/tanks.

Experienced work planners developed more than 100 Work Instruction Packages (WIPs) that defined and addressed the multiple radiological and industrial hazards associated with the 01-14 Building deactivation and demolition. The planners' understanding of the complexity and interrelationships of the 01-14 Building systems was vital to the development of successful WIPs that contained a logical sequencing of work activities. Work planners remained involved throughout demolition of the 01-14 Building, and were called in for consultation (along with specific subject-matter experts) whenever a change in technique or strategy was proposed.

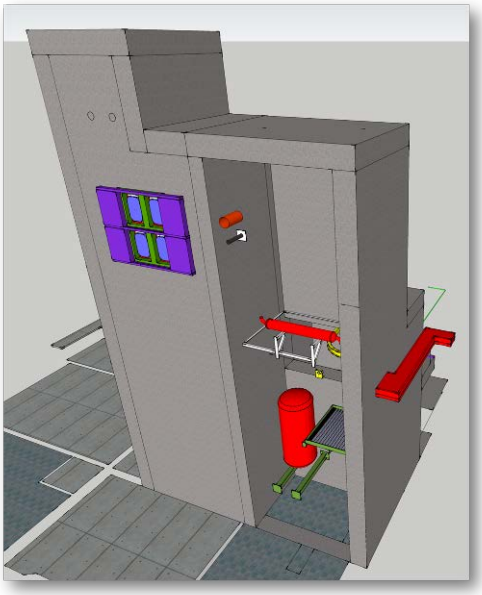

Figure 1 - Internal features of the 01-14 Building, such as the Waste Dispensing Cell shown above, were illustrated in three-dimensional diagrams and included in WIPs.

Final pre-demolition preparations included removal of ventilation system filters, performing utility and fire line isolations, hazardous and asbestos material removal, establishment of demolition boundaries and water management controls, and preparing for debris waste management. High visibility paint and sheathing was applied to nearby features that needed to be avoided during demolition. Considerable attention was given to ensuring the MPPB's main stack guy wires were marked for high-visibility, along with utility piping to the MPPB and the nearby site water tower. Additionally, specific pieces of equipment remaining in the structure that required special handling due to their radiological characteristics. This equipment was painted with a high visibility paint to warn the equipment operator to avoid damage to them and remind him that special handling was required to remove them.

Figure 2 – The 01-14 Building's close proximity to adjacent structures is depicted in the drawing above.

Prior to the start of demolition, internal and corporate management self-assessments were conducted to verify readiness for the start of demolition. An emergency response exercise was also held prior to the start of demolition to ensure the response organization was adequately prepared in the event of an actual emergency.

Regulatory Strategy and Compliance

CHBWV's Regulatory Strategy Department maintained an active role in maintaining environmental compliance during the 01-14 Building demolition, ensuring regulatory compliance

throughout the project. National Emissions Standards for Hazardous Air Pollutants (NESHAPs), state regulations for asbestos containing materials removal, New York State Pollutant Discharge Elimination System (SPDES) regulations and Resource Conservation and Recovery Act (RCRA) guidelines were regulatory areas of compliance during the project.

A number of unrelated non-radiological facility demolition activities were conducted at the WVDP prior to 01-14 Building demolition that served as an opportunity to establish and demonstrate air monitoring protocols in cold (non-radiological) applications. Air monitoring was also used to establish baseline radiological readings that were used for comparison purposes during the 01-14 Building radiological demolition. Those demonstrations served as the basis for establishing NESHAPs-compliant demolition area air monitoring stations, which remained in operation throughout 01-14 Building demolition.

The 01-14 Building's ventilation stack was a NESHAPs compliance point. To prepare for the structure's demolition, the U.S. Environmental Protection Agency (EPA) was provided 90-day advance notification of the intent to cease monitoring of the stack discharges due to building demolition.

Regulatory Strategy submitted predicted air concentration data to demonstrate expected compliance with air emissions standards during mechanical demolition. Pre-demolition estimates established the Effective Dose Equivalent (EDE) of 0.003 mrem per year, which is well below the exemption standard of 0.1 mrem per year.

Prior to the start of demolition, American DND conducted asbestos surveys to identify asbestos-containing materials that would be removed from the facility prior to demolition. Regulatory Strategy used that information to complete the required asbestos removal 10-day advance New York State Department of Labor notification and an asbestos removal plan notification for the non-friable asbestos materials identified in the pre-demolition survey. A variance request from NYS Code Rule 56 was submitted for the removal of the asbestos-containing roof on an attached single story metal structure.

The existing WVDP SPDES permit provided adequate coverage for the collection and management of storm waters and dust suppression waters associated with demolition of the 01-14 Building. Work planning documents detailed specific activities and controls that were implemented prior to the commencement of demolition activities and remained in-place throughout the demolition. Storm and dust suppression waters were able to be collected and sampled to confirm the results were within releasable limits prior to discharge to interceptors for treatment in the low-level waste treatment building (LLW2).

Regular interactions with oversight agencies during the planning and demolition stages of 01-14 Building demolition ensured regulatory compliance and approvals were in place on a timely basis. Agency involvement included routine teleconferences and field visits, which continued throughout the project.

Radiological Planning, Monitoring and Safety

In addition to direct Radiological Engineering involvement during planning and demolition, three radiological control technicians were assigned to the 01-14 Building demolition project. This crew was involved in the extensive evaluation of the radiological components in 01-14 Building prior to

the start of demolition and remained active throughout demolition. Monitoring activities emphasized maintaining As Low As Reasonably Achievable (ALARA) radiological exposure for employees, preventing an unplanned radiological release, and monitoring an air monitoring system that recorded airborne contaminants and validated compliance with NESHAPs requirements.

There were several contaminated vessels and components in the 01-14 Building at the start of demolition planning. The potential for radiological contamination existed in several areas of the structure, thus smear surveys were collected on the walls, ceiling and floor of each of the 01-14 Building's rooms to assess contamination levels. The data collected was used for demolition preparation and planning purposes.

A number of measures were instituted to prevent contamination spread from the 01-14 Building demolition site. They included source term reduction prior to demolition through flushing and the removal of select equipment; internal foaming and grouting of vessels, ducts and large pipes; contamination lockdowns of large surfaces using spray fixatives; dust suppression using a remote-controlled water cannon; and daily lockdown of the debris pile at the end of each work day. A radiological control boundary was established around the work zone and inside equipment cabs prior to the start of demolition. Radiological surveys were conducted frequently on the equipment and debris piles.

To measure airborne releases and record airborne radiological data, a series of demolition area perimeter air monitors and continuous air monitors (CAMs) were positioned to collect air samples during demolition. The data obtained was monitored and recorded on an ongoing basis. Equipment operators and the nearby facility air compressor intake for the WVDP were equipped with monitors to detect airborne contamination. More than 950 long-lived air samples were obtained from inside and outside the established demolition boundary, with none greater than 0.5 of the derived air concentration (DAC) levels. Gross alpha/beta counting was performed on air sample filters at the end of each shift and the previous day's air sample results were evaluated prior to the start of the next day's shift. The site's ambient air monitoring system found no detectable radioactivity offsite as a result of the demolition.

Routine radiological sample collection was maintained outside the demolition zone to verify the effectiveness of radiological controls. Thousands of routine smears and towel wipe samples were obtained on vertical and horizontal surfaces outside the radiological control barrier, with no samples found to be above release limits for alpha and beta-gamma contamination.

Specific tasks were mocked up during the deactivation and demolition process to ensure radiological activities could be conducted safely and to demonstrate the effectiveness of proposed techniques. These evolutions helped identify potential improvements while work was still in the planning stages and verified the intended results would be achieved. Mockups included a demonstration of the ability to fill a horizontal 20-centimeter (8-inch) diameter schedule 10 ventilation pipe with grout and then shear it with the equipment available during demolition; the application of flexible coating to demonstrate the efficacy of coating the vitrification off gas system prior to demolition; and a fully integrated waste loading demonstration to verify equipment operation, waste loading procedures and roles and responsibilities.

Physical Demolition

Three distinct demolition phases were identified for the demolition of the 01-14 Building. The phases were identified based on structural characteristics, radiological and hazardous constituents, and the waste types that would be generated.

Phase I – These sections of the 01-14 Building consisted of the lower story, metal-sided non-radiological areas of the building. They included the control room, truck bay, conference room, motor control center rooms, drum loading area, ammonia pipe gallery, and a utility pipe bridge.

Phase 2 – These portions of the 01-14 Building consisted of the roof, structural steel and the masonry block areas of the structure.

Phase 3 – This final phase involved the reinforced concrete portions of the building, including equipment and contaminated areas. Structural steel was also removed during Phase 3.

Photo 2 – Phase 1 demolition of the 01-14 Building.

Photo 3 – Phase 2 demolition of the 01-14 Building.

Waste Management

Touch-waste-once principles were used in planning for the packaging and offsite shipment of 01-14 Building waste. Waste packaging costs were minimized by obtaining from another site intermodals being excessed at no capital cost to the receiver. Waste contracts for shipment and disposal were in place well in advance of debris loading. Contamination was controlled during waste loading by wrapping the inside and outside surfaces of the intermodals with herculite or poly liners. To prevent overloading of intermodals, a leased forklift equipped with a scale was used inside the waste loadout area to provide real-time intermodal weights during loading. Pre-populated inventory sheets were developed in advance for each waste container to minimize input errors. Aquadox® was added to waste containers to absorb moisture during mildly inclement weather. Waste loading activities were suspended during periods of heavy snow, wind or rain.

Photo 4 – Phase 3 demolition of the 01-14 Building.

Demolition of the 01-14 Building generated approximately 323 metric tons (356 U.S. tons) of industrial waste and approximately 2,350 cubic meters (83,000 cubic feet) of low-level and mixed low-level

waste. The debris was shipped to licensed facilities in Pennsylvania, Tennessee, Utah and Nevada for disposal.

BEST PRACTICES AND LESSONS LEARNED

Dust Reduction Using Spray Water – Spray water effectively reduced airborne dust during demolition, however, it also presented water management issues in the form of a secondary waste stream. Effective containment features were in place to collect runoff from the demolition site and water was collected and processed through the site's low-level liquid waste treatment facility. The volume of spray and runoff water generated during radiological building demolition must be balanced with water containment and effluent processing capabilities.

Identification of Easily Removed Radiological Items – When planning work, consideration should be given to the ease of removing contaminated items before or during demolition. In the 01-14 Building, a small, contaminated filter housing and nitrogen oxide (NOx) analyzers were left in place for removal during demolition. Due to their location and small size, they proved to be difficult to remove and segregate using large, heavy equipment. Removal of these items in the pre-demo stages would have expedited demolition activities and reduced waste disposal costs.

Weather Considerations – Physical demolition of the 01-14 Building was initiated in December 2012. Demolition activities proceeded effectively throughout the winter and spring, with the exception of periods of high winds, when the potential for dust particle migration and wind-chill impacts to personnel were increased. Wind speed monitoring and dust monitoring were conducted in real time during demolition. Heavy equipment was equipped with special winterizing systems prior to the onset of cold weather to ensure proper starting and operation.

End State – The floor slab of Building 01-14 Building had a very irregular footprint. The demolition end state required the slab to be covered with structural fill overburden which was then sloped to drain. High visibility survey markers were installed on the overburden surface at each change of direction in order to aid in follow-on actions to be conducted at specific locations on or below the slab.

Photo 5 – The 01-14 Building slab covered with backfill.

CONCLUSIONS

Demolition of the radioactively-contaminated 01-14 Building served as a proof-of-concept project for open-air demolition of a radioactive facility at the West Valley Demonstration Project. The experience of the demolition crew, an "in the field" presence of the project team, a proactive relationship with regulatory agencies, effective work planning and implementation of controls, and a graduated approach to demolishing the structure contributed to the overall success of the project.

Through careful planning and execution, there were no recordable or lost time injuries, no unplanned radiological exposures, no unintended airborne releases, no environmental releases,

and no impact to neighboring facilities. The cumulative worker radiological dose resulting from 01-14 Building demolition was approximately 10 person-mrem.

The proof of this concept and the applicability of lessons learned from the 01-14 Building will serve as a starting point for future demolition at the WVDP as the project moves forward with an aggressive plan to take down several contaminated and non-contaminated structures in the next few years. The WVDP's highly contaminated Main Plant Process Building and former Vitrification Facility are being prepared for demolition under the current DOE contract with CHBWV.