Demolishing a Cold-War-Era Fuel-Storage Basin Superstructure Laden with Asbestos - 9475

E.R. Lloyd, J.M. Stevens, L.C. Zinsli, M.A. Green, C.H. Larson
Fluor Hanford, Inc.
P.O. Box 1000, Richland WA 99352

T.K. Orgill
Energy*S*olutions
2345 Stevens Drive, Richland, WA 99354

E.B. Dagan
U.S. Department of Energy
P.O. Box 550, Richland, WA 99352

ABSTRACT

The K East (KE) Basin facilities are located near the north end of the Hanford Site's 100 K area. The facilities were built in 1950 as part of the KE Reactor complex and constructed within 400 meters of the Columbia River, which is the largest river in the Pacific Northwest and by volume the fourth largest river in the United States. The basin, located adjacent to the reactor, was used for the underwater storage of irradiated nuclear fuel discharged from the reactor. The basin was covered by a superstructure comprising steel columns and beams, concrete, and cement asbestos board (CAB) siding. The project's mission was to complete demolition of the structure over the KE Basin within six months of turnover from facility deactivation activities.

The demolition project team applied open-air demolition techniques to bring the facility to slab-on-grade. Several innovative techniques were used to control contamination and maintain contamination control within the confines of the demolition exclusion zone. The techniques, which focused on a defense-in-depth approach, included spraying fixatives on interior and exterior surfaces before demolition began; applying fixatives during the demolition; misting using a fine spray of water during demolition; and demolishing the facility systematically.

Another innovative approach that made demolition easier was to demolish the building with the non-friable CAB remaining in place. The CAB siding covered the exterior of the building and portions of the interior walls, and was an integral part of the multiple-layered roof. The project evaluated the risks involved in removing the CAB material in a radiologically contaminated environment and determined that radiological dose rates and exposure to radiological contamination and industrial hazards would be significantly reduced by using heavy equipment to remove the CAB during demolition.

The ability to perform this demolition safely and without spreading contamination (radiological or asbestos) demonstrates that contaminated structures can be torn down successfully using similar open-air demolition techniques.

INTRODUCTION

The KE Reactor, the associated basin for storing fuel under water, and the superstructure over the basin were constructed as part of the Manhattan Project and operated between 1955 and 1971. Cleaning up the

KE facility is a high priority with the DOE and the regulators due to its proximity to the Columbia River. Located within a half kilometer of the Columbia River, near the north end of the Hanford Site, the KE Basin was determined to have leaked to the surrounding soil during its operational life.

Because of the significant hazard to the environment, decisions were made to remove/demolish the facility. Processes of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) were followed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington Department of Ecology (WDOE). As part of the CERCLA decision process, a Record of Decision (ROD) for the 100 Area Remaining Sites CERCLA ROD, 1999 was signed by EPA, WDOE, and DOE-RL on July 21, 1999. The ROD addresses — at a very high level — the cleanup of the facilities and waste sites in the general area around the KE Reactor.

In keeping with the CERCLA ROD requirements, a Remedial Action Work Plan (RAWP) was prepared and approved for the KE Basin Demolition Project to safely demolish, package, and properly dispose of all material generated as a result of, or associated with, the demolition of the KE Basin. The RAWP encompassed the three major phases of the project.

Phase One of the project entailed decommissioning and general preparation for demolition such as building utility isolations, introduction of demolition utilities and removal of friable asbestos and other hazardous materials prohibited by the Hanford Site land fill.

Phase Two, and the focus of this paper, is the demolition of the superstructure (above grade) portion of the KE Basin, which included the above-grade structure immediately covering the basin, a portion of the administrative area adjacent to the basin, and the reactor basin interface area.

Phased Three included removing the basin itself and the associated piping in the immediate vicinity.

A deactivation effort was conducted at the facility before demolition that included containerizing and transporting any remaining fuel to dry storage. In addition, any remaining sludge left in the basin was characterized, vacuumed and transferred to the nearby KW basin via a specially designed system. The deactivation effort was initiated in 2001 and was completed in early 2008 when the basin was dewatered and the below-grade portion was re-filled with controlled density fill (CDF) so work above grade could commence. Filling the basin with the CDF was also significant because it allowed a reduction in the facility hazard classification to a less than Hazard Category 3 facility and initiated the turnover of the basin from the operations program to the demolition project.

PROJECT SCOPE

The project scope included the KE Basin superstructure covering of the basin proper, the Fuel Transfer Station (FTS), the office complex, the transfer bay and the F-to-G line portion where the superstructure is attached to the main reactor building (Fig. 1). The basin's superstructure was primarily steel columns and beams covered with cement asbestos board (CAB) siding and CAB/built up roof. The superstructure built immediately over the basins and transfer bay ranged from 5 meters to 12 meters high and was 23 meters wide and 71 meters long. The F-G Line, or reactor basin interface area, ranged in height from 12 to 22 meters high, 5 meters wide, and 71 meters long. The office area was 5 meters high, 17 meters wide and 22 meters long. The FTS annex was a metal-skinned steel structure built in the early 1980s.

105KE Reactor and Fuel Storage Basin

Fig. 1. This aerial view shows the superstructure covering the KE Basin facilities.

DEMOLITION PREPARATIONS

As with all safely performed demolition projects, the preparations are often as important, or more important, than the demolition itself. Without proper preparations, reliable support systems, and an experienced workforce, demolition can turn ugly in a hurry. Water, electricity, lighting, boundaries, access points, materials and equipment, to list a few, are all critical elements that must be addressed for a demolition project to run safely and efficiently. To complete this demolition project in the scheduled timeframe, two 10-hour shifts worked four days-a-week plus a few weekends of overtime were implemented. Managing two shifts required extra coordination and turnover briefings, additional staffing, and implementation of nighttime work controls.

Temporary electrical support for mobile offices, air monitors, tools, and lighting were required to support this project. Mobile offices and facilities were installed to facilitate the transition from day-to-day nuclear operations to demolition activities. Installation of interior and exterior temporary lighting and organizing the layout of cords and interfaces with the equipment and pedestrian pathways were crucial for the safe and efficient execution of demolition activities. Commercial cord protectors were used for all equipment and pedestrian pathways to protect the cords supplying the tools and monitors and to eliminate tripping hazards.

Temporary water systems for dust suppression, application of fixatives, and decontamination activities were a mandatory infrastructure component and required additional coordination due to equipment pathways, wind and demolition sequences. Due to a main waterline break, water trucks were employed to supply water during the last half of the demolition activities.

After the demolition project's temporary infrastructure was in place, the focus shifted to preparing the basin superstructure for demolition. This preparation included removing asbestos-containing insulation from over-basin piping. Access to this piping insulation was limited by the configuration of the basin construction such as floor grating that hung from the rafters. The presence of the grating made installing scaffolding complex and time consuming. In addition to the above-grating work, a large amount of piping and equipment required asbestos abatement and removal of hazardous material (e.g., oils, antifreeze) before demolition. Lead shielding was either removed for reuse prior to demolition, or marked for removal during demolition. Facility lighting was removed due to the potential for PCBs in the ballasts.

An engineering review was performed to ensure the building remained stable throughout the demolition and to determine ways to protect the structural interfaces from the basin to the remaining reactor structure. These interfaces were identified before demolition and the selected columns painted. Then, the building was demolished in a prescribed sequence to keep the building stable and avoid damaging the critical interface points.

Another complicating aspect was the height of the structure and the extent of radiological contamination. To address this challenge, the project procured a high-reach excavator with shear and custom dust suppression system. (This procurement took almost 10 months from specification development to startup.) The high-reach excavator specification was written to require the high-reach boom to be changed out to a standard type boom for general demolition and excavation. Additional training for operators was required because the high-reach excavator posed a new set of operational requirements to operate safely The high-reach excavator, however, proved to be well worth the effort because it allowed the safe, controlled demolition of the higher portions of the F-G line.

To ensure worker safety and environmental compliance, asbestos monitors and radiological air samplers were procured and installed in several locations around the boundary because the radiologically contaminated building was to be demolished with the CAB in place.

Last, before demolition activities began, all interior and exterior surfaces were sprayed with a fixative solution to control dust and mitigate the potential release of radiological contamination and asbestos.

CEMENT ASBESTOS BOARD SIDING AND ROOFING

The CAB covered the entire exterior of the building including the roof. The CAB panels were 1- meter wide and 3-meters long, and weighed approximately 70 kilograms. The majority of the CAB siding was at levels that required the use of man lifts, scaffolding, and cranes to remove. To work under these conditions would be dangerous, time consuming, and costly. In addition, handling and packaging these large panels, especially working from lifts and scaffolding create significant industrial-type safety risks and are a recipe for worker injury.

Therefore, the project initiated discussions with the DOE and the regulators to proceed with demolition, without first removing the CAB siding or CAB roofing. Initially, only demolition with the CAB roof panels left in place was approved; however, after continued discussions with regulators and the ability to demonstrate the control measures that would be implemented, demolition with the CAB siding and roofing both left in place, commenced.

The approval to demolish the facility with the CAB in place was based on the successful previous use of methods to suppress dust and contamination during open-air demolition of other radiologically (uranium and plutonium) contaminated facilities. Waste was packaged, as much as practical, on a daily basis to minimize the potential for release of contaminants. In addition, the work area was periodically sprayed with fixatives and fixative was applied at the end of each shift.

Asbestos perimeter air samples and individual worker samples were collected and analyzed on a daily basis. The project confirmed that the potential emissions control measures employed were working, and both the workers and the environment were being protected.

FACILITY DEMOLITION

The demolition effort was focused on working safely, and controlling both the asbestos and radiological contamination. Although the building was minimally contaminated, some piping and equipment had substantial levels of internal contamination. Again, using misting, fire hoses, and fixatives, the contamination and asbestos were controlled within the established demolition boundary. The debris was not only kept wet, but also was coated with a fixative at the end of every shift. Water runoff was kept in check with the help of the hot summer weather, sandy soil, and judicious use of fire hoses.

The demolition progressed with two 10-hour shifts. The day crew focused on demolition because the lighting provided better working conditions, especially with the high-reach operations. The night shift demolition crew's focus was on removing waste and packaging the material demolished during the day shift (Fig. 2).

Fig. 2. Demolition of the KE Basin's superstructure literally continued round-the-clock.

The CAB was removed and packaged, to the extent possible, on a daily basis. To minimize the potential for the CAB to become friable, size reductions of any CAB material were kept to only those required to load the waste into the 15-cubic meter containers. The debris was managed to minimize heavy equipment from running over any of the debris.

The taller sections of the project were removed by a high-reach demolition excavator (Fig. 3). This equipment provided a safe method to bring the building to the ground while minimizing damage to the reactor wall as the floors were structurally "tied" into the reactor wall. All piping and conduit penetrations of the wall were isolated during demolition preparation activities, so there was no concern about damaging the wall or items on the other side of the wall.

Fig. 3. A high-reach excavator was used to demolish the F-G (reactor interface area) area.

All the demolition excavators were equipped with dust-suppression systems that sprayed a mist covering the immediate area being demolished. The excavators had their own water tanks, pumps, and spray heads that allowed the equipment to move freely.

In addition to the dust-control systems on the excavators, the project used large fog cannons and remotely controlled spray nozzles. The large fog cannons limited the use of water by providing a fine mist that covered over 50 meters of the general area. Although water can be the project's ally for keeping contamination under control, it can also cause problems with runoff, standing water, and waste packaging.

The fog cannons provided a nice balance. The remote spray nozzles provided accurate “fire hose” type of water spray up close and without personnel in the immediate area.

The weather often results in some of the biggest challenges for demolition projects. The KE Basin project was done during the summer months, where the temperatures in the desert can soar to 46 degrees Celsius and the winds can gust at over 100 kilometers per hour. As a result, heat stress and high-wind events covered the most frequent concerns.

Numerous times during the demolition, work/rest regiments were required to minimize heat-related stresses to the workers. At times, the workers were on a 50-50 work/rest regimen. Approaches to continuing progress even under extreme heat involved using cool-down areas, rotating workers, and scheduling heavy work during the morning hours.

Wind was the next challenge. The project had a 24-kilometer per hour wind speed restriction where no activities that had the potential to generate dust were allowed. Experience has shown that this wind speed limit is reasonable to control water applications, as well as debris and potential emissions within the demolition areas.

At the conclusion of the basin superstructure demolition activities (Fig. 4), the area was prepared for phase three, basin removal.

Fig. 4. The superstructure has been completely removed to slab-on-grade.

LESSONS LEARNED

The project identified several noteworthy lessons that could be applied to future demolition activities and are useful for improving the existing process:

- *Fixative Applications Are Effective* – The fixative spayed just prior to demolition kept radiological and hazardous contamination "locked down" and helped to prevent it from spreading during demolition. The fixatives applied during demolition, kept contamination locked down during loading and periods of inactivity.

- *Misting Devices and Water Are Effective at Controlling Radiological Contamination and Asbestos* – The point-source excavator-mounted misting, in combination with general-area misting using large fog cannons and water from hoses and remotely controlled nozzles, kept the dust and contamination under control. The fine mist captured airborne particles and kept them within the confines of the radiological and asbestos boundaries. One downside to the misting is that during breezy periods, the effectiveness is reduced.

- *Demolition Can Be Done with CAB Intact*– Utilizing the contamination controls mentioned above, demolishing buildings with CAB in place is safer, faster, reduces risk to the workers, and remains environmentally compatible.

- *Planning Every Evolution Carefully…the Human Element* – During one short evolution where contaminated piping was being flattened, the demolition team failed to incorporate the misting as prescribed in the plan. As a result, a small amount of contamination was released outside the radiological boundaries. Water from hoses was used to keep the area wet; however, it is believed that if the misting were incorporated in this evolution, the mist would have captured the contamination and kept it within the established boundaries.

CONCLUSION

Open-air demolition of radiologically contaminated facilities with CAB left in place can be accomplished safely and compliantly. By implementing strict demolition dust control measures, (e.g., fixatives, misting, and water) and proper work sequencing, the project can keep both workers and the environment safe and clean.