METHODOLOGIES USED, CONSTRAINTS IMPOSED, AND LESSONS LEARNED IN THE REMOVAL OF RADIOACTIVELY CONTAMINATED CONCRETE SLAB AND SUBSLAB SOIL AT THE ELZA GATE SITE

Narendran Ramachandran
Bechtel National, Inc.
Oak Ridge, TN

ABSTRACT

This paper discusses the methodologies used to remove a large contaminated concrete slab and underlying contaminated soil, the operational difficulties and problems encountered with the employed methodologies, the constraints imposed, the difficulties caused by these constraints, and the solutions implemented to expedite the work. The lessons learned on the job and recommendations are also presented.

The work at the Elza Gate site is being conducted under the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), which is designed to identify, clean up, or otherwise control sites where low-level radioactive contamination remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

INTRODUCTION

Elza Gate is a FUSRAP site in Oak Ridge, Tennessee, that is currently owned by MECO, a development company. During the 1940s, the Manhattan Engineer District (MED) used the site to store pitchblende (high-grade African uranium ore) and residues resulting from the processing of this ore. The site is divided into several parcels, some of which contain concrete slabs that were once the foundations and floors of warehouses used to store the uranium ore (Fig. 1). The warehouses on the site were demolished, and the debris was removed several years ago.

Parcel 1 has a new manufacturing plant that was built partially on the original warehouse concrete slab and partially on a new extension of the original slab. The original concrete slab is 1,115 m^2 (12,000 ft^2) in area and 15 cm (6 in.) thick and is surrounded by a 30-cm- (12-in.-) thick unreinforced grade beam extending from the surface to about 2.13 m (7 ft) below grade. The radioactive isotopes radium-226, thorium-230, thorium-232, and uranium-238 migrated into the original concrete slab matrix, into the subsoil via expansion joints and cracks in the concrete, and into the soil adjacent to the building. Consequently, the slab, subsoil, and surrounding soil were contaminated above the current guidelines.

Remedial action at the Elza Gate site was performed in two phases. Phase 1 consisted of removing the original concrete slab on parcel 1 and the soil beneath it while minimizing interruptions to manufacturing operations in the building. Exposed surface areas of the slab had previously been shotblasted to remove the surface contamination, but portions of the underside of the concrete slab, expansion joints, cracks in the slab, and soil beneath the slab remain contaminated. Phase 2, which commenced several months later, completed full-scale remediation of the site.

METHODOLOGIES

The following methodologies were employed during the removal of the large contaminated concrete slab and underlying soil during remedial action at the Elza Gate site.

The slab was sectioned into 1-m (3.3-ft) squares using self-propelled, gasoline-powered concrete saws. The size was selected to facilitate the radiological survey for release of the squares as uncontaminated waste. These squares were removed using a rubber-tired backhoe (being cautious not to break them during relocation) and stacked one at a time on wooden pallets (usually about five pieces to each pallet). These pallets were then transported to a storage area approximately 152 m (500 ft) away using a forklift.

A contingency method to break the concrete into pieces using a ram-hoe (hydraulic ram) attached to a backhoe was developed and later implemented to improve remedial action progress. The large pieces were handled as described above. Pieces smaller than 0.2 m^2 (2 ft^2) were simply treated as soil and loaded into trucks for dumping at the storage area. Plywood was placed on the liner at the storage area to minimize possible damage to the liner from the falling debris. All concrete and soil were maintained under cover in the storage area. Before the contingency plan was implemented, a concrete sawing method was used to generate squares measuring 1 m (3.3 ft). The contingency method enabled the concrete to be broken faster with minimal labor and water usage.

The underlying contaminated soil was excavated using a rubber-tire backhoe after the boundaries of contamination were established by a radiological survey technician using field detection instruments. The soil was loaded into trucks and hauled to the storage area.

OPERATIONAL DIFFICULTIES

Several operational difficulties and problems with the employed methodologies were encountered during the remedial action activities.

The concrete saw blades used to cut the slab had to be cooled with water during the cutting process. The water, which was generated at a rate of approximately 3.8 L/min (1 gal/min), was potentially contaminated and therefore had to be collected for disposal. With three saws operating at the same time for an average of four hours a day, approximately 10 to 12 55-gal drums of water were generated each day. Handling this large amount of water using shop vacs and HEPA vacs, hoses, drums, and pumps was a major effort. The vacuum units were not very efficient, and all electrical cords supplying power to the units had to be kept dry. One benefit of using cooling water was that dust levels were minimized. However, to reduce dust levels even further to prevent airborne contamination, a customized skirt was attached to the concrete saws.

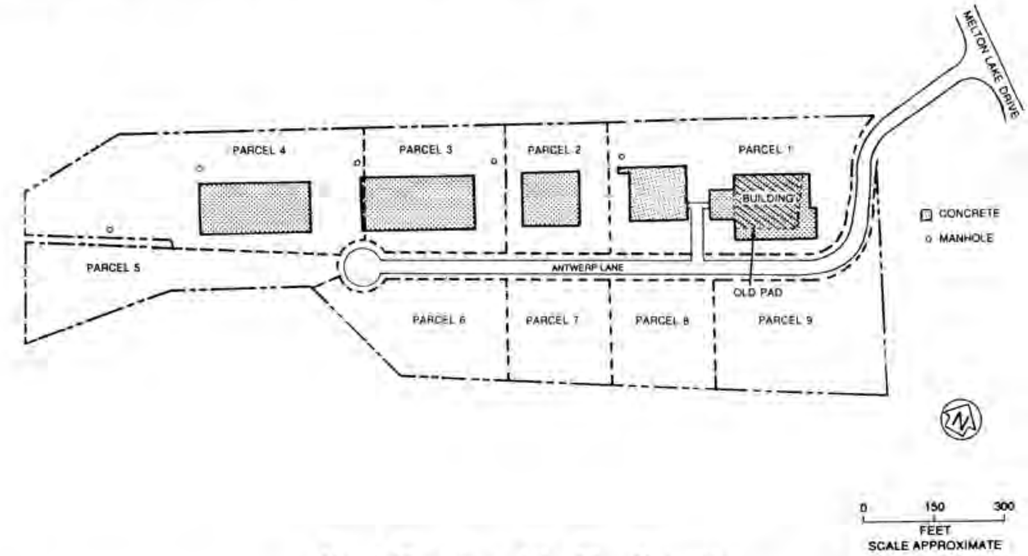

Fig. 1. Plan view of the Elza Gate site.

Progress of the sawing operations was another major problem. The saw crews were unable to make sufficient cuts in time to meet the schedule. The concrete was 45 years old and the aggregate used in the concrete mix consisted of hard river rock that was approximately 1.3 to 2.5 cm (0.5 to 1 in.) in diameter. At the rate the cuts were made [an average of 0.3 m/h (1.0 ft/h) for each saw], the schedule would have had to be extended by 50 percent, which would have dramatically increased the cost. Replacing the saw blades with more expensive diamond-tipped blades improved productivity only minimally. This methodology was terminated after three days, and the contingency method was adopted.

The contingency method of removing the concrete by breaking it with a ram-hoe was adopted in order to meet the schedule, but several problems arose. The gasoline-powered concrete saws generated carbon monoxide fumes causing the operation to be shut down several times. When the saws were replaced by the ram-hoe, the fume problem still remained and was compounded by high dust levels caused by the constant pounding on the concrete. Dust control measures (water spraying) were implemented. Natural venting from the building was minimal; therefore, the work had to stop when carbon monoxide levels exceeded allowable levels until natural venting could occur. Ear protection was also required because of the noise generated by the ram-hoe and saws.

Another disadvantage of using the ram-hoe was that the sizes and shapes of the broken concrete could not be controlled, which failed to comply with the desire to generate 1-m (3.3-ft) pieces. Therefore, the area of each concrete piece had to be determined during radiological surveys, and the calculations done to average the area of each piece had to be adjusted.

The technique used to remove the large concrete segments from the ground, to stack them on wooden pallets, and then to transfer them to the storage area posed more difficulties. The large pieces were lifted off the ground and slid onto the forks of a skid steer loader. The loader placed the concrete on pallets with cribbing between them to facilitate their removal during later radiological surveys. Handling the large, heavy concrete pieces with small equipment was challenging. The slab was free of any reinforcement or embedded conduits, which simplified the task of removing the slab. The process of transferring the pieces from the ground to the wooden pallets was time-consuming but better than the other methods considered. One method attempted was lifting the pieces of concrete using anchor bolts and slings onto the wooden pallets, but this was determined unsafe and very laborious.

CONSTRAINTS IMPOSED AND RELATED DIFFICULTIES

Minimization of exposure to plant personnel was a high priority, and therefore monitoring and environmental controls were performed continuously throughout the remedial action. Limited work space for remedial action efforts due to ongoing plant operations was another major constraint. To resume normal operations as quickly as possible, the plant owner set rigorous time constraints. The radiological subcontractor requested that the concrete pieces measure 1 m (3.3 ft), but DOE required that the volume of waste generated be minimized.

These constraints created several difficulties, which had to be solved to expedite the work. Because the concrete slab on parcel 1 houses an operating facility, some operations continued during the remedial action activities and only a portion of the slab to be remediated was available at any time. The work was performed in three phases: each area was remediated, an independent verification contractor confirmed that it was clean, and then it was restored to its original condition before other areas were available for remediation. Therefore, limited working space and possible exposure to plant personnel were important issues. To resolve these issues, smaller equipment was used, safety of personnel near the operating equipment was closely monitored, noise and carbon monoxide levels were constantly monitored, the perimeter of the controlled area was barricaded using saw horses to stop any accidental or careless entry, and only essential personnel were allowed in the area.

To minimize potential exposure, work was performed during off-peak shifts when the number of personnel at the site was minimal. Plant personnel were informed of the nature of the work and the hazards involved. The work schedule was accelerated when possible to free the facility for full-scale operations. Precautionary measures were taken to identify and control the spread of contamination.

To meet the time constraints, the tasks had to be performed in the most expeditious and efficient manner with high concern for safety. This requirement was met by properly planning the work, organizing and educating the labor force of their tasks, and cooperating and coordinating the effort with all support personnel involved.

The desire that the concrete be broken into 1-m^2 (3.3-ft^2) pieces to facilitate radiological release surveys was relaxed when the need to complete the remedial action work in the building on time became a priority over the dimension of the concrete generated.

The overall attempt to minimize the volume of waste generated was the driving force that led to cutting the concrete into prescribed sizes, handling them for transport to the collecting area, and then double-handling them for radiological surveys. If waste minimization had not been a goal, the floor slab could have been rubbled and hauled off with minimal effort, time, and cost. The volume reduction achieved as a result of the extra effort was 99 m^3 (130 yd^3) or 61 percent of the original waste.

LESSONS LEARNED AND RECOMMENDATIONS

The lessons learned and recommendations for future work of this nature are explained below.

The age, hardness, and type of reinforcement in the concrete, if any, will be thoroughly investigated before demolition techniques are selected. Test cuts will be performed to determine the feasibility and production rates of the methodology proposed for a more reliable projected schedule. Contingency methods are always necessary.

If saw cutting is the chosen methodology, high-quality, reliable water collection equipment will be employed. Electrically powered equipment will not be used. The water collection/treatment system will be sized to accommodate the expected load. The possibility of continuous treatment of the collected water will be investigated, and treated water will be recycled to minimize the net volume of water used.

Adequacy of ventilation in the facility will be investigated prior to beginning any work; if marginal, provisions will be made for engineered ventilation.

All efforts will be coordinated with the site owner/occupant and arrangements will be made to conduct the remedial action activities when the number of plant personnel is at a minimum and the nature of the plant operations is favorable to remedial action efforts. Studies will be conducted to evaluate the cost effectiveness of minimizing the volume of waste versus the cost of disposal. Finally, contamination control and decontamination techniques will be emphasized if waste minimization is deemed a priority.