Challenges Achieved By Innovative Technologies
Our Link to a Safer, Cleaner, Healthier Tomorrow – 12369

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ABSTRACT

The River Corridor Closure Project is the nation's largest environmental cleanup closure project where innovative technologies are being utilized to overcome DOE's environmental clean-up challenges. DOE provides a Technology Needs Statement that specifies their on-site challenges and the criteria to overcome those challenges. This allows for both the private sector and federally funded organizations to respond with solutions that meet their immediate needs. DOE selects the company based on their ability to reduce risk to human health and the environment, improve efficiency of the cleanup, and lower costs. These technologies are our link to a cleaner, safer, healthier tomorrow.

INTRODUCTION

Since August 2005, the company Washington Closure Hanford has been responsible for the safe execution of the $2.3 billion, 10-year River Corridor Closure Project (RCCP) for the US DOE. This includes the demolition of 329 facilities, remediation of two high-risk burial grounds known to contain transuranic waste, remediation and closure of an estimated 555 waste sites, placement of three nuclear facilities into interim safe storage condition, management of disposal operations (treatment, transportation, disposal of 6.5 million tons of waste) and expansion of the facility, as necessary. Located in the southeastern portion of Washington State, DOE's Hanford site is comprised of 586 square miles where 220 square miles consist of the River Corridor along the northern boundary of the site. [1]

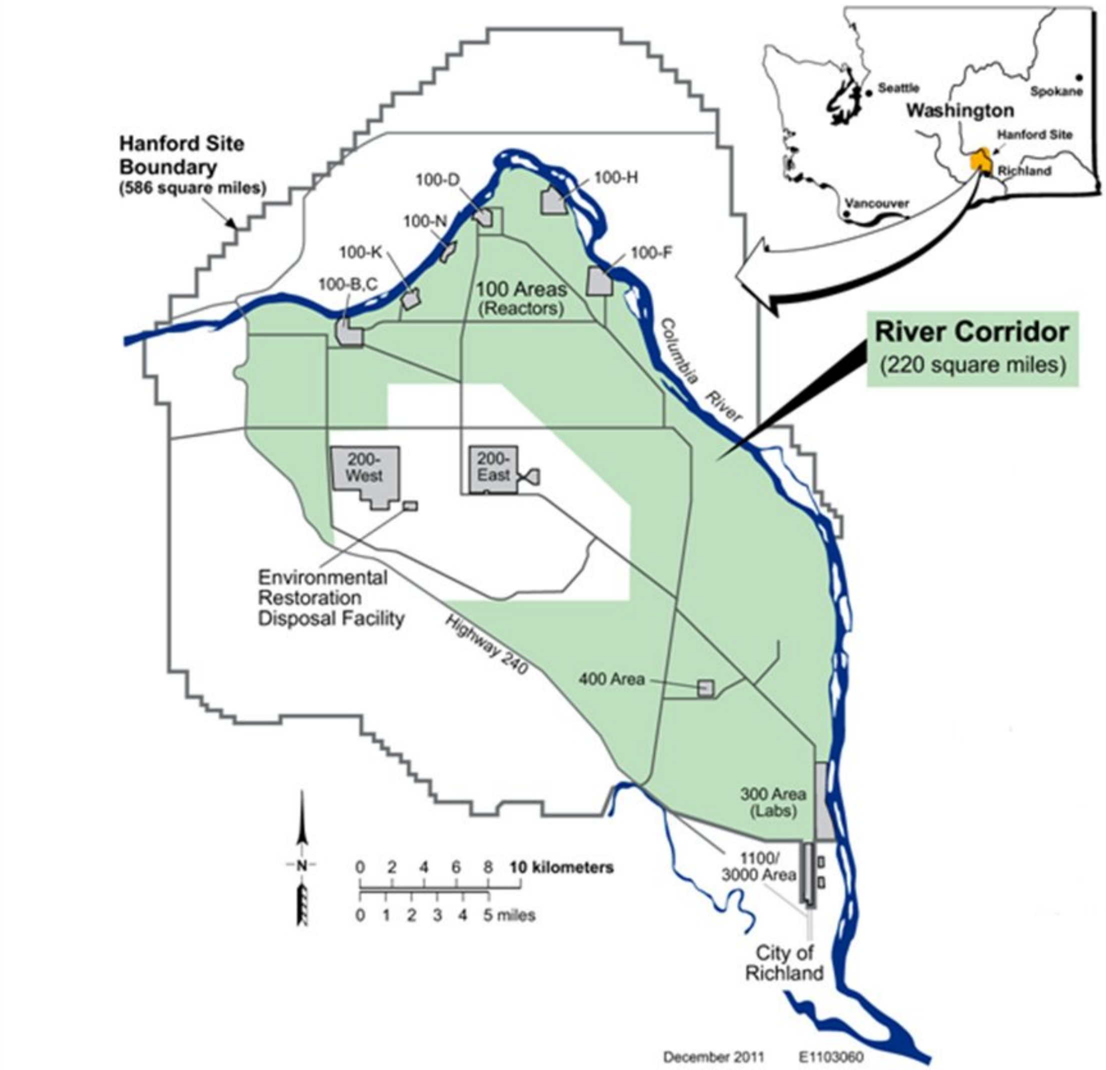

Figure 1. Hanford Site

DOE’s mission is to ‘remove the environmental risk and hazards near the Columbia River Corridor through efficient, safe and compliant procedures while safeguarding people and the environment’. [1] In order to execute the cleanup efficiently, the RCCP has been divided into five projects to complete the work:

1. **D4 Project** – deactivates, decommissions, decontaminates and demolishes retired nuclear and support facilities and encompasses the 100 Area (nine nuclear reactors) and 300 Area.

2. **Field Remediation Project** – cleans up and removes materials from waste sites and burial grounds consisting of the 118-K-1, 618-1, 618-7, and 618-10 burial grounds as well as the N Area.

3. **Waste Operations Project** – transports, treats and disposes of low-level radioactive, hazardous and mixed waste and manages the Environmental Restoration Disposal Facility and includes the Environmental Restoration Disposal Facility (ERDF).

4. **Environmental Protection** – helps protect workers and the environment by ensuring cleanup work is performed within applicable state and federal environmental laws and guidelines.

5. **Technology Needs** - DOE executes the RCCP by deploying technologies in the field that prove to be safe, efficient and cost-effective. Through the use of Technology Need Statements, DOE proactively communicates opportunities for the private sector and federally-funded organizations to respond with solutions to real needs. [1]

The RCCP scope of work consists of the following cleanup project areas:

1. The 100 Area, where plutonium was produced in nine nuclear reactors;

2. The 300 Area, where uranium was fabricated, manufacturing and waste disposal processes were developed and research was conducted;

3. The 400 Area, where the Fast Flux Test Facility and support facilities are located;

4. The 600 Area, where two challenging and highly radioactive burial grounds, 618-10 and 618-11, are located. [1]

Hanford consists of 140 waste sites located in the area of the N Reactor. The N Reactor was the nation's only dual-purpose reactor. It was built in the early 1960s to produce plutonium for the nation's weapons program and to produce electricity via a steam generator. In addition, the N reactor differed from other DOE reactors by having a 'closed-loop' cooling system, meaning that the water was not discharged into the Columbia River. Instead, if the water was not being recycled through the looped system, it was disposed of into unlined, cement-covered trenches and cribs where it made its way into the groundwater and migrated into the Columbia River.

Approximately six miles of contaminated reactor piping is being demolished as a part of the site cleanup effort in the N Area. [2]

METHOD

To meet the demands of the decontamination and decommissioning of Hanford's facilities, DOE deploys technologies in the field that are safe, efficient, and cost effective. DOE provides a Technology Needs Statement that specifies their on-site challenges and the criteria to overcome those challenges. This allows for both the private sector and federally funded organizations to respond with solutions that meet their immediate need. DOE then selects the company based on their ability to reduce risk to human health and the environment, improve efficiency of the cleanup, and lower costs. [3] In FY2011, the following advanced technologies were deployed to overcome Hanford site challenges:

1. River Structures' Sediment Removal Filtration System
2. 327 Building Hot Cell Disposition
3. 618-10 Burial Ground Drum Radiation Screening Tool
4. 118-K-1 Modified Clamshell Boom Excavator

River Structures' Sediment Removal Filtration System

Heavy metals were found present in soil samples near the Columbia River where the 100-N river structures, 181-N and 181-NE pumphouses and the 1908-NE outfall structure, reside. The structures were installed in the 1960's to support the on-site operations. When the nuclear weapons mission was terminated, the once essential drainage system was abandoned in place for decades. There was concern that the equipment remaining caused the contamination of the sediments in and around the river, and a solution for their removal was needed. The 100-N river structures housed fourteen pumps and motors that were used to divert water from the river to cool the N-Rector and the Hanford Generating Plant operations. The issue was addressed by implementing a multi-step filtration process that began with the use of a screened suction unit from a submersible hydraulic pump. To begin, five hundred gallons per minute of water and sediments were extracted from the river and surrounding area. In addition, divers performed two passes to remove visible sediments in the river. Settling time between passes was accounted for. [3]

The water and sediments were pumped into a GeoTube® that was located inside a lined retention area. The GeoTube® acts as a dewatering system and is made of high strength permeable geotextiles® that allow for water to seep through small pores while retaining the contaminated sediments. The water drained from the dewatering system into the retention pond was pumped into an 18,000-gallon weir tank while the sediments were properly contained and transported to the ERDF for disposal. The water from the weir tank was directed to flow through four parallel 40-micron sand filters to remove any remaining sediments. Lastly, there was concern that the water needed to be further filtered to ensure that polychlorinated biphenyls (PCBs) are not present before discharging the waters back into the river. Thus, the solution was to construct two parallel granular activated carbon (GAC) filtration beds. However, the GAC is highly porous and filtration beds tend to clog. Thus, prior to the routing of the filtration beds, the water was pumped through two parallel 25-micron bag filters to ensure even the smallest particles would be removed. [3]

327 Building Hot Cell Disposition

The 327 Building was designed to contain specially equipped laboratories (termed hot cells) for the examination and testing of irradiated fuels, concentrated fission products, and structural materials in support of operational efforts. The hot cells were no longer of any use and needed to be transported to the ERDF. In order to do so, a series of actions had to occur. First, the east wall of the 327 Building was removed. Next, a specially designed 700-foot gantry railing system and supports were installed. Three hundred feet of the gantry system was constructed inside the building and four hundred feet outside the building in order to transport the 75-ton and 230-ton hot cells to the ERDF. Contamination surveys were administered before moving the structures out of the building. Four (400-ton capacity) hydraulic legs with two 25-foot header beams were installed onto the rail system to physically separate the hot cells from the building's structure. Once the cells were outside, four steel walls were erected around the individual hot cell. Grout was poured into the steel box to fill the void spaces, the box was bolted shut, and placed on a 12-axle transporter located on a separate gantry system for disposal. [3]

Figure 2. 327 Building Hot Cell Disposition

618-10 Burial Ground Drum Radiation Screening Tool

There was a need for non-destructive instrumentation to assist in the categorization of the containers that sit in the burial grounds. It was known that the containers contained contaminated wastes but to what extent was unknown. Pajarito Scientifc Corporation (PSC) responded to DOE's needs and proposed the installation of two neutron slab counters that employ total neutron counting technology. The counters contain helium (He^3) proportional detectors installed in a polyethylene moderator. This system was housed in a steel case and placed on a purpose-designed trolley. The slab counters are connected to an operating computer where the system software requests the container type, ID, weight, matrix, slab configuration and start measurement. The system then identifies the container and configuration information, date and time of measurement, the raw data, a go/no go flag, and the lower-limit of detection (LLD) for that container type/matrix. If the waste contained more than 0.5 g plutonium (Pu) then it was considered to be transuranic waste (TRU waste). If the waste contained less than 0.5 g Pu then it was categorized as low-level waste. There is a significant difference in cost between the disposal of the low-level waste and the TRU waste. [3]

Figure 3. 618-10 Burial Ground Drum Radiation Screening Tool

118-K-1 Modified Clamshell Boom Excavator

Low-level radioactive wastes associated with reactor operations were buried in the 16-acre 118-K-1 burial ground. The grounds were used from 1955 to 1973 and consisted of 11 large metal corrugated silos and 16 unlined trenches. Six of the eleven silos were reported to have extremely high cobalt-60 (Co-60) levels; concerns for worker safety arose and the decision to move the silos was made. The vertical silos (as shown below in Figure 4. Vertical Silo) were 3 m (10 ft) in diameter and 7.6 m (25 ft) in length. Vertical extraction of the silos was enabled by the use of a standard excavator modified with a clamshell boom. Exposure control was of concern and was managed via a suite of nuclear instrumentation with telemetry capability, shield barriers, and high resolution cameras. [3]

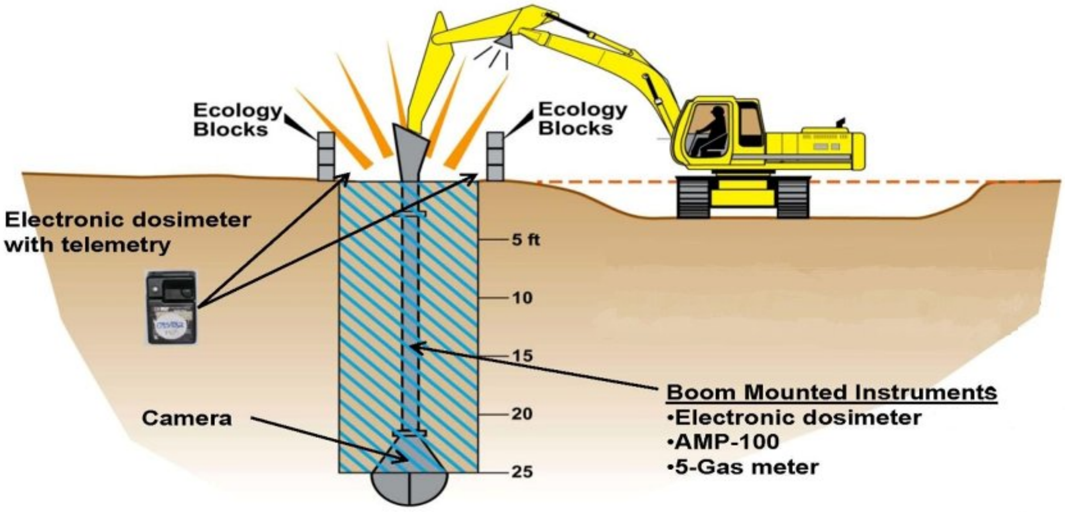

Figure 4. Vertical Silo

RESULTS

River Structures' Sediment Removal Filtration System

The need to remove a vast amount of sediment in a relatively short amount of time was met via a series of advanced technologies. The uniquely designed GeoTube® provided an effective dewatering system by allowing the sediments to remain in place while water was filtered through the small pores and, in turn, was an efficient volume reduction mechanism of the material. After the final cycle, the sediments were consolidated via dehydration prior to its disposal in the ERDF. The use of sand filters was a cost effective way to remove particles from the water. To address the concern of possible PCBs within the water prior to its release, GAC filtration beds were utilized. The GAC filtration beds remove organics and chlorine effectively. PCB's are hydrophobic in nature, meaning they can be removed from the water if they come into contact with media. [4] Additional benefits gained from the train of technologies are that the workers were not exposed to the contaminated sediments or water and that the project was completed on time and within budget.

327 Building Hot Cell Disposition

The specially designed 700-ft gantry system allowed for the transportation of monolithic structures. The four (400-ton capacity) hydraulic gantry legs granted the safe disposition of the cells from the building. Thorough contamination surveys provided the assurance that there was no disturbance of the radiation. The steel box and grouting of void spaces were utilized for ease of disposal. This system may be classified as an ALARA technology, meaning that the workers exposure to the release of radioactive materials was limited to a level ‘as low as reasonably achievable’ (ALARA). [3]

Conventional demolition would have caused the spreading of hazardous materials during demolition; the gantry system eliminated the occurrence of air contamination by encapsulating the cells while they were transported to the ERDF. This method compared to conventional demolition was measured by the safety of the workers, the protection of the environment, and its efficiency with both the schedule and the costs of the project.

618-10 Burial Ground Drum Radiation Screening Tool

The non-invasive technology allowed for the distinction between transuranic (TRU) and low-level waste without exposing hazardous materials to the workers and their environment. This is a revolutionary way to decipher the type of waste located within the barrels. If the workers had to go through each one of the barrels, a considerable amount of time would have been needed to segregate the waste and a significant amount of personal protective equipment would have been consumed. The manhours and materials would have added significantly to the cost in addition to the waste disposal. This innovative tool saved the workers and the environment from being directly exposed to radioactive materials and instead allowed them to separate the waste efficiently. The project schedule and budget was decreased significantly because of this tool. This is a great example of an ALARA technology. [3]

118-K-1 Modified Clamshell Boom Excavator

Utilization of nuclear instrumentation with telemetry capabilities, shield barriers, and high resolution cameras provided the right tools for limiting radiation exposure to the workers. The cameras provided visual observation of the waste prior to extraction which allowed the waste to be properly identified. The combination of a clamshell boom excavator and the nuclear instrumentation equates to an ALARA technology that enhanced the workers safety and protected the environment by limiting radiation exposure. [3]

DISCUSSION

DOE has used a proactive approach by utilization of their Technology Need Statements online where private sectors and government agencies can compete to provide the most cost effective way to improve the cleanup efficiency and, most importantly, to reduce the risk to human health and the environment. By advertising the DOE's needs via the Technology Needs Statements, at least 45 technologies have been deployed over the past six years at Hanford. [3] Each technology and methodology is uniquely designed according to its challenge. It is exciting to see science and engineering come together to produce forward-thinking solutions. DOE is even considering solar powered light plants instead of using diesel powered, trailer-mounted, metal-halide or high pressure sodium lights at the Hanford site. The diesel-powered lights are relatively inexpensive; however, they are not cost-effective in the long run due to constant refueling and maintenance. They also create high ambient noise levels, ground level pollution, and are a potential fire hazard if there were to be a collision or a spill. The solar power lights have been successfully tested onsite and are being considered to replace the diesel-powered light plants. The benefits of the solar powered lights are that they reduce the green house gas emissions; they are less costly, produce less ambient noise, and are not considered a hazard. [3]

There is still a significant amount of cleanup to do at the Hanford site. Currently, five of the nine reactors (C, D, DR, F and H) have been decommissioned. As for the N-Area, the cleanup of N Reactor is scheduled to be completed by 2013. Many of its supporting structures have already been decontaminated and demolished. [5] Currently, the steam generator and supporting buildings have been relocated to an interim safe storage area while the remaining 119 sites are being address. [1] Additional innovative technologies and methodologies are needed to meet the remaining challenges at the DOE complexes. These innovative technologies and methodologies are our link to achieving a cleaner, safer, healthier tomorrow.

REFERENCES

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