Environmental Cleanup of the Idaho National Laboratory
Status Report - 9037

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ABSTRACT

This paper describes the status of the cleanup of the U.S. Department of Energy's Idaho National Laboratory (INL) Site.

On May 1, 2005, CH2M-WG Idaho (CWI) began its 7-year, $2.4 billion cleanup of the INL.[1] By the time the work is completed in 2012, 3,406,871 liters (900,000 gallons) of sodium-bearing waste will have been treated; 11 high-level waste tanks will have been grouted and closed under the Resource Conservation and Recovery Act[2]; more than 150 facilities will have been demolished or disposed of including three reactors, several spent fuel basins, and hot cells; thousands of containers of buried transuranic waste will have been retrieved under the Comprehensive Environmental Response, Compensation, and Liability Act[3]; more than 8,000 cubic meters (10,464 cubic yards) of contact-handled transuranic waste and more than 500 cubic meters (654 cubic yards) of remote-handled transuranic waste will have been characterized, packaged, and shipped off-Site; almost 200 release sites and voluntary consent order tank systems will have been remediated; and 3,186 units of spent nuclear fuel will have been moved from wet to dry storage.

In 2008, while meeting all regulatory cleanup objectives, CWI continued the construction of the Integrated Waste Treament Unit that will treat the sodium-bearing waste for on-Site storage leading to eventual disposal; removed and disposed of two massive reactors, the Power Burst Facility reactor and the Engineering Test Reactor; completed the transfer of nearly three-fourths of more than 3,000 spent nuclear fuel units from wet to dry storage; completed the demolition and environmental remediation of all U.S. Department of Energy's Office of Environmental Management buildings and structures at the Test Area North facility; continued the exhumation of buried transuranic wastes from the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex; continued to be the only shipper of remote-handled transuranic waste to the Waste Isolation Pilot Plant, completing 184 shipments; and disposed of thousands of cubic meters of low-level and low-level mixed radioactive wastes both on-Site and off-Site.

INTRODUCTION

The U.S. government established the National Reactor Testing Station in 1949 in the high desert of southeastern Idaho, roughly 64 kilometers (40 miles) west of Idaho Falls. Now called the Idaho National Laboratory (INL) Site, the remote setting provided an ideal location where prototype nuclear reactors could be designed, built, and tested. Over the years, 52 first-of-a-kind reactors were constructed at the INL Site, which comprises a vast 571,000 acres (893 square miles).

During the 1970s, the INL's mission broadened into other areas such as biotechnology, energy and materials research, and conservation and renewable energy. At the end of the Cold War, treating waste and cleaning up previously contaminated sites became a priority.

Today, the INL Site serves two distinct missions: (1) nuclear and energy research, science, and national defense programs directed by the U.S. Department of Energy (DOE) Office of Nuclear Energy and (2) cleanup programs directed by the DOE Office of Environmental Management (EM). Three major

programs operate from the INL Site: the Idaho National Laboratory managed by the Battelle Energy Alliance; the Idaho Cleanup Project managed by CH2M-WG Idaho (CWI); and the Advanced Mixed Waste Treatment Project managed by Bechtel BWXT Idaho.

The seven year Idaho Cleanup Project focuses on cleanup activities in five major geographic areas at the INL Site:

- Idaho Nuclear Technology and Engineering Center (INTEC)—Began operations in 1953 to recover usable uranium from spent nuclear fuel from government reactors and storage of spent nuclear fuel

- Radioactive Waste Management Complex (RWMC)—Began operations in 1952 to manage, store, and dispose of waste contaminated with radioactive elements generated in national defense and energy programs

- Test Area North (TAN)—Supported numerous research efforts since 1955 to advance the country's nuclear industry from the development of nuclear powered jet engines to operation of reactors that simulated the loss of coolant

- Advanced Test Reactor Complex (ATRC)—Served as the focal point in delivering the INL's energy research mission since 1952, housing three major test reactors that have operated at the facility: the Materials Test Reactor, the Engineering Test Reactor, and the Advanced Test Reactor

- Power Burst Facility (PBF)—Used since 1972 to conduct experiments at the INL to help determine safe operating parameters for the commercial nuclear industry.

Figure 1 illustrates the location of these facilities on the INL Site. Cleanup activities in those areas consist of the following:

- At INTEC, 3,406,871 liters (900,000 gallons) of sodium-bearing waste will be treated in the nearly completed Integrated Waste Treatment Unit (IWTU), 3,186 units of spent fuel are being moved from the wet storage to dry; highly radioactive facilities including legacy spent fuel basins and hot cells are being demolished or otherwise dispositioned; 11 of 15 high-level waste tanks are being cleaned, grouted, and prepared for closure under the Resource Conservation and Recovery Act (RCRA); and various environmental remediation activities are being completed

- At RWMC, buried transuranic waste are being retrieved from about 1 hectare (2.5 acres) of the Subsurface Disposal Area (SDA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and various radioactive and mixed wastes are being characterized, packaged, and shipped for disposal on-Site and off-Site

- At TAN, various radioactively contaminated facilities have been demolished and disposed

- At ATRC, one reactor has been demolished and disposed of and the demolition of another, more complex reactor, is under way

- At PBF, a 61-ton reactor and ancillary facilities were demolished and disposed

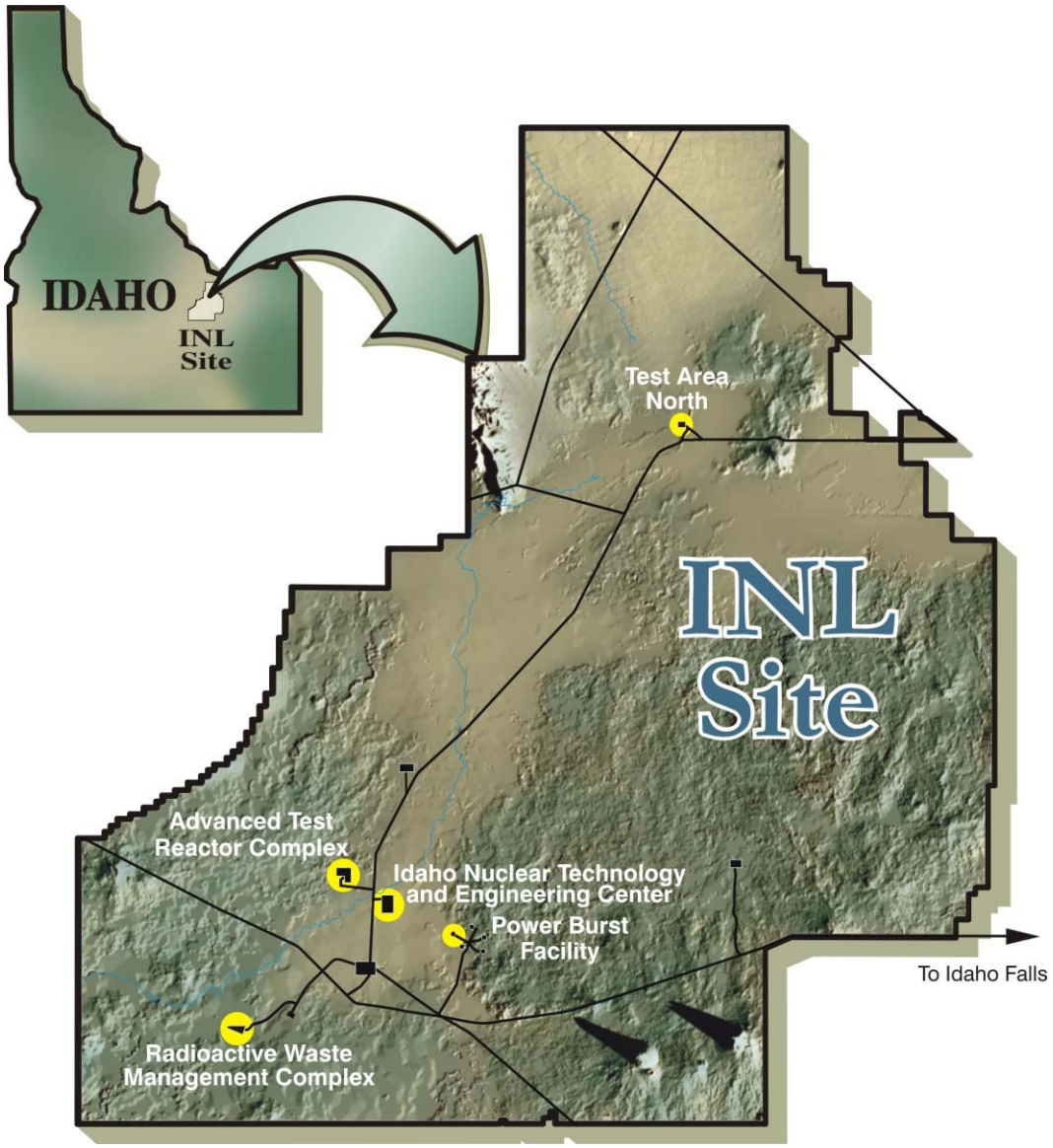

Fig. 1. Location of cleanup activities at the Idaho National Laboratory Site.

The Idaho Cleanup Project contract between DOE and CWI contains the following physical completion criteria:

- Demolish or dispose of more than 150 excess DOE EM facilities including three reactors, legacy spent fuel basins, hot cells, and numerous tank systems
- Treat sodium-bearing waste in the IWTU, and store the resulting treated waste
- Empty 15 Tank Farm Facility high-level waste tanks and clean, grout, and prepare 11 tanks for closure
- Place all DOE EM spent fuel in dry storage

- Remediate all voluntary consent order (radiologically contaminated) tank systems
- Retrieve stored transuranic waste, and dispose of it at the Waste Isolation Pilot Plant
- Maintain and operate two radioactive waste disposal facilities, the SDA and the Idaho CERCLA Disposal Facility (ICDF)
- Retrieve certain buried transuranic wastes located at the SDA
- Remediate identified areas of INL Site soil and groundwater contamination.

To accomplish this undertaking, CWI developed an approach that safely achieves these cleanup criteria on an accelerated schedule and at the lowest feasible cost. That approach had the following key elements:

- Emphasize safety as the foundation of all work
- Eliminate the highest health risks first
- Focus the highest attention on the critical path and near-critical path activities (i.e., those that will significantly impact project completion if they slip)
- Reduce the Site's mortgage costs to make additional funds available to accomplish more cleanup
- Share a substantial portion of the company's fee with employees who work safely and efficiently
- Encourage the use of and employing proven, innovative technologies and approaches to increase work efficiency and safety.

IDAHO CLEANUP PROJECT STATUS

More than 60% completed, the Idaho Cleanup Project is under cost and ahead of schedule. Through December 2008, the project cost and schedule performances against the life-cycle project baseline are as follows:

- Cost variance is $155,000,000, with a cost performance index of 1.10
- Schedule variance is $128,000,000, with as schedule performance index of 1.09.

CWI also tracks a number of key cleanup project performance metrics in addition to monitoring traditional project performance cost and schedule parameters. Figure 2 shows the work completed on these metrics through December 2008 and how much work remains.

Notable Accomplishments in 2008

Key enablers of any nuclear cleanup work are robust safety and environmental management programs. Calendar Year 2008 saw a number of noteworthy accomplishments in both of these areas at the Idaho Cleanup Project. In safety management performance, CWI met its Total Recordable Case Rate goal, achieving 1.24 against its goal of 1.26. In the Day Away Case Rate, at 0.50, CWI is slightly over its goal of 0.30. Overall, total recordable and days away case rates dropped by 26% from 2007 to 2008. In the area of environmental management, all regulatory milestones were met and CWI's Environmental Management System was ISO 14001 recertified.

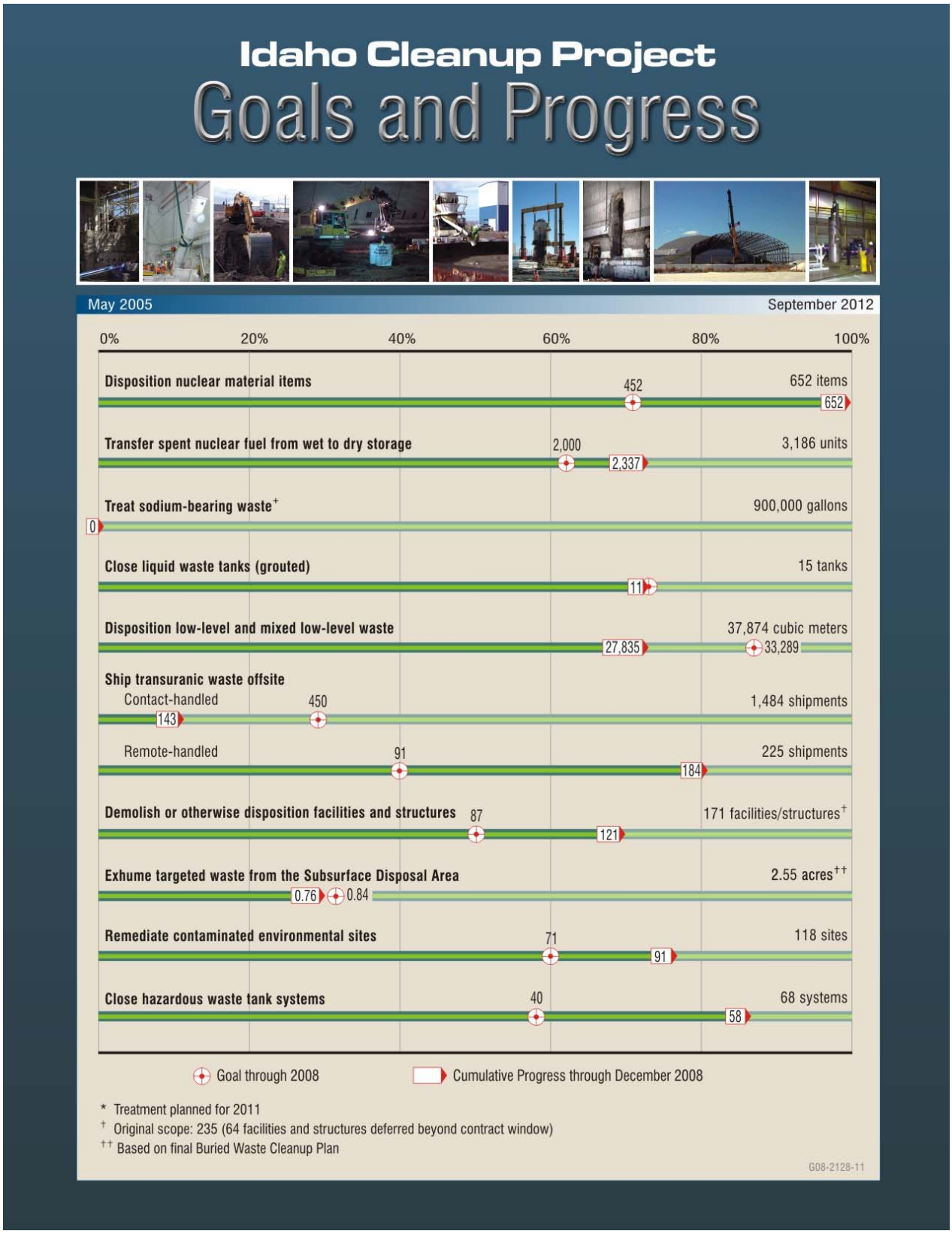

Fig. 2. Project performance metrics that reflect cleanup progress.

CWI continues to make good progress toward accomplishing its cleanup scope of work. Specific project accomplishments follow.

Decontamination and Disposition of the Power Burst Facility

In November 2008, CWI completed the decontamination and removal of the Power Burst Facility (PBF) (Figure 3) nearly four years ahead of schedule. As a result of a number of innovative decontamination and decommissioning and waste management techniques, the reactor vessel was disposed of and the facility demolished for about $21 million less than planned.

Fig. 3. The Power Burst Facility was demolished 4 years ahead of schedule.

The Power Burst Facility became operational in 1972 and ran until 1985. It was used to test the performance of light water reactor fuel elements during transition or sudden bursts of power. A variety of research was performed on reactor fuels and operational parameters, including evaluation of loss-of-coolant accidents.

The 61-ton reactor vessel was lifted from the facility on July 25, 2008, transported to the ICDF on July 28, 2008, and disposed. Following removal of the three-story reactor vessel, concrete slabs and facility walls were removed to approximately 1 meter (3 feet) below grade.

Other Decontamination and Decommissioning Progress

In 2008, decontamination, decommissioning and demolition have been completed on 26 industrial buildings, 15 radiological buildings, six nuclear facilities, and 74 other structures. In addition to the disposition of the PBF, the other major success occurring in 2008 included decontaminating and demolishing all of the TAN facilities owned by DOE's EM. ATRC D&D crews have made steady progress in demolishing the Materials Test Reactor, the most complex and challenging of ICP's demolition projects.

As of December 2008, 121 industrial, radioactively contaminated facilities, nuclear facilities, and other facilities, covering more than 1 million square feet (23 acres), have been demolished and disposed.

Treatment of Sodium-Bearing Waste

More than 3,406,871 liters (900,000 gallons) of sodium-bearing waste stored at INTEC must be retrieved, treated, and placed into storage during the course of the seven year Idaho Cleanup Project contract. CWI will design, construct, and operate the IWTU, a first-of-its-kind facility, to treat the waste. The design is robust, drawing on lessons learned from around the DOE Complex, especially with regard to meeting seismic criteria. The IWTU will deploy steam reformer technology to treat the waste starting in 2011. The DOE has approved Critical Decisions CD-3 for the IWTU. Construction of the IWTU facility is moving at a fast pace (Figure 4).

Fig. 4. An aerial view of extensive rebar during in-progress construction of the IWTU process building.

As of the end of December 2008:

- 600 tons of reinforcement steel and 3,517 cubic meters (4,600 cubic yards) of concrete have been placed to complete the process building base slab and walls, as well as the product storage, mechanical, and off-gas building foundations

- More than 2,676 cubic meters (3,500 cubic yards) of controlled low-strength material backfill have been placed within the above foundations

- The Power Distribution Center was received in October 2008, with each of the three components weighing greater than 50 tons

- 1,100 tons of a total of 1,500 tons of structural steel have been received to date for the mechanical, process, and off-gas buildings

- 300 tons of a total of 535 tons of structural steel have been installed for the mechanical building

- Major procurements for the building air handling units, process and building high-efficiency particulate air (HEPA) filter housings, building chillers, facility cable trays, and wire and conduit have been placed.

Closure of High-Level Waste Tanks

CWI's scope of work at the INTEC's high-level waste tank farm includes the eventual RCRA closure of 15 underground storage tanks. Closure of these tanks involves cleaning the tanks followed by grouting and then placement of a cap over the tank farm to prevent any future water infiltration. Of the 15 existing tanks, 11 tanks have been grouted to date including eight 300,000-gallon tanks and their ancillary equipment in 2007 and 2008 and three smaller 30,000-gallon tanks in 2006. Four 300,000-gallon tanks remain to be grouted. Three of these four tanks still hold 900,000 gallons of sodium-bearing waste awaiting treatment in the IWTU and one of these tanks is empty, being held in reserve in the event that it is needed.

CWI intends to empty the three remaining 300,000-gallon sodium-bearing waste tanks and treat the waste before the end of 2012. Tank grouting and closure activities will soon follow.

Disposition of Nuclear Materials

CWI is responsible for the disposition of specified excess nuclear materials. Nearly one year ahead of schedule, CWI dispositioned the remaining nuclear materials owned by DOE EM in its contract in 2008. Much of this material consisted of unirradiated nuclear fuel that was shipped to DOE's Nevada Test Site. A total of 652 nuclear material items have been safely and successfully shipped off the INL Site.

Spent Nuclear Fuel

Spent nuclear fuel stored at INTEC consists of four broad types: DOE-owned spent nuclear fuel from commercial and research reactors, Navy fuel, spent nuclear fuel from the Advanced Test Reactor at the ATRC, and commercial spent nuclear fuel from Three Mile Island and the Ft. St. Vrain facility in Colorado.

As part of its accelerated cleanup mission, a "wet to dry" transfer campaign was initiated. The campaign consists of moving select fuels from wet storage in the Fluorinel Dissolution Process and Fuel Storage (FAST) facility to dry storage.

The Spent Fuel Completion Group transferred 551 fuel handling units in 2008 from wet storage in FAST pools to dry storage in the Irradiated Fuel Storage Facility, ahead of schedule. Through December 2008, the group had transferred a total of 2,337 fuel handling units of 3,186 units to be moved, or 74%.

During 2008, the group received two casks of foreign research reactor fuel from Romania and placed the fuel in dry storage. The group also prepared 135 modules of Navy fuel for shipment to the Naval Reactors facility located on the INL Site.

Waste Shipping and Disposal

CWI is responsible for managing waste generated during its cleanup activities. Much of the waste, particularly that arising from demolition and environmental remediation activities, is disposed of on-Site at the ICDF, located near INTEC. Cumulative to date, more than 136,960 cubic meters (179,136 cubic yards) of waste had been disposed of.

On January 18, 2007, CWI completed the first shipment of remote-handled transuranic waste (TRU) to WIPP. As of December 2008, 184 shipments of remote-handled TRU waste had been sent to WIPP. To date, CWI remains the only shipper of remote-handled TRU waste to WIPP.

In 2008, CWI disposed 7,457 cubic meters (9,753 cubic yards) of low-level and low-level mixed wastes either on-Site at the SDA or off-Site at DOE or commercial disposal facilities. Cumulative to date, more than 27,835 cubic meters (36,407 cubic yards) of low-level and mixed low-level wastes have been disposed either on-Site or off-Site.

Retrieval of Waste from the Radioactive Waste Management Complex

During the course of its contract, CWI will retrieve about 1 hectare (2.5 acres) of buried waste located in the 39-hectare (97-acre) SDA at the Radioactive Waste Management Complex. The contract requires that certain targeted wastes be selectively removed, characterized, packaged, and shipped to DOE's Waste Isolation Pilot Plant. The wastes consist mostly of sludges with higher concentrations of plutonium and volatile organics compounds, graphite wastes, and uranium roaster oxides.

In 2008, 6,225 cubic meters (8,142 cubic yards) of waste materials were exhumed. Cumulative to date, more than 15,720 cubic meters (20,561 cubic yards) of waste materials have been exhumed. Also, to date, more than 0.3 hectare (three-fourths acre) has been exhumed.

In September 2008, DOE, the Idaho Department of Environmental Quality, and the U.S. Environmental Protection Agency signed a record of decision finalizing plans to complete the remediation of the SDA. After reviewing hundreds of public comments on a proposed plan released in October 2007 and based on the results of decades of research data on the waste contents of the SDA, the DOE, the Idaho Department of Environmental Quality, and the U.S. Environmental Protection Agency have agreed to exhume a minimum of 6,238 cubic meters (8,158 cubic yards) of targeted waste from a minimum combined area of 5.69 acres. Targeted waste for retrieval contains transuranic elements such as plutonium, as well as uranium and co-located organic solvents such as carbon tetrachloride. It is estimated that retrieval operations will now extend until about 2018.

Environmental Remediation

During the course of the management contract, CWI's Environmental Restoration Group will remediate 118 contaminated environmental sites and close 68 hazardous waste tank systems.

In 2008, CWI remediated 23 environmental sites and closed five hazardous waste tank systems. To date, 91 contaminated environmental sites have been remediated and 58 hazardous waste tank systems have been closed.

CLEANUP PROJECT CHALLENGES

The Idaho Cleanup Project is managed with a close eye paid toward identifying and managing project challenges and programmatic risks. Some of the key challenges and risks facing the project are discussed below.

- The need to continuously maintain the highest safety standards while performing work that involves increasing industrial hazards

- The management of future project risks related to potential project cost growth—specifically related to the construction of the IWTU, the new nuclear facility being built to treat highly radioactive wastes

- Achieve and maintain required production levels of work associated with the retrieval of buried transuranic wastes at the SDA.

Continuous Safety Improvement

Key enablers of any cleanup effort—robustness and continuous improvement of the safety program—are particularly evident at the Idaho Cleanup Project. Over the past year, safety performance has continued to improve, both in terms of days away case rate and recordable case rates.

But, as long as the Idaho Cleanup Project has one first-aid case or one recordable injury, CWI's performance is not satisfactory. CWI believes that each and every accident or injury is preventable, and so the Idaho Cleanup Project must continue to find new and innovative approaches to eliminate these events. To that end, CWI remains steadfast in its commitment to its Integrated Safety Management System, Voluntary Protection Program and Human Performance safety programs.

Project Cost Management

Despite the overall excellent project cost performance to date (CPI of 1.10), CWI faces a number of future project cost and schedule risks. The most significant of these future costs risks involves the construction and subsequent operation of the IWTU, which ultimately will treat the sodium-bearing waste stored at the INTEC tank farm.

IWTU project risks are focused around two major areas. The first risk area is construction productivity related to the installation of the seismically-qualified (Performance Category 3) process facility. The complexity of the design of the facility has presented a number of difficulties related to the construction of the facility. For example, the size and spacing of rebar has presented some unique challenges related to the construction of the facility walls. The second risk area relates to the fabrication of the large, high-temperature specialty metal vessels that constitute the main process components of the steam reformer treatment process. Early welding problems of the unusually thick (about two inches) specialty metal have placed the fabrication of the vessels on critical path for completion of the facility.

Pursuant to DOE Order 413.1A, "Program and Project Management for the Acquisition of Capital Assets," [4] formal project risk management plans including risk mitigation action plans have been prepared.

These areas of project risk are being managed daily and are comprehensively evaluated at least monthly by project staff and senior management.

Achieving and Maintaining Production Levels in Retrieving Targeted Transuranic Waste at the Subsurface Disposal Area

The retrieval of transuranic waste from selected areas of the SDA began quickly following contract assumption. However, two subsequent events temporarily suspended exhumation activities: (1) the presence of pyrophoric waste materials that spontaneously combusted during the exhumation of a drum of depleted uranium oxide waste and the lengthy recovery from that event, and (2) addressing subsidence issues that affected the stability of the tent-like structures that cover the areas of buried waste retrieval work. Furthermore, specialized earth moving equipment reliability issues plagued the project early on.

Now that retrieval work has resumed, time lost as a result of the temporary shutdowns must be made up. The project has implemented a number of corrective actions to improve productivity. For example, redundant equipment such as specialized telehandlers and other earth moving equipment have been procured to respond to previous equipment reliability issues. Additionally, the project has been systematically examining the various controls that govern the work being performed looking for opportunities to improve operational flexibility, productivity and achieve cost savings while maintaining the highest levels of safety and conduct of operations.

The project remains confident, based on production levels achieved and sustained in 2008, that they will complete the exhumation of the one hectare (2.5 acres) of the SDA before the contract is slated to end in September 2012.

THE OUTLOOK FOR SUCCESS IN 2009

Some key project milestones for 2009 include:

- Near completion of the construction of the IWTU and fabrication of process vessels and skids
- Complete shipment of all remote-handled transuranic wastes
- Removal and disposition of the Materials Test Reactor
- Continued retrieval of transuranic waste at the SDA
- Continued transfer of spent nuclear fuel from wet to dry storage.

Based on its project performance to date, CWI remains optimistic about the probability of achieving project completion by September 30, 2012, for the contract target cost of approximately $2.4 billion. Nevertheless, project challenges remain that must be managed carefully for these contract targets to be achieved.

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