Environmental Cleanup of the Idaho National Laboratory Status Report

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ABSTRACT

On May 1, 2005 CH2M♦WG Idaho LLC (CWI) began its 7-year, $2.4 billion cleanup of the Idaho National Laboratory Site (INL). When the work is completed in 2012, 3,406,871 liters (900,000 gallons) of sodium-bearing waste will have been treated; 15 high-level waste tanks will have been closed; more than 200 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; 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 offsite; almost 200 release sites and voluntary consent order tank systems will have been remediated; and 3,278 units of spent fuel will have been moved from wet to dry storage.

Since assuming its responsibilities as the Idaho Cleanup Project contractor, CWI has completed its life-cycle project baseline, retrieved transuranic wastes from the pits within the Subsurface Disposal Area, disposed of special nuclear materials previously stored at the site, demolished several contaminated facilities, including the Loss-of-Fluid Test reactor complex at Test Area North, moved hundreds of spent fuel units from wet to safer, dry storage, completed grouting of a legacy spent fuel basin, disposed of tens of thousands of cubic meters of low-level wastes both onsite and offsite, closed several contaminated tank systems regulated by the State of Idaho, grouted several high-level waste tanks in preparation for RCRA closure, and made good progress in the design of the Integrated Waste Treatment Unit that will process 3,406,871 liters (900,000 gallons) of sodium-bearing waste in preparation for offsite disposal.

Plans for 2007 are even more ambitious: the initiation of construction of the facility to treat sodium-bearing waste, continued removal of buried waste from a number of pits at the Subsurface Disposal Area, closure of additional high-level waste tanks, shipment of remote-handled transuranic waste to the Waste Isolation Pilot Plant, continuation of the onsite and offsite disposal of low-level radioactive wastes, decontamination and decommissioning of the Engineering Test Reactor at the Reactor Technology Complex, and remediation of RCRA-regulated tank systems and release sites.

CWI continues to manage potential project challenges and risks associated with the construction of the sodium-bearing waste treatment facility, which is on the critical path for the project; achieving and sustaining necessary production levels in the retrieval of wastes from the Subsurface Disposal Area; and managing other potential project cost risk items.

INTRODUCTION

In 1949, the U.S. government established the National Reactor Testing Station in the high desert of southeastern Idaho, roughly 64 kilometers (40 miles) west of Idaho Falls. Known as 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.

During the 1970s, the laboratory'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 DOE's Office of Nuclear Energy and (2) cleanup programs directed by DOE's Office of Environmental Management. 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, LLC (CWI); and the Advanced Mixed Waste Treatment Project managed by Bechtel BWXT Idaho.

The 7-year Idaho Cleanup Project focuses on five major geographic areas:

- Idaho Nuclear Technology and Engineering Center (INTEC)—established in the 1950s to recover usable uranium in spent nuclear fuel from government reactors and also to store spent fuel
- Radioactive Waste Management Complex—used since the 1950s to manage, store, and dispose of waste contaminated with radioactive elements generated in national defense and energy programs
- Test Area North—supported numerous research efforts 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
- Reactor Technology Complex—served as the focal point in delivering the laboratory's energy research mission, 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—used to conduct experiments at the facility to help determine safe operating limits for the commercial nuclear industry

Figure 1 illustrates where these facilities are located on the 2,305 square kilometer (890-square-mile) INL site. cleanup activities in those areas consist of the following:

- INTEC, where 3,406,871 liters (900,000 gallons) of sodium-bearing waste will be treated in the Integrated Waste Treatment Unit, 3,278 units of spent fuel will be transitioned from the wet storage to dry, highly radioactive facilities including legacy spent fuel basins and hot cells will be demolished or otherwise disposed of, 15 high level waste tanks will be cleaned and grouted, and various environmental remediation activities will occur
- Radioactive Waste Management Complex, where transuranic waste will be retrieved from 1.1 hectares (2.8 acres) of the Subsurface Disposal Area as part of the Waste Area Group 7 remediation and various radioactive and mixed wastes will be characterized, packaged and shipped for disposal onsite or offsite
- Test Area North, where various radioactively contaminated facilities will be demolished
- Reactor Technology Complex, where two reactors will be demolished and disposed of
- Power Burst Facility, where one reactor will be demolished and disposed of

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

The cleanup contract contains the following physical completion criteria:

- Demolish or dispose of more than 200 excess DOE Environmental Management (EM) facilities, including 3 reactors, legacy spent fuel basins, hot cells, and numerous tank systems.
- Treat sodium-bearing waste, and dispose of the resultant waste.
- Empty and close all Tank Farm Facility high-level waste tanks.
- Place all Environmental Management spent fuel in dry storage.
- Maintain and operate the INL CERCLA Disposal Facility (ICDF) and the Subsurface Disposal Area.
- Retrieve stored transuranic waste, and dispose of it at the Waste Isolation Pilot Plant.
- Retrieve certain buried transuranic wastes located at the Subsurface Disposal Area.
- Remediate identified areas of soil and groundwater contamination.
- Remediate all Voluntary Consent Order (radiologically contaminated) tank systems.

To accomplish this undertaking, CWI developed an approach that safely achieves cleanup of the site 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. (Critical path activities are those that will significantly affect project completion if they slip.)
- Reduce the site's mortgage costs to make additional funds available sooner to accomplish more cleanup activities.

- Share a substantial portion of the company's fee with employees who work safely, cost-effectively, 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 20 percent of the way through the cleanup project, the project is under cost and slightly ahead of schedule. Through December 2006, the project cost and schedule performances against the life-cycle project baseline are as follows:

- Cost variance is $14,000,000; CPI: 1.02
- Schedule variance is $5,600l,000; SPI: 1.01

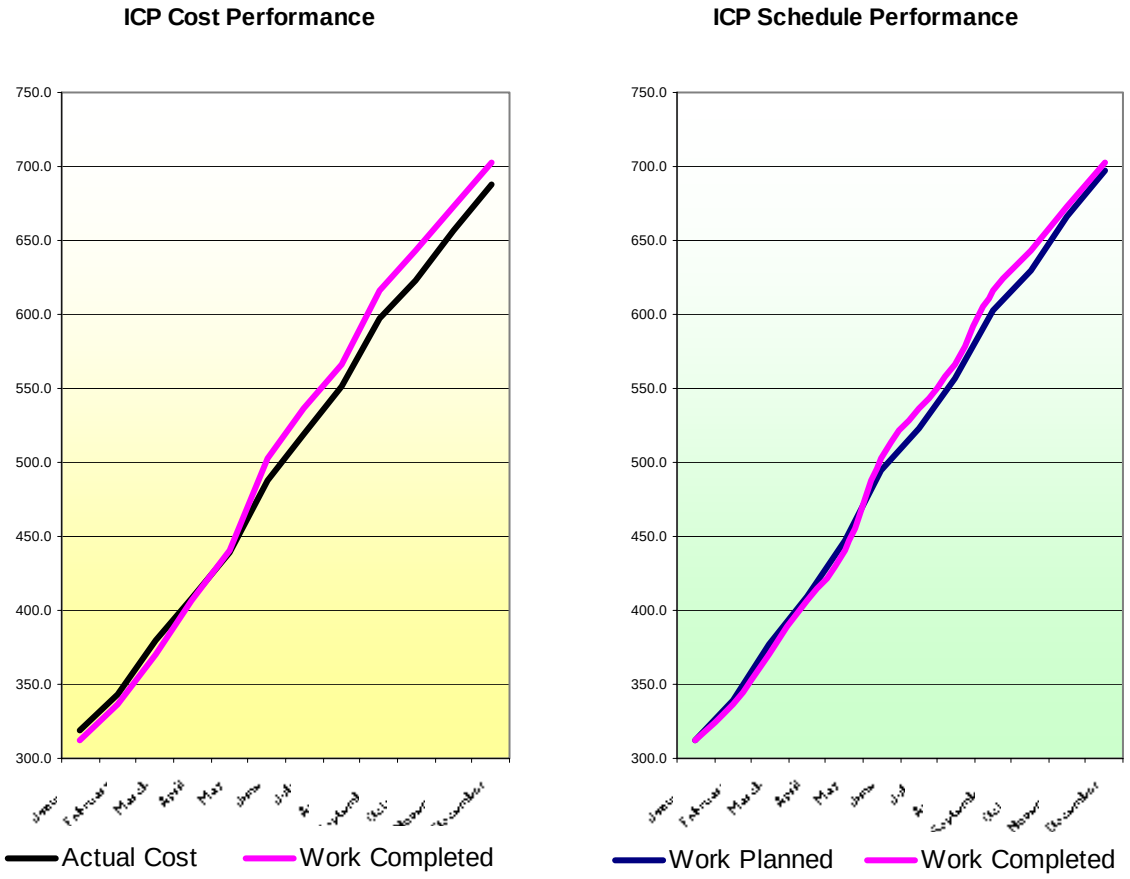

Fig. 2. Idaho Cleanup Project Life-Cycle Project Baseline Cost and Schedule Variances

CWI also tracks several key cleanup project performance metrics, in addition to monitoring traditional project performance cost and schedule parameters. Figure 3 shows the work completed on these metrics through December 2006 and how much work remains.

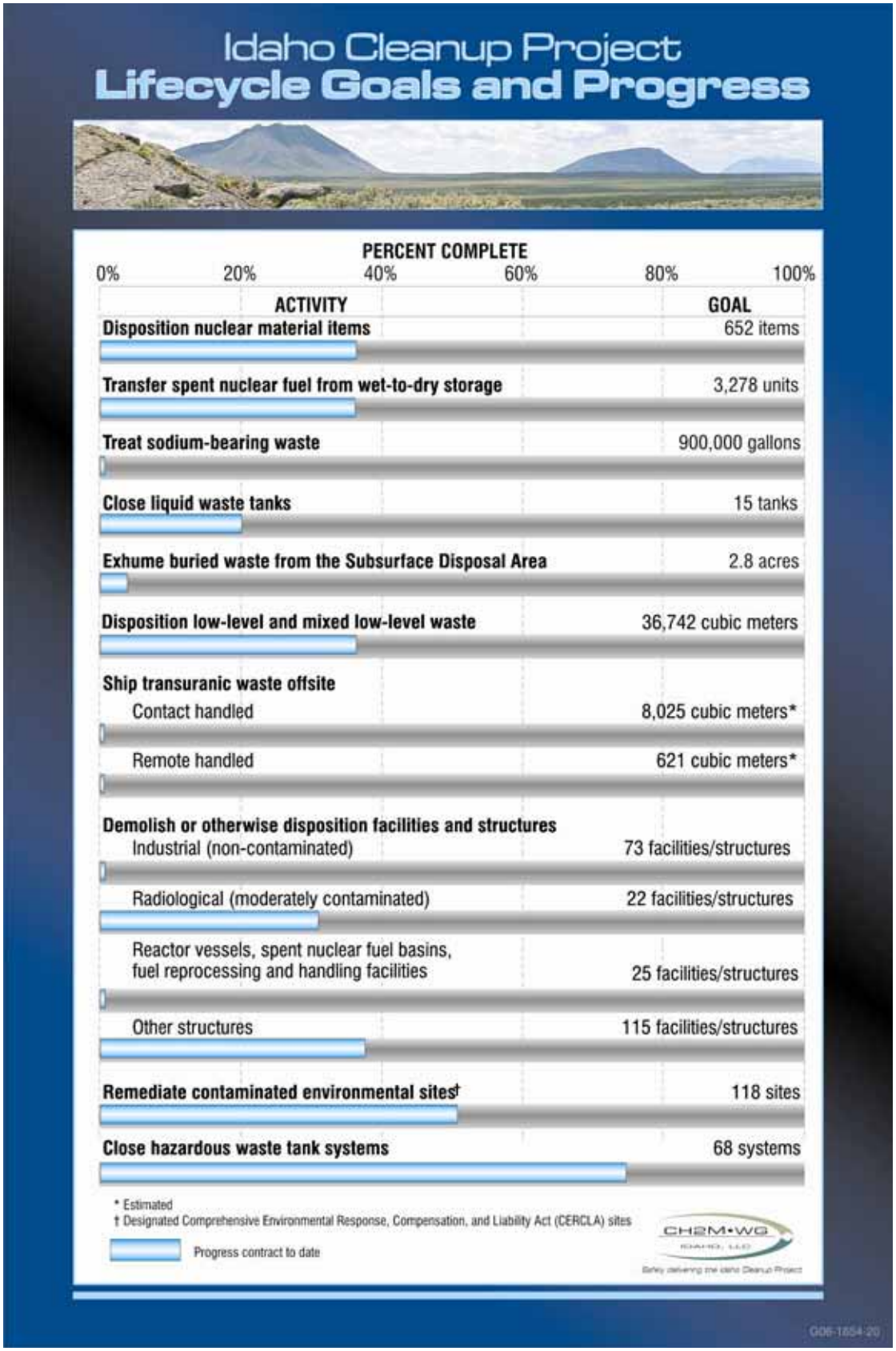

Fig. 3. Key activities to complete the cleanup scope of work

Notable Accomplishments in 2006

CWI has made swift progress in its 18 months as the cleanup contractor. Since assuming its responsibilities, the company has completed its life-cycle project baseline, launched the design of the sodium-bearing waste treatment unit (CD-2 approved), begun retrieving transuranic waste from the Subsurface Disposal Area, dispositioned special nuclear materials previously stored at the site, demolished several contaminated facilities, including the Loss-of-Fluid Test reactor complex at Test Area North, moved more than 1,000 units of spent fuel from wet storage to dry, disposed of tens of thousands of cubic meters of low-level wastes both onsite and offsite, remediated or closed a large number of contaminated tank systems regulated by the State of Idaho, and grouted three high-level waste tanks in preparation for RCRA closure.

In the areas of safety and environmental compliance, CWI's Integrated Safety Management System was recertified (Phase I and II), all environmental compliance regulatory milestones were met, CWI's Environmental Mamagement System was recertified in ISO 14001, and its Voluntary Protection Program Star Status reapplication submitted.

Demolition of Loss-of-Fluid Test Facility

In October 2006, CWI completed the decontamination, decommissioning, and demolition of the Loss-of-Fluid Test facility (Figure 4). The 30-year-old research reactor posed significant challenges involving regulations governing the demolition of a historical facility and also worker safety issues associated with the removal of the reactor's domed structure.

Fig. 4. Test Area North 650 and 630, where the Loss of Fluid Test Facility was demolished.

Through formal survey and research, the Loss-of-Fluid Test facility was determined to be a DOE Signature Property, as defined by the "INEEL Cultural Resource Management Plan," and thus eligible for inclusion in the National Register of Historic Places. The proposed decontamination and decommissioning (D&D) of the facility constituted an adverse effect of the historic property which required resolution through the contractor, the U.S. Department of Energy, the Idaho State Historic Preservation Office, and the Advisory Council on Historic Preservation.

To address cultural resource issues, the project team engaged all parties early and often in negotiations and mapping a path forward. The open and frequent communication resulted in a Memorandum of Agreement, with stipulations that mitigated the adverse affects of the intended demolition action. The unique mitigating actions resulted in a favorable agreement being signed and issued.

The project team also identified multiple hazards that would result if conventional demolition techniques were used in dome demolition. The physical structure of the vessel containment facility reached 30 meters (97 feet) above grade, presenting significant worker safety hazards posed by hoisting and rigging activities. The dome also included a polar crane, 19 meters (61 feet) above grade that posed similar risks to workers. The thickness of the dome walls—30-millimeter (1-3/16-inch) carbon steel—would prove

difficult with conventional plasma arc cutting tools, again at elevations up to 30 meters (97 feet). Finally, the dome's proximity to operating facilities with sensitive equipment added to demolition challenges.

To mitigate hazards posed by the height of the physical structure of the containment facility, the project team had to abandon traditional D&D techniques and employ alternate methods to complete demolition work safely. This alternative approach involved the controlled demolition of the facility's dome top that allowed the dome top to fall within the containment facility. The approach reduced the use of aerial lifts, aboveground size reduction, and dangerous hoisting and rigging that would pose significant hazards to workers. It also minimized the impact to adjacent, operating facilities in terms of both D&D debris and vibration.

Other D&D Progress

During the course of the 7-year cleanup, CWI will demolish or otherwise dispose of the following facilities and structures:

- 73 industrial
- 22 radiological (moderately contaminated)
- 25 reactor vessels, spent nuclear fuel basins, and fuel reprocessing and handling facilities
- 115 other structures

To date, decontamination, decommissioning and demolition has been completed of 4 industrial buildings, 11 radiological buildings, 2 nuclear facilities, and 42 other structures. In addition, major dismantlement on the interior of the Engineering Test Reactor has been completed. The company delivered an innovative regulatory approach for disposal of D&D waste onsite, saving millions of dollars in transportation costs. A first was completed in 2006, when a 50-year old spent fuel basin was filled with grout. The basin was previously de-inventoried of fuel and divers were used to vacuum the sludge from the basin floor. The sludge was subsequently grouted in containers for disposal and then the 4,921,000-liter (1,300,000-gallon) basin was filled with grout.

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 dispositioned during the course of the 7-year cleanup contract. CWI is designing and will construct the Integrated Waste Treatment Unit, deploying the steam reformer technology, to treat the waste starting in 2009. This project is being performed in accordance with DOE Order 413, "Project Management," and has met all DOE Order requirements. The DOE has approved Critical Decisions CD-0, CD-1, and CD-2 for the Integrated Waste Treatment Unit. Confirmatory seismic drillings have been made at the construction site, and final design is planned for 2007. Early site work packages for utilities, site grading and initial concrete pours are being prepared. Full construction release is anticipated in late 2007.

Closure of High Level Waste Tanks

CWI's scope of work at the INTEC's high-level waste tank farm includes the closure of 15 underground storage tanks. The tank farm project team will remove remaining sodium-bearing waste from three 1,135,624-liter (300,000-gallon) tanks, enabling tank farm capping and closure. The tanks, located above the Snake River Plain Aquifer at the Idaho National Laboratory site and which once stored high-level radioactive waste, have been emptied, cleaned, and filled with grout (November 20-22, 2006), thus beginning a process that will ensure the safety of the underlying aquifer. More tanks will be grouted by October 2008. Closure of the tank farm is targeted for December 2012.

Disposition of Nuclear Materials

CWI's mission is the disposal or disposition of select excess nuclear materials by September 30, 2009. This includes safely packaging and shipping the material in accordance with transportation regulations and receiver site requirements. The Nuclear Materials Completion team successfully completed its Fiscal Year (FY) 06 scope of work in March (six months early) and exceeded its baseline plan by addressing 240 of the project's 652 unirradiated excess nuclear material items.

Transfer of Spent Fuel from Wet to Dry Storage

INTEC's legacy spent nuclear fuel consists of four broad types: DOE-owned spent nuclear fuel from both commercial and research reactors, Navy fuel, spent nuclear fuel from the Advanced Test Reactor at the Reactor Technology Complex at INL, and commercial spent nuclear fuel from Three Mile Island and the Ft. St. Vrain facility.

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

The Spent Fuel Completion group was scheduled to transfer 500 fuel handling units in FY 06 from wet storage in FAST pools to dry storage in the Irradiated Fuel Storage Facility. The group not only met that goal 4 months ahead of schedule, it also doubled the actual completed transfers to 1,000 units, thus meeting the FY 07 goal. CWI is tasked with transferring 3,278 fuel handling units during the 3+ year wet-to-dry campaign.

Waste Shipping and Disposal

CWI is responsible for managing the waste generated during its cleanup activities. Much of the wastes, particularly those arising from D&D and environmental remediation activities, are disposed of onsite at the ICDF facility, located near INTEC. To date, more than 70,000 cubic meters (91,557 cubic yards) of waste have been disposed of, and construction of a second ICDF cell is now complete.

In January 2007, CWI completed the first shipment of remote handled transuranic waste to Waste Isolation Pilot Plant in the DOE Complex. In support of this effort, drum venting and real time radiography systems are operational.

To date, more than 11,000 cubic meters (14,387 cubic yards) of low-level and mixed low-level wastes have been disposed either onsite at the Subsurface Disposal Area or offsite at commercial or DOE disposal sites.

Retrieval of Waste from Waste Area Group 7

During the course of the contract, CWI will retrieve 1.1 hectares (2.8 acres) of buried waste located in the 39-hectare (97-acre) Subsurface Disposal Area located 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 roaster oxides.

To date, 607 square meters (0.15 acre) have been completed, and more than 2,829 cubic meters (3,700 cubic yards) of waste materials have been exhumed. A feasibility study report was published that supports the final remedial decision for all the buried waste in the Subsurface Disposal Area.

Environmental Remediation

CWI's environmental restoration group will remediate 118 contaminated environmental sites, close 68 hazardous waste tank systems, and close 550 unnecessary monitoring wells during the cleanup effort. The group's scope of work includes sitewide groundwater monitoring. Through October 2006, CWI has remediated 43 environmental sites, closed 51 hazardous waste tank systems, and closed 135 unnecessary monitoring wells.

Cleanup Project Challenges

Achieving the physical completion criteria specified in the cleanup contract would be challenging under any schedule. The contract scope of work includes the following key challenges:

- 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
- Recovery of required production levels of work associated with the retrieval of buried transuranic wastes at the Subsurface Disposal Area

Continuous Safety Improvement

A key enabler of any cleanup effort is a robust and continuously improving safety program. This is particularly true for the Idaho Cleanup Project. Recent project safety accomplishments include the passing of DOE's ISMS Phase I and II validation process. CWI has also submitted its Voluntary Protection Program application and awaits the audit to maintain its Star Status. It also has begun to implement a Human Performance Improvement Program based largely on the previous work of the Institute of Nuclear Power Operations and DOE's center of excellence.

Over the past year, safety performance has varied between statistically excellent performance and less than desirable performance. A recent challenge has been the spate of recordable injuries in the fall of 2006 that occurred outside the normal work control process. (Although minor, the injuries are nonetheless of concern.) A formal cause analysis is being conducted to determine likely causes so that appropriate corrective actions can be taken. A fully implemented and robust human performance program should go a long way in improving safety performance.

Safety must be managed day to day and person to person. As long as there is one recordable injury or one first aid case, there is room for improvement. Every accident or injury is preventable, and so we must continue to find new and innovative approaches to eliminate them.

Project Cost Management

Despite the excellent project cost performance to date, CWI faces several future project cost challenges (risks). Key areas of project management focus are on the costs for (1) the design, construction, and operation of the Integrated Waste Treatment Unit, the steam reformer that will eventually treat the 3,406,871 liters (900,000 gallons) of sodium-bearing waste; (2) the services provided by the INL site landlord contractor, such as emergency preparedness, bus service, fire department and office space; and (3) the possibility of future work stoppages related to the retrieval of transuranic waste from the Subsurface Disposal Area.

Formal project risk management plans, including risk mitigation action plans, have been prepared for the potential project cost risk items. These areas of project risk are evaluated at least monthly by the projects and quarterly by senior management.

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

The retrieval of transuranic waste from selected areas of the Subsurface Disposal Area as part of the Waste Area Group 7 remediation began quickly following contract assumption. However, two subsequent events resulted in the temporary suspension of exhumation activities related to (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 could have affected the stability of the tent-like structures that cover the areas of retrieval work.

Now that retrieval work has resumed, time lost due to the temporary shutdowns must be made up. The project remains confident, based on production levels achieved before the shutdowns, that this can be accomplished.

THE OUTLOOK FOR SUCCESS IN 2007

Some key project milestones for 2007 include:

- Begin construction on the IWTU
- Demolish the Engineering Test Reactor at the Reactor Technology Complex
- Continue retrieval of transuranic waste at the Subsurface Disposal Area
- Grout 8 additional high-level waste tanks
- Continue to more spent nuclear fuel from wet to dry storage

Based on its project performance to date, CH2M♦WG Idaho remains optimistic about the probability of achieving project completion by September 30, 2012 for the contract target cost of $2.4 billion. Nevertheless, project challenges remain that must be overcome in order for these goals to be reached.

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