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# Environmental Cleanup of the Idaho National Laboratory Status Report

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## ABSTRACT

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

On May 1, 2005 CH2M♦WG Idaho, LLC (CWI) began its 7-year, $2.4 billion cleanup of the INL. When the work is completed, 3,406,871 liters (900,000 gallons) of sodium-bearing waste will have been treated; 15 high-level waste tanks will have been grouted and Resource Conservation and Recovery Act (RCRA)-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 3,178 units of spent fuel will have been moved from wet to dry storage.

In 2007, CWI began the construction of the Integrated Waste Treament Unit that will treat the sodium-bearing waste for eventual disposal; removed and disposed the 112-ton Engineering Test Reactor vessel; demolished all significant radiological facilities at Test Area North; continued the exhumation of buried transuranic wastes from the Subsurface Disposal Area at the Radioactive Waste Management Complex; shipped the first of hundreds of containers of remote-handled transuranic waste to the Waste Isolation Pilot Plant; disposed of thousands of cubic meters of low-level and low-level mixed radioactive wastes both onsite and offsite while meeting all regulatory cleanup objectives.

## 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 the U.S. Department of Energy's (DOE) 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 (BEA); the Idaho Cleanup Project (ICP) managed by CH2M♦WG Idaho, LLC (CWI); and the Advanced Mixed Waste Treatment Project managed by Bechtel BWXT Idaho.

The Idaho Cleanup Project focuses on cleanup activities in five major geographic areas:

- Idaho Nuclear Technology and Engineering Center (INTEC)—established in the 1950s to recover usable uranium from spent nuclear fuel from government reactors and also to store spent nuclear fuel
- Radioactive Waste Management Complex (RWMC)—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 (TAN)—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 (RTC)—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 (PBF)—used to conduct experiments at the facility to help determine safe operating parameters 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 (IWTU); 3,178 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 dispositioned; 15 high-level waste tanks will be cleaned, grouted and Resource Conservation and Recovery Act (RCRA)-closed; and various environmental remediation activities will occur
- RWMC, where buried transuranic waste will be retrieved from 1.1 hectares (2.8 acres) of the Subsurface Disposal Area (SDA) as part of the Waste Area Group 7 (WAG7) remediation and various radioactive and mixed wastes will be characterized, packaged and shipped for disposal onsite and offsite
- TAN, where various radioactively contaminated facilities will be demolished
- RTC, where two reactors and ancillary facilities will be demolished and disposed

- PBF, where one reactor and ancillary facilities will be demolished and disposed


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

The cleanup contract between DOE and CWI 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 in the IWTU, and disposition the resultant waste.
- Empty and close all Tank Farm Facility high-level waste tanks.
- Place all DOE 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 (WIPP).
- Retrieve certain buried transuranic wastes located at the Subsurface Disposal Area (SDA).
- Remediate identified areas of soil and groundwater contamination.
- Remediate all Voluntary Consent Order (radiologically contaminated) tank systems.

To accomplish these objectives, 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. (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 employ proven, innovative technologies and approaches to increase work efficiency and safety.

## IDAHO CLEANUP PROJECT STATUS

More than 46 percent of the way through the cleanup project, the project is under cost and slightly ahead of schedule. Through December 2007, the project cost and schedule performances against the life-cycle project baseline are as follows:

- Cost variance is $57,851K; CPI: 1.05
- Schedule variance is $64,845K; SPI: 1.06

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 2007 and how much work remains.

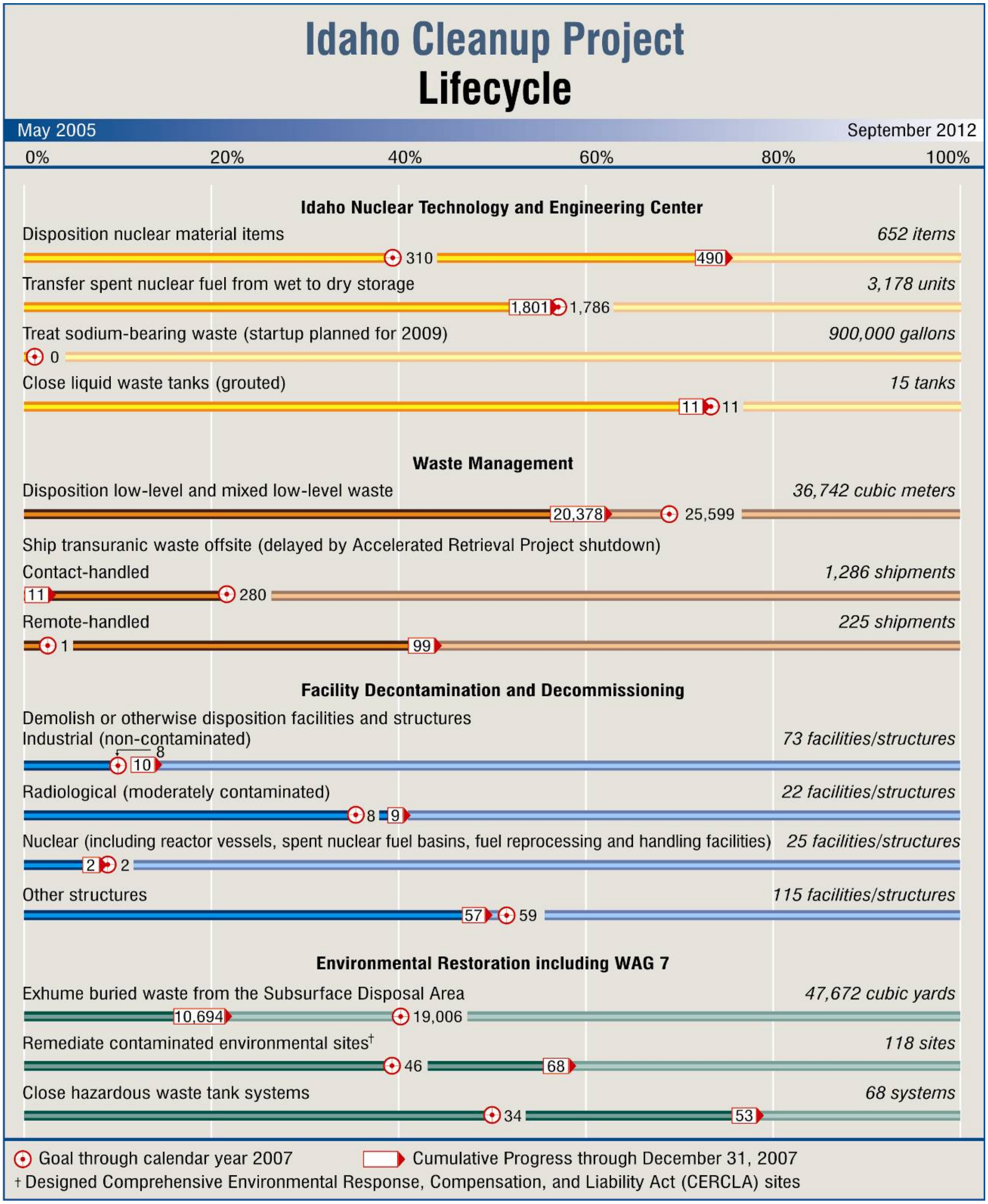


Fig. 2. Key activities to complete the cleanup scope of work

## Notable Accomplishments in 2007

Key enablers of any nuclear cleanup work are robust safety and environmental management programs. Calendar year 2007 saw a number of noteworthy accomplishments in both of these areas. In the areas of safety management performance, CWI was certified as a Voluntary Protection Program (VPP) Star site by the DOE's Office of Health, Safety and Security - indicative of excellence in its safety program. During the National VPP Participants Association annual conference, CWI received three of five top awards from DOE for its VPP culture and leadership. CWI president, Bob Iotti, was recognized for outstanding management leadership. CWI employee, Dave Fox, was recognized for his role in development of the project's COBRA (Changing Our Behavior Reduces Accidents) peer observation program. Finally, CWI was recognized as the "Most Innovative Contractor" for 'CWI-Light Zone' a safety video series.

In the area of environmental management, all regulatory milestones were met and CWI's Environmental Management Systems remains ISO 14001 certified.

Another key enabler to the successful delivery of any project is an excellent project management/project control system. CWI's Earned Value Management System (EVMS) was certified by DOE in 2007 as meeting the American National Standards Institute's criteria for EVMS.

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

## Disposal of the Engineering Test Reactor Vessel

In September 2007, CWI completed the decontamination and removal of the 112-ton Engineering Test Reactor (ETR) vessel (Figure 3). The vessel was originally located at the RTC. The ETR first began operation in 1957. At that time, it was the most advanced nuclear fuels and materials test reactor in the United States. It had a maximum capacity of 175 megawatt thermal.

Although the reactor had been defueled in 1981, it contained significant amounts of highly radioactive cobalt, strontium, and cesium. The ETR vessel also contained tritium and cadmium as well as irradiated beryllium. The facility contained nearly 1.5 million pounds of lead and vast amounts of asbestos-lined piping with a majority of it residing in the 17 experimental cubicles.

The reactor vessel required isolation in order to be removed. Due to activated metal within the reactor vessel, dose rates in the core region were approximately 1100R/hr. Subsequent dose rates outside the vessel varied from 60mR to greater than 2R. Due to the dose rates, the project team decided to fill the reactor vessel with grout to a level above the core region and below the discharge to the canal.

To remove the reactor, access to the 17 mounting shoes was required. These shoes were encased in the high density concrete biological shield approximately 8 feet below grade. The project team used explosives to remove the biological shield. The demolition had to be controlled to prevent damaging the reactor vessel and to limit the seismic impact on a nearby operating reactor. Upon completion of the blast, the concrete was removed exposing the support shoes for the vessel.

The reactor building was then demolished to accommodate the twin gantry system used to lift the reactor vessel. Finally, the reactor vessel was lifted and placed onto a multi-axle trailer for transport to an onsite disposal facility, the ICDF.

Fig. 3. The 112-ton Engineering Test Reactor vessel was removed and subsequently disposed at the ICDF.

## Other D&D Progress

In 2007, CWI completed decontamination, decommissioning and demolition of six industrial buildings, four radiological buildings, one nuclear facility, and 13 other structures. In addition to the disposition of the ETR vessel, the other major demolition activity that occurred in 2007 involved the TAN "Hot Shop." The Hot Shop was built in 1954 to support research related to the Aircraft Nuclear Propulsion project, to build and fly a nuclear-powered airplane. The aircraft project was eventually cancelled, and the facility was put to many other nuclear safety and accident research uses over the years.

With seven-foot-thick steel reinforced concrete walls, the Hot Shop was built to last. Thus, explosive demolition was called for given the robustness of the facility. Two sets of explosions were necessary—the first to open the gaps in the walls on the sides and around the building's bay doors to allow placement of additional explosives that would bring the building to the ground in a second blast. The Hot Shop was the last major facility to be demolished at Test Area North.

To date, 10 industrial facilities, nine radioactively-contaminated facilities, two nuclear facilities, and 57 other facilities 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 dispositioned during the course of the cleanup contract. Sodium-bearing waste contains radioactive and hazardous constituents from the decontamination of highly radioactive waste facilities and some nuclear reprocessing activities. CWI will design, construct and operate the IWTU to treat the waste. The design is robust, drawing on lessons-learned from around the DOE Complex, especially with regard to meeting applicable seismic criteria. The IWTU will deploy steam reformer technology to treat the waste. 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 through CD-3 for the IWTU. Confirmatory seismic drillings have already been performed and construction has begun (Figure 4).


Fig. 4. Weather enclosure allows IWTU construction to continue during winter months

**Closure of High-level Waste Tanks**

CWI's scope of work at 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 existing 15 tanks, 11 tanks have been grouted to date, three small tanks (30,000 gallons each) in 2006 and the remaining eight tanks (300,000 gallons) in 2007. Four tanks remain to be grouted. Three of four tanks still hold sodium-bearing waste awaiting treatment in the IWTU and one empty tank that is being held in "reserve" in the event it is needed. The grouting of the 11 tanks was accomplished nearly one-year ahead of schedule.

**Disposition of Nuclear Materials**

CWI is responsible for the disposition of select excess nuclear materials by September 30, 2009. Much of this material consists of unirradiated nuclear fuels. Work includes safely packaging and shipping the material in accordance with transportation regulations and receiver site requirements.

The Nuclear Materials Completion team successfully completed its 2007 scope of work by shipping 250 items. When the project is completed, a total of 652 items will have been shipped offsite. Through December 2007, 490 specified items have been shipped offsite, two years ahead of schedule.

Work included shipments containing highly enriched uranium to Oak Ridge Y-12 as well as excess nuclear material to Nevada Test Site. Disposition of these items completed the project scope for fiscal 2007 as well as much of the 2008 scope.

The team also dispositioned 120 more Engineering Test Reactor elements from the Reactor Technology Complex to Y-12, in addition to transferring the remaining spent nuclear material in CPP-602 to the Savannah River 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 RTC, and commercial spent nuclear fuel from Three Mile Island and the Ft. St. Vrain facility (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 615 fuel handling units in 2007 from wet storage in FAST pools to dry storage in the Irradiated Fuel Storage Facility, ahead of schedule. Through December 2007 the group has transferred 1,801 (of 3,178) fuel handling units.

During 2007, the group also received and stored Advanced Test Reactor fuels from BEA and transferred Navy-owned fuels to the Naval Reactor Facility at the INL Site.

### 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, located near INTEC. To date, more than 106,257 cubic meters (138,984 cubic yards) of waste have been disposed.

On January 18, 2007, CWI completed the first shipment of remote-handled transuranic waste to the Waste Isolation Pilot Plant. This was the first shipment of this type of waste made to WIPP. Through the end of CY07, CWI made 99 shipments of remote-handled waste to WIPP. To date, the ICP is the only project that has shipped remote-handled transuranic waste to WIPP.

In 2007, CWI disposed of nearly 7,000 cubic meters (9,156 cubic yards) of low-level and low-level mixed wastes either onsite at the Subsurface Disposal Area or offsite at DOE or commercial disposal facilities. To date, 20,378 cubic meters (26,654 cubic yards) of low-level and mixed low-level wastes have been disposed either onsite or offsite.

### Retrieval of Waste from the Subsurface Disposal Area

During the course of the contract, CWI will retrieve 1.1 hectares (2.8 acres) of buried waste from the 39-hectare (97-acre) Subsurface Disposal Area located at RWMC. The contract requires that certain targeted wastes be selectively removed, characterized, packaged, and shipped to WIPP. The wastes consist mostly of sludges with high concentrations of plutonium and volatile organics compounds, graphite wastes, and roaster oxides.

Two tent-like retrieval enclosures, located on top of the Subsurface Disposal Area’s disposal pits are currently in operation with a third structure under construction. By calendar year end, 8,176 cubic meters (10,694 cubic yards) of waste materials have been exhumed.

In October, DOE issued the proposed plan for the SDA. In November, about 200 citizens, elected officials, civic leaders, community organizations, environmental interest groups, and employees attended public meetings to learn more about plans for the buried waste. DOE, the Idaho Department of Environmental Quality (DEQ), and the Environmental Protection Agency (EPA) explained the results of a 12-year environmental study of the buried waste and outlined the preferred alternative for addressing the contamination and long-term protection of people and the environment.

The agencies evaluated the following alternatives in addressing the buried waste:

1. No action

2. Surface barrier

3. In situ grouting

4. Partial retrieval, treatment, and disposal

5. Full retrieval, treatment, and disposal

The preferred alternative identified by the agencies incorporates elements of Alternatives 2, 3 and 4. DOE has proposed expanding current targeted waste exhumations to 4.8 acres.

Following review of public comments, a Record of Decision (ROD) will be developed. The next milestone is submittal of a draft ROD to the state and EPA for review in March 2008.

### Environmental Remediation

During the course of the contract, CWI's Environmental Restoration group will remediate 118 contaminated environmental sites and close 68 hazardous waste tank systems. The group's scope of work also includes site-wide groundwater monitoring.

In 2007, CWI remediated 20 environmental sites and closed two hazardous waste tank systems. Through December 2007, 66 environmental sites have been remediated, and 53 hazardous waste tank systems have been closed.

## CLEANUP PROJECT CHALLENGES

The Idaho Cleanup Project is managed with a close attention to identifying and managing project challenges and programmatic risks. Some of the key challenges and risk facing the project include:

- 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 project cost growth – specifically related to the construction of a significant new nuclear facility to treat highly radioactive wastes, the IWTU
- Achieving and maintaining 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. Over the past year, safety performance has continued to improve, both in terms of day away and recordable case rates. Through December, safety performance remained good – 1.33 total recordable case rate (goal is ≤ 1.40) and 0.33 day away case rate (goal is ≤ 0.3). Additionally, the project experienced fewer injuries than the previous year. It is clear that safety must be managed on day-to-day and person-to-person bases. As long as there is one recordable injury or one first aid case, there is room for improvement. We continue to focus on areas causing frequent injuries as well as on preventative efforts to achieve safer, smarter ways to accomplish work.

**IWTU Cost Management**

Despite the overall excellent project cost performance to date (CPI of 1.05), CWI faces a significant, future project cost risk. Specifically, the cost to design, construct, and operate the IWTU - that will ultimately treat the sodium-bearing waste - is increasing beyond original estimates.

The cost increases are largely due to (1) higher than anticipated costs for commodities and raw materials such as concrete and steel, and (2) increased costs related to implementation of both seismic upgrades as well as other facility features that would enable the facility to treat other types of wastes.

Considerable attention is being spent managing this project to ensure that any cost increases are kept as low as possible.

### 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 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 removal 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.

Further, issues related to the reliability of excavation and other mobile equipment inside the tent structures have also plagued the project.

A number of actions have been taken to mitigate these risks including implementation of engineering "fixes" to address the subsidence issues and the purchase of backup equipment.

In recent months, the amount of waste being exhumed has approached, and exceeded at times, the production rates necessary to complete the project within the contract period.

## THE OUTLOOK FOR SUCCESS IN 2008

Some key project milestones for 2008 include:

- Continue construction of the IWTU and fabrication of process vessel and skids
- Remove and disposition the Power Burst Facility
- Complete all D&D activities at Test Area North – effectively ending DOE EM's obligations there (with the exception of some long-term groundwater treatment)
- Continue retrieval of transuranic waste at the Subsurface Disposal Area
- Continue to move spent nuclear fuel from wet to dry storage
- Complete the offsite disposition of all specified excess nuclear materials (unirradiated light water breeder reactor materials) to the Nevada Test Site

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

For additional information, call Allen Schubert at (208) 526-7432 or send an e-mail to allen.schubert@icp.doe.gov.

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