

**Cost Savings through Innovation in Decontamination,  
Decommissioning, and Dismantlement**

Neal A. Yancey

Idaho National Engineering and Environmental Laboratory  
P.O. Box 1625 MS 3710, Idaho Falls, Idaho 83415-3710

Work supported by the U.S. Department of Energy, Office of Environmental Management, under DOE Idaho Operations Office Contract DE-AC07-99ID13727

**ABSTRACT**

The United States Department of Energy (DOE) continually seeks safer and more cost-effective technologies for the decontamination and decommissioning (D&D) of nuclear facilities. The Deactivation and Decommissioning Focus Area (DDFA) of the DOE's Office of Science and Technology (OST) sponsored large-scale demonstration and deployment projects (LSDDPs) to help bring new technologies into the D&D programs. The Idaho National Engineering and Environmental Laboratory (INEEL) LSDDP generated a list of needs defining specific problems where improved technologies could be incorporated into ongoing D&D tasks. The needs fell into 5 major categories – characterization, dismantlement, safety, material dispositioning, and decontamination.

Technologies were carefully selected that provide a large benefit for a small investment. The technologies must provide significant improvements in cost, safety, radiation exposure, waste volume reduction, or schedule savings and widely applicable throughout the DOE complex. The LSDDP project provided training for the new technologies and worked with technology suppliers to resolve any questions that arose.

Since 1998, 26 technologies have been demonstrated or deployed through the LSDDP for the D&D program at the INEEL. Of the 26 demonstrated and deployed technologies, 14 were in characterization, 3 were in decontamination, 4 were in dismantlement, 3 were in safety, and 2 were in material dispositioning. To promote the use of these technologies at other sites within the DOE complex, the LSDDP team published fact sheets, videos, technology summary reports, articles in INEEL star newspaper, posters, and maintained an internet home page on the project. As a result, additional deployments have taken place at the Hanford, Mound, Fernald, Oak Ridge, Ashtabula, and West Valley. Eight of the 26 technologies evaluated were developed in foreign countries.

The technologies demonstrated have been shown to be faster, less expensive, and/or safer. The technologies evaluated through the LSDDP have provided improvements in the following D&D areas: robotic underwater characterization of fuel storage pools, characterization of scrap metal for recycle, PCB and RCRA metals analysis in soil, water, paint, or sludge, subsurface characterization, personnel safety, waste disposal, scaffolding use, and remote radiation characterization of buildings and soil. It is estimated that the technologies demonstrated and deployed through this program will save more than \$50

million dollars over the next 10 years at the INEEL alone. Of the \$50 million estimated dollars saved, about 75% of the savings will come from characterization technologies, 11% from technologies associated with material dispositioning, 10% are associated with dismantlement technologies and the balance split between safety and decontamination.

## INTRODUCTION

The United States Department of Energy (DOE) continually seeks safer and more cost-effective technologies for decontamination and decommissioning (D&D) of nuclear facilities. To this end, the Deactivation and Decommissioning Focus Area (DDFA) of the DOE's Office of Science and Technology sponsored large-scale demonstration and deployment projects (LSDDPs). As one of four major technology development Focus Areas in the DOE Office of Science and Technology (EM-50), the DDFA was responsible for developing, demonstrating, and implementing cost-effective and safe technologies to deactivate approximately 7,000 contaminated buildings, and decommission approximately 700 contaminated buildings that are currently on DOE's list of surplus facilities.

Deactivation refers to ceasing facility operations and placing the facility in a safe and stable condition to prevent unacceptable exposure of people or the environment to radioactive or other hazardous materials until the facility can be decommissioned. Typically, deactivation involves removal of fuel and stored radioactive and other hazardous materials and draining of systems. Decommissioning is the process of decontaminating or removing contaminated equipment and structures to achieve the desired end state for the facility. Desired end states include complete removal and remediation of the facility, facility entombment, release of facility for unrestricted use, or release of facility for restricted use.

The INEEL was awarded an LSDDP project in 1998, which specifically supported the INEEL D&D operations. In 2001, the INEEL was awarded a second LSDDP, which supported work at multiple DOE laboratories across the complex. In general, sufficient baseline technologies exist to deactivate and decommission the DOE surplus buildings, structures, and their contents, but these baseline technologies are often labor intensive, time consuming, expensive, and can excessively expose workers to radioactive and other hazardous materials. Additionally, many baseline technologies also generate secondary waste beyond those of the building materials and their contents.

The DDFA addressed these problems by developing, demonstrating, and facilitating deployment of technologies that generate less secondary waste, are lower in cost, require less labor, reduce exposure of personnel to radioactive and other hazardous materials, and improve worker safety. Innovative technologies are continually being developed for characterization of contamination, decontamination of buildings and materials, dismantlement of buildings and equipment systems, reuse or recycle of materials, waste minimization, and worker protection and safety.

Ultimately, the end goal of any technology development program is to commercialize the technology and make it available to potential end users at a competitive price. A key phase of technology development is "demonstration" of the technology to these potential

end users. Technologies reaching the demonstration stage need clear end user support for the demonstration; firm cost-sharing arrangements and partnership agreements; and resolution of technical, safety, regulatory, public, and intellectual property issues. It was the intent of the DDFA to conduct technology demonstrations in DOE facilities at a scale and test duration that is convincing to potential end users. Data from demonstration of the technology should provide potential end users with sufficient information to make decisions regarding subsequent use of the technology. Primary end users for DDFA technologies were the DOE Office of Environmental Restoration (EM40).

The operating contractor at each site generated a list of need statements defining specific needs or problems where improved technologies could be incorporated into ongoing D&D tasks. Through the LSDDP, these needs were separated into 5 categories: characterization, dismantlement decontamination, material disposition, and worker safety. Benefits sought for these innovative technologies included decreased health and safety risks to personnel and the environment, increased productivity, and decreased cost of operation and accelerated schedules.

Since the first LSDDP at the INEEL in 1998, 176 technologies have been evaluated. Of those 176 technologies 26 technologies have been demonstrated or deployed. As a result of these technologies being used at the INEEL and other laboratories, 2 million dollars has been saved, and it is anticipated that a total of \$50 million will be saved in the next 10 years.

## TESTED TECHNOLOGIES

Since 1998, the INEEL LSDDP has demonstrated or deployed 26 technologies at 7 different field offices across the DOE complex. Fourteen of the 26 technologies were used for characterization activities, 6 technologies were used in decommissioning work, 4 were used in decontamination, two technologies were demonstrated for material disposition work, and two technologies specifically addressed worker safety.

These technologies came from 6 different countries from around the world. Eighteen were developed in the United States, 2 were developed in Germany, 2 in Russia, 2 in Japan, 1 in Canada, and 1 in Great Britain.

Because much of the D&D work was started in the last 6 years, characterization activities (which occur primarily on the startup of the D&D project) have dominated the area where new technology needs occurred. As a result 14 of the 26 technologies tested were in the category of characterization work.

Within the area of characterization, 7 of the 14 technologies were used to measure radioactive contamination levels. Many of these technologies can be deployed robotically, reducing the potential for human exposure to radiation. One example is the Russian



Figure 1. Russian GLD at the INEEL

developed Gamma Locating Device (GLD) (Figure 1). The GLD was used at the INEEL to remotely detect radiation hot spots in a contaminated building prior to human entry for D&D activities.

Of the seven other characterization technologies demonstrated or deployed, one was used to detect polychlorinated biphenyls (PCBs), one was used for subsurface characterization, and the remainder were used in support of lead paint detection or sample collection.

Six technologies were used to improve decommissioning work. These technologies included an innovative scaffold system, air casters (Figure 2.0), electronic field logbooks, a tool to aid workers who sleeve electrical cords or air hoses prior to use in a contaminated area, a circular saw used to cut stainless steel, and a remotely operated demolition tool called the BROKK.



Figure 2. Air Casters Being Used to Move a 70,000 lb. Incinerator Tank.

Four technologies were used to decontaminate buildings prior to releasing the building for other uses. Two of the four technologies used were large area mechanical scabbling tools. The ENVAC is a robotically operated scabbler that can cling to walls or ceilings as it scabbles. Two other tools used to decontaminate INEEL buildings were the Aerosol Fogging System used to lock down contaminants prior to human entry and a liquid paint removing compound used to remove lead or PCB contaminated paint from buildings undergoing D&D.

Soft sided containers were used at the INEEL, Hanford, and Fernald sites to make more efficient use of space when disposing of low level radioactive waste (LLW). The soft-sided bags are large volume waste bags that can take larger pieces of debris and will conform to the shape of the waste to some extent. Another waste dispositioning technology tested was a German- made copper wire recycling technology. The copper recycler separated contaminated wire insulation from the non-contaminated copper core so that the copper could then be reused.

The INEEL LSDDP also tested a powered air-purifying respirator. This respirator provides a greater degree of protection than negative pressure respirators and is cooler than most respirators. The LSDDP also purchased a temperature monitoring system to help prevent heat stress related injuries. These technologies decrease the risk of negative health affects associated with construction/demolition related work.

## COST SAVINGS REALIZED

As part of the demonstrations and deployments, data was collected to compare the cost, effectiveness, production rate, and safety aspects of the new technology compared to the baseline technology. The cost-benefit analyses were done using data collected during the demonstrations and deployments. The cost savings were monitored for the first year of use for each technology. It was found that in the first year of use, a combined savings of \$1.96 million dollars was saved using the innovative technologies.

While some technologies realized huge savings on a single use, other technologies produced much smaller savings per use, but were used many times throughout the year. Although most of the technologies were only used at the INEEL, some of the technologies have been used at multiple DOE sites. The following table shows a list of all of the technologies tested through the LSDDP and the demonstration/deployment sites.

Table I. Sites Where Technologies were Used

Technology Tested	Sites Where Technologies have been Demonstrated or Deployed							
	INEEL	Mound	Hanford	LANL	Oak Ridge	West Valley	Ashtabula	Fernald
Characterization Technologies	14	3	1		1			
Dismantlement	4		2	1		1		1
Decontamination	4						1	
Material Disposition	2		1					1
Worker Safety	2		2					

One of the technologies tested at the INEEL was an air caster system manufactured by AeroGo Inc. The system was used to move an incinerator weighing 70,000 lbs out of a building (Figure 2). The only other way to get the incinerator out of the building was to remove the roof, bring in a crane, lift the incinerator out of the building, and rebuild the roof. Using the air casters on this project alone saved the INEEL \$135,000. It was also deployed two other times at the INEEL.

Technology Tested	
-------------------	--

Another much simpler technology tested at the INEEL was the Bosch Rotary Hammer Drill (Figure 3) used to collect paint samples by mechanically chipping the paint from concrete or metal surfaces as apposed to using hand tools to collect paint samples. While the air casters saved much more money on a single project, the Bosch tool was deployed many more times in the first year. The cost of the Bosch Rotary Hammer Drill with attachments is about \$800. The use of the Bosch resulted in about \$2,000 being saved in

the first year. Even though the annual savings was only \$2,000, a more significant benefit was how much easier the worker could accomplish his tasks.



Figure 3. Using the Bosch Hammer Drill to Remove Paint During Characterization Work.

### **ANTICIPATED FUTURE SAVINGS**

The Deactivation, Decontamination, and Decommissioning in Support of 2012 Initiatives report, written in April of 2002 for the INEEL (1), reports an estimated budget of \$198 million will be spent to complete the decommissioning activities at the INEEL by 2012. Using that information, an estimated cost savings was projected based on the use of the innovative technologies that were tested through the LSDDP. It was estimated that using these innovative technologies to assist in the D&D operations at the INEEL could save slightly more than \$51 million.

This \$51 million can be traced back to savings associated with direct labor and equipment costs, reduction in secondary waste, schedule savings, reduction in exposure savings (ALARA), and reduction in surveillance and maintenance costs. The following figure shows the relative contributions associated with each of these categories.

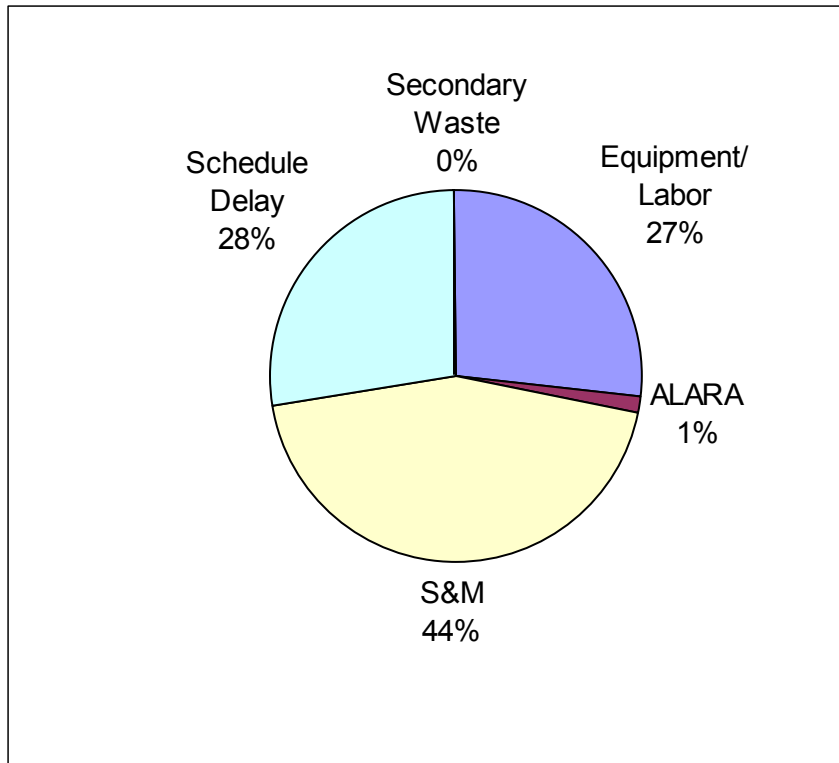


Figure 4. Cost Savings Percentages

As shown above, the largest cost savings area is in surveillance and maintenance. The use of innovative technologies in D&D activities results in a significant decrease in schedule. This in turn, decreases the amount of time that the buildings must continue to be monitored in the surveillance and maintenance program.

## CONCLUSIONS

The success of the LSDDP at the INEEL has resulted in 26 new or innovative technologies being demonstrated or deployed at the INEEL, Fernald, Mound, Savannah River, Oak Ridge, West Valley, Ashtabula, and Hanford. These new technologies have resulted in a tremendous cost savings to the INEEL D&D program. Almost \$2 million dollars was saved during the first years of use for these new technologies. In addition, the use of these innovative tools has accelerated the D&D work resulting in a decrease in schedule, decrease in surveillance and maintenance costs, and a decrease in personnel exposure to hazardous environments.

All but 6 of the technologies tested have become baseline technologies for the D&D operations. At the INEEL, the heat stress monitoring pill is expected to be used, not only in the D&D program, but in operations activities as well. It is anticipated that this technology will help prevent future heat stress related incidents at the INEEL.

The D&D budget over the next ten years is about \$198 million. By continuing to use these innovative technologies, a savings of over \$50 million can be achieved. D&D

workers now look to the LSDDP program to assist them in identifying technologies that can increase productivity, decrease costs, and increase worker safety on all future projects.

## **REFERENCE**

1. Lopez, Steve, 2002, *Deactivation, Decontamination, and Decommissioning in Support of 2012 Initiatives*, INEEL/INT-02-00610, April 2002.

## **PRODUCT DISCLAIMER**

References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government, any agency thereof, or any company affiliated with the Idaho National Engineering and Environmental Laboratory.