# Robots Clean Up the Cold War Mess

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*With the collapse of the Soviet Union came a sudden end to the Cold War. Now, robots are being used to remedy the nation's environmental problems caused by 50 years of building nuclear weapons.*

## Background

With the fear that Germany might invent the world's first atomic bomb, in 1942 the US began the top secret "Manhattan Project." In less than three years the US was successful in building both uranium and plutonium bombs. During that time, the US Army Corps of Engineers managed the construction of huge plants to enrich uranium, production reactors to make plutonium, and reprocessing plants to extract plutonium from the reactor fuel. On August 6, 1945, the US dropped "Little Boy," a uranium bomb, on Hiroshima, and on August 9, 1945, a plutonium bomb, "Fat Man," was dropped on Nagasaki. Twenty-three days later, Japan surrendered. Following World War II, relations between the US and USSR deteriorated, and the "Cold War" began. Over the next five decades the US spent an estimated $300 billion manufacturing nuclear weapons until 1991 when the sudden collapse of the Soviet Union brought an abrupt end to the nuclear arms race and the Cold War. Now, the Corps of Engineers is assisting the Department of Energy in decontaminating and decommissioning portions of the nation's vast nuclear weapons sites with the help of robots.

## The Cold War Legacy

Like most industrial and manufacturing operations, the production of nuclear weapons has generated wastes. But unlike other wastes, these have unique radiation hazards. In the late 1980's all major facilities in the nation's nuclear weapons complex were shut down temporarily. Because the end of the Cold War was so sudden, many of the facilities were not closed properly and much of the wastes remain in temporary storage posing environmental and health risks. The Department of Energy currently owns and maintains more than 2,000 contaminated buildings that will require decontamination and decommissioning. It also must remediate about 2,700 metric tons of spent fuel, 100 million gallons of high level waste which is enough to fill up 10,000 tanker trucks, 100 metric tons of plutonium, and 550,000 metric tons of contaminated metal.

## Estimates to Clean Up the Nuclear Weapons Complex

In its 1995 Baseline Environmental Management Report the Department of Energy estimated that it would take 75 years and $227 billion to clean up the nuclear weapons complex. Because of this enormous price tag, in June 1997 the Department introduced its "2006 Plan," formerly called the "Ten Year Plan," which urges the use of innovative technologies, processes, and thinking to reduce the Cold War mortgage by completing clean up activities at many of its sites by 2006 at a cost of about $120 billion.

## Interagency Agreement

The Department of Energy's Federal Energy Technology Center located in Morgantown, West Virginia, and Pittsburgh, Pennsylvania, has the lead for innovative technology development for decontamination and decommissioning of the nation's nuclear weapons complex. In 1995, the Center executed an interagency agreement with the Army which allows the Corps of Engineers to assist the Department of Energy in a variety of areas including the clean up of the nuclear weapons complex. The Corps' Huntington District in Huntington, West Virginia, serves as the Army's program director for the agreement and assigns work to the Corps' district nearest to the Department of Energy project, if that district has the necessary expertise and resources.

## Decontamination and Decommissioning Projects

The Corps played a major role in building the nuclear weapons complex in the 1940's and now it is a vital part of the team decontaminating and decommissioning these facilities. Currently, the Corps is assisting the Federal Energy Technology Center in the decontamination and decommissioning of a portion of three sites: the Chicago Pile 5 Reactor at the Argonne National Laboratory, Fernald's Plant 1 near Cincinnati, and Hanford Reservation's C-Reactor near Richland, Washington. The Chicago Pile 5 Reactor was a heavy-water uranium-fueled thermal reactor that operated for 25 years prior to its shutdown in 1979. The decontamination and decommissioning of the reactor includes the removal of the reactor core and the biological shield structure, decontamination of the rod storage area, and dismantling the structure. At Fernald, uranium ore was milled for distribution to other nuclear weapons sites. This work generated low-level radioactive dust which settled over much of the 1000-acre site. The C-Reactor at Hanford was a full-scale surplus production reactor which was constructed in 1951 in rapid fashion to respond to increased tensions in the Cold War. Startup of the reactor occurred in November 1952 and operations were stopped in April 1969. The C-Reactor was scheduled to be the first of eight reactors at Hanford to be dismantled. However, due to site priorities and limited resources, the Department is exercising the option to maintain the reactor in safe storage for 75 to 100 years prior to final disposition.

Four new projects also are getting underway at Mound, Ohio, at the Los Alamos National Laboratory in New Mexico, at the Savannah River National Laboratory in South Carolina, and at the Idaho National Laboratory. The Corps is providing management support and cost engineering services to determine the performance and cost effectiveness of innovative technologies and processes being demonstrated for the first time at these sites. The Federal Energy Technology Center's ultimate goal is to demonstrate innovative technologies in order to facilitate their acceptance and deployment for repetitive and reliable use across the nuclear weapons complex.



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**Figure 1.** The Mobile Automated Characterization System can detect alpha and beta contamination on the floors. Department of Energy photo.

## Mobile Automated Characterization System

The Mobile Automated Characterization System is a battery-powered, autonomous robot with a laser positioning system. It can detect alpha and beta contamination on floor space in preparation for decontamination and can perform long-term surveillance and maintenance tasks. This technology reduces worker exposure through automated remote operation and provides accurate characterization data (Figure 1).

## Rosie Remote Work System

A remote mobile work system, called "Rosie," provides a telerobotic, mobile platform from which other robotic tools can be deployed for a wide variety of demolition and decontamination tasks. At the Chicago Pile 5 Reactor Project it broke up high-density concrete in an hour compared to several days for workers using jackhammers (Figure 2).

## Dual-Arm Work Platform

The Dual-Arm Work Platform has two hydraulic manipulator arms mounted on a hydraulic positioning base. Equipped with a circular saw, it cut up large sections of the Chicago Pile 5 Reactor, removed contaminated lead panels, and dismantled graphite bricks. It can accept a variety of tooling configurations and its remote operation removes workers from high radiation environments (Figure 3).

## Lessons Learned

It was an enormous challenge to build the nuclear weapons complex, and it is perhaps an even greater challenge to safely and effectively decontaminate and dismantle these facilities. This endeavor will require a high level of commitment and cooperation among government, federal and state regulators, industry, academia, and the public. To safely accomplish the enormous undertaking of cleaning up the aftermath of the Cold War, we must use ingenuity to develop and modify robots so they can be used effectively on delicate and heavy decontamination and dismantling tasks in highly radioactive environments.

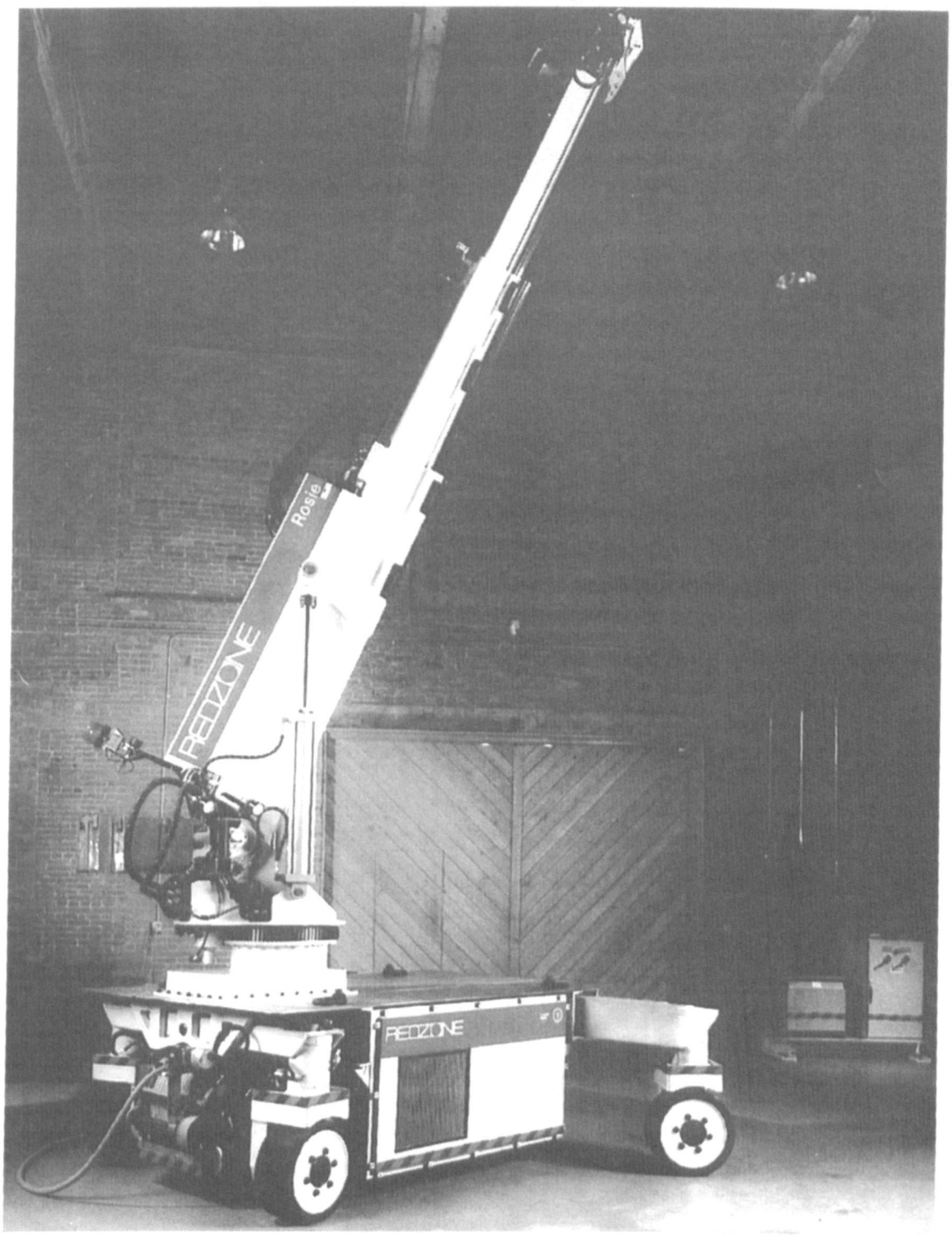


**Figure 2.** "Rosie" broke up high-density concrete in an hour compared to several days for workers using a jackhammer. Department of Energy photo.



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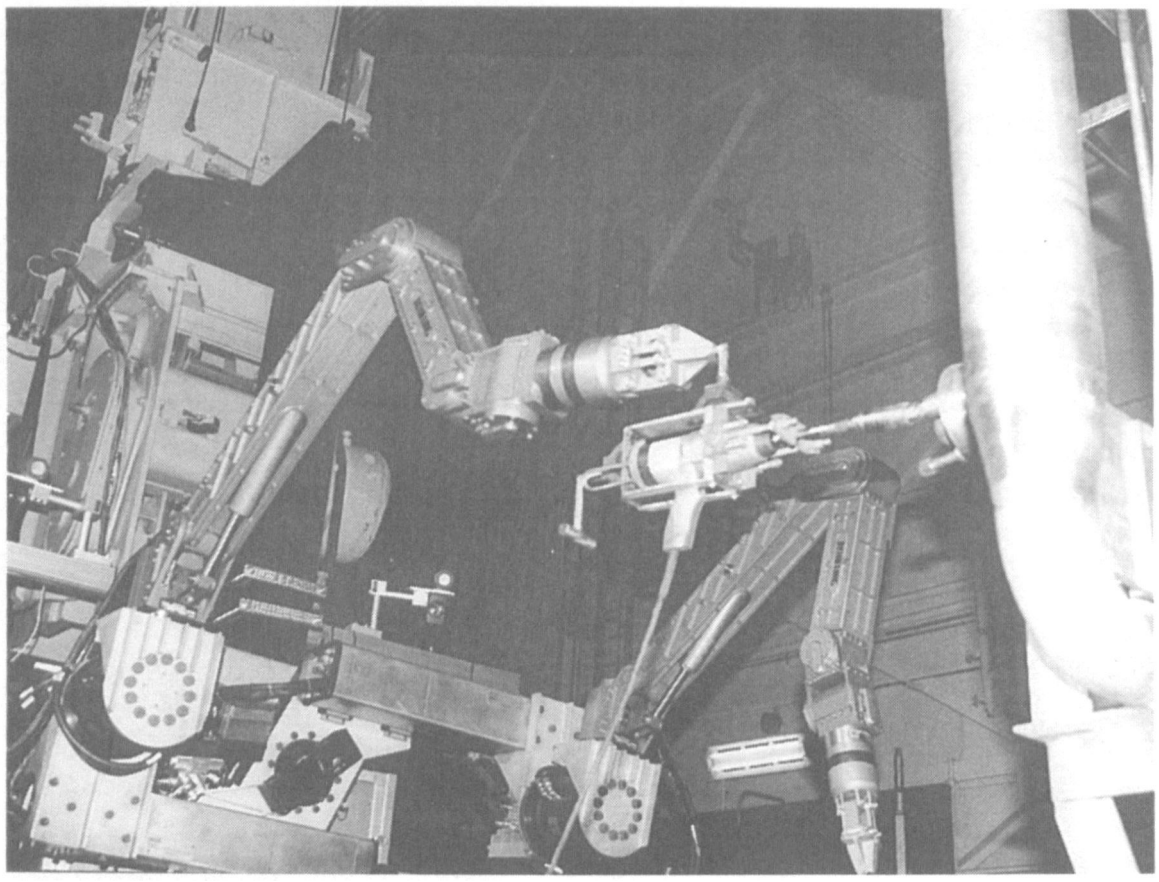

**Figure 3.** The Dual-Arm Work Platform can manipulate a variety of tools and its remote operation removes workers from high radiation environments. Department of Energy photo.

## Reference

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