EVOLUTION AND HISTORY OF THE DEPARTMENT OF ENERGY AND THE OFFICE OF ENVIRONMENTAL MANAGEMENT

THE MANHATTAN PROJECT (1939 – 1947)

From its beginning in 1939 with Enrico Fermi's graphite-pile reactor under the bleachers of Stagg Field at the University of Chicago to the fiery explosion of the first atomic bomb near Alamogordo, New Mexico, the Manhattan Project took a little less than 3 years to create a working atomic bomb. During that time, the U.S. Army Corps of Engineers managed the construction of monumental plants to enrich uranium, three production reactors to make plutonium, and two reprocessing plants to extract plutonium from the reactor fuel. In 1939, Nobel Prize-winning physicist Niels Bohr had argued that building an atomic bomb "can never be done unless you turn the United States into one huge factory." Years later, he told his colleague Edward Teller, "I told you it couldn't be done without turning the whole country into a factory. You have done just that."

At its peak, the nuclear weapons complex in the United States consisted of 16 major facilities, including vast reservations of land in the states of Nevada, Tennessee, Idaho, Washington, and South Carolina. In its diversity, the complex ranged from tracts of isolated desert in Nevada, where weapons were tested, to warehouses in downtown New York that once stored uranium. Its national laboratories in New Mexico and California designed weapons with production of various components in Colorado, Florida, Missouri, Ohio, Tennessee, and Washington.

THE ATOMIC ENERGY COMMISSION (1947 – 1975)

The Atomic Energy Act of l946 established the Atomic Energy Commission, to administer and regulate the production and uses of atomic power. The work of the Commission expanded quickly from building a stockpile of nuclear weapons to investigating peaceful uses of atomic energy (such as research on, and the regulation of, the production of electrical power). It also conducted studies on the health and safety hazards of radioactive materials.

NUCLEAR REGULATORY COMMISSSION AND ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION (1975-1977)

In 1975, the Atomic Energy Commission was replaced by two new federal agencies: the Nuclear Regulatory Commission, which was charged with regulating the civilian uses of atomic energy (mainly commercial nuclear power plants), and the Energy Research and Development Administration, whose duties included the control of the nuclear weapons complex.

DEPARTMENT OF ENERGY (1977-1989)

In 1977, the duties were transferred to the newly created Department of Energy. Individual program offices were responsible for mission and program activities as well as for any cleanup associated with those activities.

EM's HISTORY (1989 – present)

Fifty years of nuclear weapons production and energy research generated millions of gallons of liquid radioactive waste, millions of cubic meters of solid radioactive wastes, thousands of tons of spent nuclear fuel and special nuclear material, along with huge quantities of contaminated soil and water.

One of the largest and most diverse and technically complex environmental cleanup operations in the world, the Office of Environmental Management (EM) Program has a mission to complete the safe cleanup of this environmental legacy.

The EM program was created in 1989 to clean up the radioactive legacy of the Cold War. As of 2012, EM has reduced the number of contaminated sites from 107 sites in 35 states to 17 sites in 11 states. Since 2009 EM has reduced its active footprint by 688 square miles, from 931 square miles to 243 square miles, demonstrating tremendous success in the accelerated cleanup of the Cold War legacy.

In order to execute its mission, EM has ranked, in priority order, those activities with the greatest risk reduction. Safety remains the utmost priority. EM is committed to its safety principles and will continue to maintain and demand the highest safety performance to protect the workers and the communities where it operates.

EM's story has roots in a cold morning in December 1989, when workers at the Rocky Flats Plant in Colorado loaded the last plutonium "trigger" for a nuclear warhead into a tractor trailer bound southeast to the Pantex Plant near Amarillo, Texas. No one knew then that the nuclear weapon built with this plutonium trigger would be the last one made in the United States for the foreseeable future. Until then, the production of nuclear weapons had run continuously, beginning during World War II with the startup of the first reactor to produce plutonium for the top-secret Manhattan Project. But growing concerns about safety and environmental problems had caused various parts of the weapons-producing complex to be shut down in the 1980s. These shutdowns, at first expected to be temporary, became permanent when the Soviet Union dissolved in 1991. The nuclear arms race of the Cold War came to a halt for the first time since the invention of the atomic bomb. Quietly, a new era had begun.

EM'S THREE ERAS

EM's history can best be described in the context of three "eras" shown in the text box and briefly described below.

EM's Historical Eras

1989 through 1994, when focus was on identification, characterization and then actions taken to address the most urgent risks of the environmental contamination from the Manhattan Project and Cold War weapons production and research activities.

1995 through 1999, when focus shifted from identification and characterization to active cleanup where significant progress was made across the EM complex.

2000 through present, when EM continued to projectize and refine active and long-term cleanup programs to more efficiently and effectively manage accelerated cleanup and closure of sites while continuing to reduce life-cycle costs and shorten site completion schedules.

DEFINING THE CHALLENGE (1989-1994)

During this timeframe the extent of the environmental legacy of the Manhattan Project and the Cold War was just beginning to be fully understood and the magnitude of the problems were being addressed for the first time in an open and transparent way to the public. During this era, numerous EM facilities were out of safety and environmental compliance and bringing them into compliance would take years of effort and hundreds of millions or billions of dollars. At the same time, EM and regulators were entering into numerous site-specific environmental compliance agreements that defined the scope and schedule of cleanup work and established dates for coming into compliance with applicable environmental laws, called enforceable milestones. Because the state of characterization and hazards identification was still ongoing during this time frame, many of these agreements were entered into recognizing that there was insufficient or incomplete knowledge or understanding of the full extent of the cleanup challenges, hazards, risks, and extent of contamination. These cleanup challenges required resources including yet-to-be-defined technologies, processes, and schedules to achieve specified end-

states. In some cases end-states had not yet or could not be fully defined based on the lack of characterization of the hazards and risks.

The early years or first era of the EM program were focused on the following actions:

- Identifying and characterizing the scope of the EM cleanup;
- Addressing the most urgent risks;
- Characterizing soils, groundwater, facility contamination, and waste and nuclear materials;
- Developing needed cleanup technologies;
- Maintaining safety at each site;
- Negotiating state and federal environmental compliance agreements; and
- Developing the infrastructure, treatment, transportation, and disposal processes and facilities to deal with the large quantities of radioactive and hazardous waste, nuclear materials and SNF that EM became responsible for.

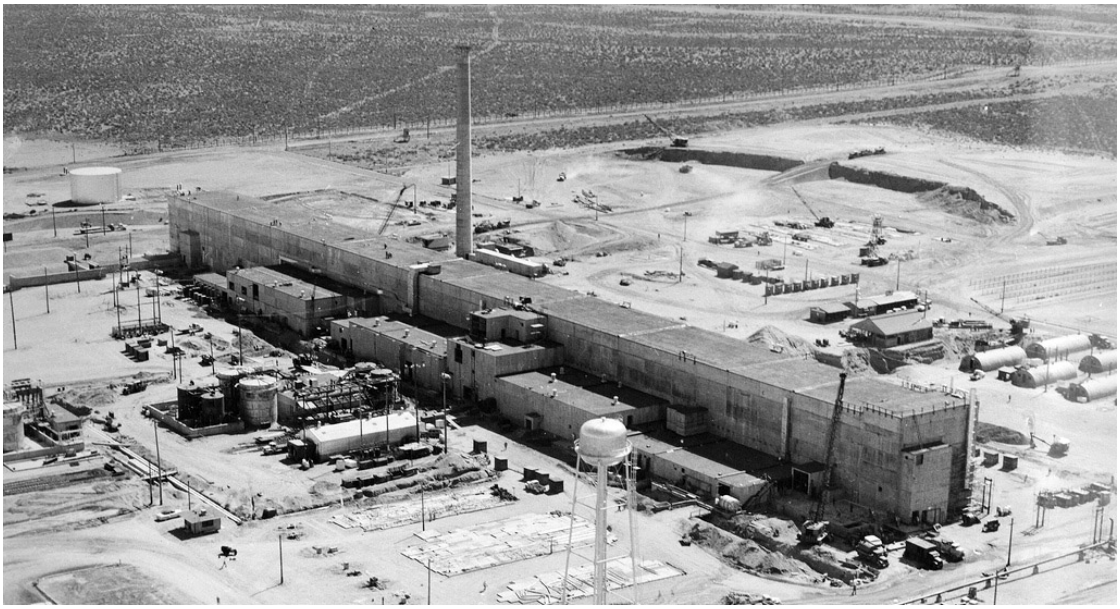
The Former Plutonium Storage Vault at Rocky Flats where Plutonium slated for weapons production was left in place upon permanent shutdown and became a responsibility of EM. The vault was eventually de-inventoried and demolished.

MEASURABLE PROGRESS (1995-1999)

By the mid 1990's, EM had made noteworthy progress in characterizing the extent of contamination and the program began transitioning to active cleanup actions and projects. Many included significant first time actions which had never been accomplished before anywhere in the country, including: Starting vitrification of liquid waste at the Savannah River Site (SRS) and West Valley Demonstration Project (WVDP); completing calcining of liquid waste at the Idaho National Lab (INL); repackaging, transporting and disposing of transuranic (TRU) waste in the nation's first deep geologic repository -- the Waste Isolation Pilot Plant (WIPP); cleaning and closing liquid waste tanks at SRS, WVDP, INL, and the Office of River Protection (ORP); and deactivating the Plutonium Uranium Extraction Plant (PUREX). The PUREX Plant, shown in Figure 2-3, a major nuclear production facility at the Hanford site in Washington, was

the first nuclear processing facility to undergo such an action in the complex. EM also documented the cleanup and closure of 44 other small sites during this timeframe. Also during this era:

- EM issued its first comprehensive life-cycle estimate (the Baseline Environmental Management Report (BEMR)), of the full scope and cost to cleanup the former weapons production complex. EM cleanup program cost was estimated at $200 -$350 billion over a 75-year period.
- Site Ten-Year Plans were developed in 1996 as a new management tool for EM to focus near-term goals and maintain and track life-cycle costs and schedule estimates for the entire EM program.
- EM shifted its paradigm from a long-term 75-year cleanup program to a streamlined and more efficient program with a goal of identifying opportunities to achieve mission completion as rapidly as possible.
- EM focused on eliminating and managing the most urgent risks, while also reducing the EM cleanup footprint.



PUREX Processing Canyon at Hanford (circa 1940's) was the first processing canyon to be deactivated in 1996

EM was determined to reduce the estimated life-cycle costs, challenging sites to identify ways in which a majority of the cleanup could be accomplished within the next 10 years. The stage was set for accelerated site closure leading to the significant achievements detailed in Appendix B & C. In 1997, the Secretary established the Pilot Closure Projects, a bold initiative for the accelerated closure of Rocky Flats and Fernald. Critical success components of the closure strategy were to establish stable funding, gain congressional support, establish a collaborative regulatory framework, and employ new types of incentive-based contracts.

ACCELERATED CLEANUP AND CLOSURE (2000-Present)

As EM moved into its third era of work, a number of new initiatives were put into place to improve how work was performed and managed in the EM portfolio of cleanup projects. Up to this point, many

projects were experiencing cost and schedule growth and Congress continued to challenge EM on these issues. To address these issues the Secretary chartered a top-to-bottom review of the overall status of the program and found a number of areas needing improvement, including contract strategies and approaches; risk prioritization; and internal business practices. In response and to improve the efficiency and effectiveness of the cleanup program during this era:

- EM redeployed, streamlined, or ceased activities that were not directly associated with completing cleanup;
- Cleanup programs were projectized and many level-of-effort activities with a planning assumption of five or more decades were managed as discrete projects to help better identify and manage cost and schedule growth;
- EM issued Five-Year budget planning documents (FY 2007-11 and FY 2008-2012) that defined EM's strategies, funding profiles, and planned accomplishments over the subsequent 5-year period;
- EM applied project management principles to all of its work including independently reviewing, validating, and approving near-term baselines and out-year planning estimate ranges;
- Project contingencies were established for the first time as part of the approved baselines to address project risks in scope, cost or schedule;
- Projects were scheduled for regular reviews by senior EM management using established performance metrics, and EM adopted a disciplined Earned Value Management System. Change control became a rigorous and disciplined process as a result of risk identification, changes in funding, shifting priorities, technology advances or setbacks, and the additions or deletions of work scope; and
- The ARRA program authorized an additional $6 billion for the EM program. EM quickly leveraged the additional ARRA investment in footprint reduction activities that would yield substantial benefits while addressing national economic, environmental, and energy security objectives.

EM Recovery Act Successes

- 5.9 million sq ft of excess facilities demolished (~103 football fields)
- 2.6 million tons of Uranium Mill tailings disposed (~18,277 rail cars)
- 6,950 cubic meters of CH-TRU processed (~33,000 55-gal drums)
- 7,191 cubic meters of TRU Waste dispositioned (~34,539 55-gal drums)
- 98,125 cubic meters of LLW/MLLW permanently disposed (~471,739 55-gal drums).
- 690 square miles of reduced contamination footprint (~size of the greater Washington, D.C.-Baltimore, MD. metropolitan area)

Rocky Flats Closure – Before and After Cleanup

EM's earlier paradigm shift to accelerated closure was successfully demonstrated and achieved with the 2006 successful closure of Rocky Flats in Colorado (Figure 2-4) and in 2007 for the Fernald Site in Ohio. The work at Rocky Flats was completed 14 months ahead of contract schedule and over $500 million under the contract ceiling. Even more impressive was the life-cycle cost savings of $20.5B and schedule acceleration of 44 years for Rocky Flats. Fernald was also a landmark success for EM, saving $7.6 billion of life-cycle cost and cutting the schedule by 12 years. Funds that were planned to be spent over the next four decades to maintain Rocky Flats and Fernald were not spent thereby generating huge savings for the taxpayers.

In August 2011, EM was re-aligned under the Office of the Under Secretary for Nuclear Security. This alignment allows DOE to capitalize on the expertise that exists among the National Nuclear Security Administration (NNSA), the Office of Legacy Management (LM), and the DOE Chief Nuclear Safety Officer in areas of project management, nuclear materials and waste handling, and nuclear safety and security.