Site A/Plot M, Illinois, Decommissioned Reactor Site History

Link to Site A/Plot M, Illinois, Decommissioned Reactor Site Timeline

Defending our nation during World War II meant that many sacrifices would need to be made. In addition to the sacrifices made by the American people, natural resource areas were also yielded to support defense activities. A portion of the Palos Forest Preserve outside of Chicago, Illinois, was one of those areas. The land would be changed to accommodate experimental laboratories, nuclear reactor research, and radioactive waste disposal. Today, however, the area known as Site A/Plot M is a clean, public-recreation area where people can safely spend time hiking, biking, and picnicking.

A Secret Project and Code Name

On August 2, 1939, a month before Germany invaded Poland and started the chain of events that became World War II, Albert Einstein signed a letter to President Franklin D. Roosevelt that was drafted by fellow physicist Leó Szilárd. The letter informed the president about work being conducted by Szilárd and his associates that indicated " . . . the element uranium may be turned into a new and important source of energy in the immediate future." The message stressed that this scientific work could lead to the construction of "extremely powerful bombs." Einstein urged the U.S. government to take action toward securing a supply of uranium ore, and to acquire funding for experimental work and facilities, alluding to the idea that Germany may already be steps ahead of the U.S. in the creation of just such a destructive weapon.

By 1940, researchers at Columbia University and the University of California had made considerable progress in understanding the phenomenon of nuclear fission and had identified its potential as a weapon of mass destruction. On June 28, 1941, the Office of Scientific Research and Development was established to develop atomic weapons. President Roosevelt tasked the U.S. Army Corp of Engineers (USACE) Manhattan District (also referred to as the Manhattan Project) with developing large-scale facilities that could mass produce the material needed to make atomic bombs.

On December 6, 1941, only 1 day before the Japanese attack on Pearl Harbor, the president officially authorized the creation of a nuclear bomb. The attack on U.S. troops had increased the urgency to develop the powerful weapon.

To accelerate the technology necessary for creating the atom bomb, researchers led by Nobel laureate Arthur Compton, created the Metallurgical Laboratory at the University of Chicago. The Metallurgical Laboratory, referred to as Met Lab, was the cover name for the central location where scientists from the east and west coasts gathered to conduct secret research on the Manhattan Project.

Location of Site A/Plot M, Illinois, Decommissioned Reactor Site

A Goal Achieved

By mid-1942, Manhattan Project scientists had defined four processes for producing fissionable material—gaseous diffusion, centrifuge, electromagnetic uranium isotope separation, and the plutonium-producing pile (reactor)—but none seemed to offer a clear advantage over the others, and the scarcity of materials, undeveloped technology, and shortage of time created barriers to the development of all four processes.

In September 1942, USACE Colonel Leslie R. Groves was appointed Commander of the Manhattan Project, then quickly promoted to Brigadier General. Asserting his new position, Groves made it clear that by the end of the year a decision would be made to determine which process would be used to produce the material necessary for making an atomic bomb. Groves understood the urgency of the situation. No one knew how far along the Germans and Japanese were in developing their own atomic weapons. Thus, the decision would be based on the process that would produce a bomb in the shortest amount of time.

Groves's accelerated timetable forced a consensus among Met Lab scientists, who determined that plutonium would be the bomb's explosive material.

The objectives were to 1) develop a chain-reacting "pile" of uranium pellets and graphite blocks for plutonium production, 2) devise methods for extracting plutonium from uranium-238 irradiated with neutrons, and 3) design the blueprint for an atomic weapon. The reactor pile, named CP-1 (for Chicago Pile No. 1), was assembled under the supervision of an associate of Szilárd, renowned physicist Enrico Fermi. The small pile would not have shielding or cooling but would be able to achieve the objective of a self-sustaining, nuclear chain reaction.

Fermi and his team built the CP-1 reactor under the west stands of Stagg Field, the University of Chicago's abandoned football stadium. At the end of production, CP-1 was comprised of 40,000 graphite blocks; 19,000 pieces of uranium metal; uranium-oxide fuel; and three cadmium control rods. The Met Lab team was ready to set the date for the reactor test.

The Italian Navigator Lands

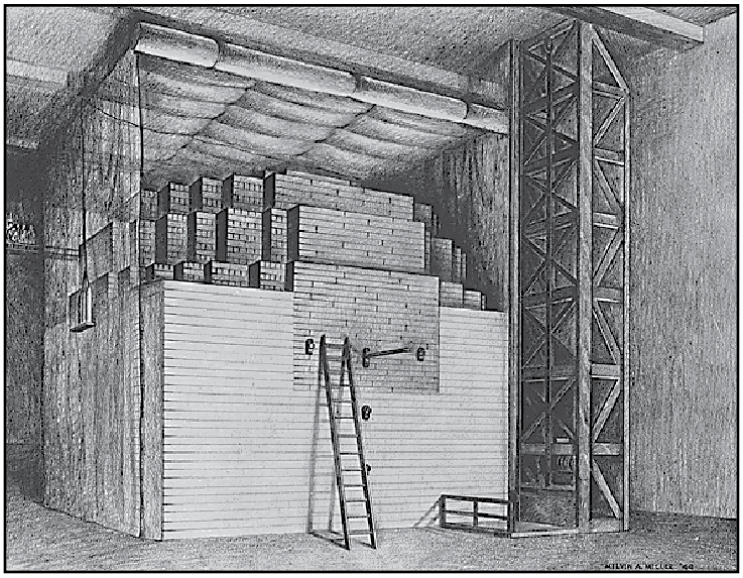
On December 2, 1942, a group of dignitaries assembled to witness the demonstration of CP-1. At 3:25 p.m. Fermi and his team created the world's first self-sustaining, nuclear chain reaction using the CP-1 reactor under Stagg Field. After observing the chain reaction, Arthur Compton, the head of Met Lab, placed an informative call to James Conant, chairman of the National Defense Research Committee. Their brief conversation was in an unrehearsed code:

Compton: "The Italian Navigator [Enrico Fermi] has landed in the New World."

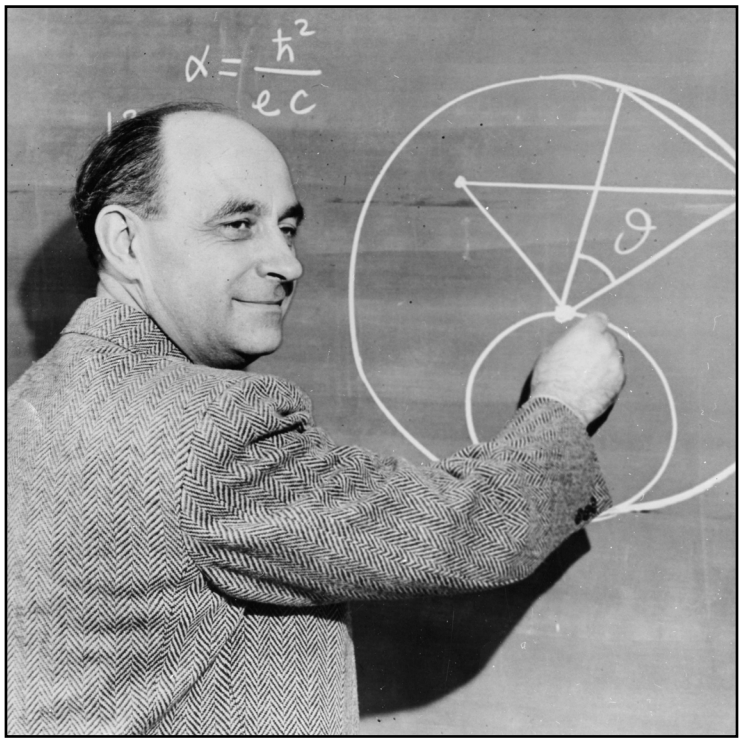
Conant: "How were the natives?"

Compton: "Very friendly."

Although the Italian Navigator had produced only one-half watt of power with his demonstration, the achievement had altered the course of history.



Artist's Drawing of CP-1
Source: DOE Office of History and Resources



Enrico Fermi

Site A/Plot M

General Groves declared that operations would be moved from under Stagg Field to a USACE-leased area of land in the Red Gate Woods section of the Palos Forest Preserve, the future location of the original Argonne Laboratory. CP-1 was dismantled, transported, and reassembled (with a shield added) at the new area, dubbed Site A, which encompassed 19 acres in the Argonne Forest (named after a World War I allied victory in the French forest of Argonne), and renamed Chicago Pile 2 (CP-2).

In 1943, a second reactor was created at Site A. This version was a uranium-fueled, heavy-water-moderated reactor. The model was given the name Chicago Pile 3 (CP-3). Both CP-1 and CP-2 had been uranium-fueled, graphite-moderated reactors. Among the research programs carried out at Site A were reactor physics studies, fission product separations, tritium recovery from irradiated lithium, and work related to the metabolism of radionuclides in laboratory animals. The site eventually had an estimated 35 support buildings, including laboratories, dormitories, a cafeteria, dog kennels, and a lead foundry.

Research at Site A generated radioactive and other waste, and it became necessary to create a waste disposal area nearby. Plot M was a 150-foot by 140-foot area approximately 1,500 feet north of Site A. The 1940s method of nuclear-waste disposal consisted of digging a 6-foot-deep trench, dumping the waste, and backfilling the trench with soil. In 1948, more stringent standards for hazardous-waste disposal required that materials be placed in steel bins before burial. The steel bins were later removed from Plot M and shipped to other federal facilities for disposal.

CP-2 Building

After World War II ended, the Manhattan Engineer District transferred from military to civilian control and became the U.S. Atomic Energy Commission (AEC). The newly formed AEC assumed responsibility for all fissionable material and atomic research and weapons facilities, including Site A and Plot M.

Operations at Site A continued until May 15, 1954, when the reactors were decommissioned. Reactor fuel and heavy water that had been used for neutron moderation and reactor cooling were removed and shipped to the Oak Ridge National Laboratory in Tennessee. The biological shield of CP-3 and other low-level waste were buried in place at Site A. To accomplish this, the waste was placed inside the shield, and the entire structure was equipped with strategically placed explosives. Upon detonation, the shield and its contents toppled into a 40-foot-deep trench that had been excavated adjacent to the structure. When CP-3 collapsed, it landed upside down inside the trench where it was entombed under concrete. The burial site was covered with soil, landscaped, and marked with a stone monument.

After the remaining project buildings were demolished and disposed of, a radioactivity survey of the area was conducted, and no contamination above natural background levels was detected. The site was officially closed in 1956.

Materials disposal at Plot M caused the area to be declared a hazardous waste site in 1956. AEC decided to encapsulate the potentially hazardous materials with an inverted concrete box. The 1-foot thick box is buried 8 feet underground, acting as a barrier to groundwater and preventing migration of contamination. The structure also prevents animals from burrowing into radioactive disposal material. The concrete box was covered with topsoil and seeded, and a stone monument was placed to mark the location of Plot M.

Radiation-detection instruments were used to survey the area after disposal activities were completed and no contamination above natural background levels was detected.

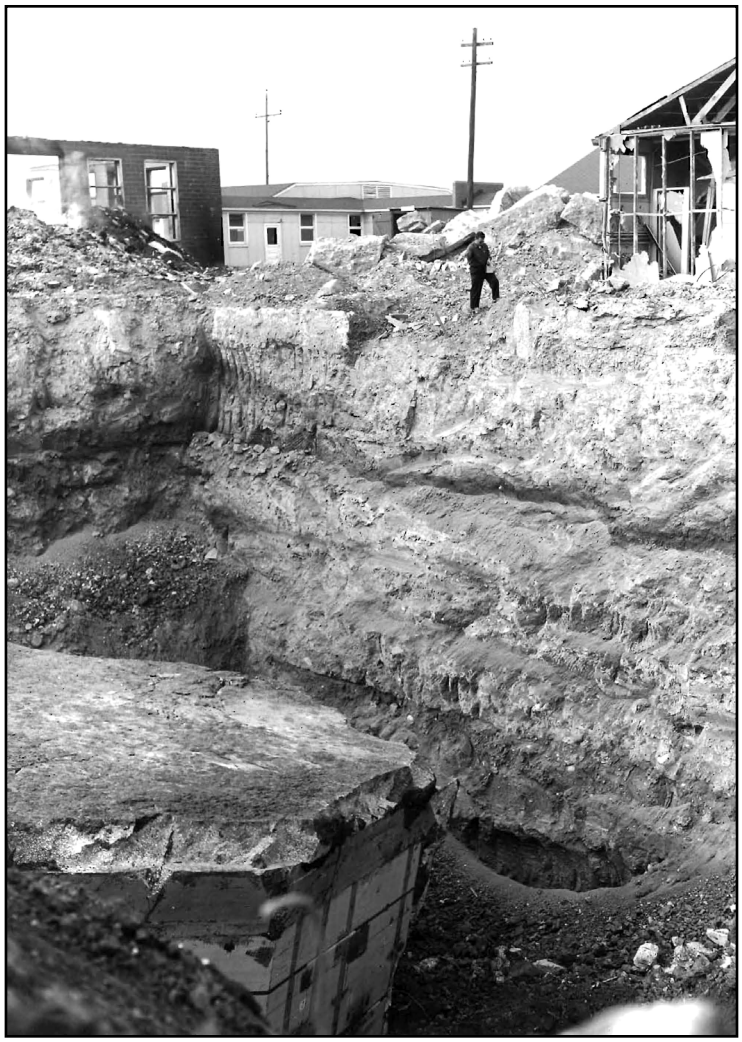
The Burial

As Argonne's experiments grew in scope and its facilities grew in area, AEC realized that more property would be needed to continue operations. Suitable land was identified 6 miles northwest of Site A—the location is still the site of Argonne National Laboratory. AEC returned the land that had been leased back to the Palos Forest Preserve. AEC successor agencies, the Energy Research and Development Administration (ERDA, 1975 to 1977), and the U.S. Department of Energy (DOE, 1975 to present) would assume responsibility for continued monitoring of the site for any potential hazards.

Post-Burial Monitoring

In 1973, AEC decided to include the nearby Red Gate Woods picnic wells in the environmental survey. Low amounts of tritium were discovered in a picnic well near Site A and Plot M. After an investigation in 1975, AEC reported low levels of tritium in three area wells.

AEC successor, ERDA, conducted detailed radiological surveys in 1976 and 1977 to document the site's condition, determine the tritium source, determine if other radioactive



CP-3 Surveying After Blast, Circa 1950

materials were migrating through the site groundwater, and consider possible corrective actions.

The 1976 and 1977 surveys had several objectives:

- Collect water samples from all existing wells and analyze them for radionuclides
- Collect samples of soil borings and surface soil and analyze them for radionuclides
- Drill several additional wells to measure radio-activity and to determine hydrologic properties of the aquifer, including the rate and direction of groundwater flow

Tritium was shown to be the only laboratory-related radioactive material that had migrated.

In 1979, DOE (successor to ERDA), Argonne National Laboratory, and several independent parties participated in an engineering study to decide what to do about the buried waste. The two best options were to either (1) leave the waste in place and monitor the area, or (2) remove the waste. Removing the waste could expose workers to unacceptable levels of radiation while they were digging, loading, and hauling the materials. DOE assessed the sites and concluded that leaving the contamination in place would not pose unacceptable risks to human health or the environment. DOE has conducted annual environmental surveys at the burial site since 1979. In May 1990, the Illinois Department of Nuclear Safety conducted routine oversight monitoring at Site A and uncovered debris, which included a piece of uranium metal. They concluded that this area was a forgotten sanitary landfill that had been exposed by natural weathering of the area.

DOE conducted several studies to characterize Site A and to search the area for any other debris. The studies identified "investigation groupings" and "suspect areas" from historical knowledge of Site A and Plot M. Areas were sampled and analyzed for both radiological and chemical constituents.

The investigations determined that surface soils in two suspect areas (suspect area 3 and suspect area 4) at Site A contained radioactivity above natural back-ground levels. A number of physical hazards were also identified (e.g., pipes protruding from the ground, concrete rubble).

USACE removed all physical hazards in 1995, including concrete debris from former building foundations, various pieces of protruding pipes, manholes, and other construction rubble. In 1997, a voluntary removal action of contaminated soil and debris was completed at Site A. Approximately 360 cubic yards of contaminated soil were excavated. An additional 140 cubic yards of debris, consisting primarily of graphite blocks, were removed. The soil and debris were mixed with cement and shipped to DOE's Hanford site near Richland, Washington, for disposal.

Marker at Plot M

Aerial photograph of Site A at Beginning of Decommission

Marker at Site A

Contacts

Documents related to the Site A/Plot M site are available on the LM website at http://www.lm.doe.gov/sitea_plotm/Sites.aspx.

For more information about LM activities at Site A/Plot M Site, contact:

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