

**The Walls Come Tumblin' Down:
Decontamination and Demolition of 29 Manhattan Project and Cold War-Era
Buildings and Structures at Los Alamos National Laboratory-12301**

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ABSTRACT

When the nation's top scientists and military leaders converged on Los Alamos, New Mexico in the 1943, to work on the Manhattan Project, the facilities they used to conduct their top-secret work were quickly constructed and located in the middle of what eventually became the Los Alamos town site. After one of these early facilities caught on fire, it seemed wise to build labs and production facilities farther away from the homes of the town's residents. They chose to build facilities on what was then known as Delta Prime (DP) Mesa and called it Technical Area 21, or TA-21. With wartime urgency, a number of buildings were built at TA-21, some in as little as a few months. Before long, DP Mesa was populated with several nondescript metal and cinderblock buildings, including what became, immediately following the war, the world's first plutonium production facility. TA-21 also housed labs that used hazardous chemicals and analyzed americium, tritium and plutonium. TA-21 was a bustling center of research and production for the next several decades. Additional buildings were built there in the 1960s, but by the 1990s many of them had reached the end of their service lives. Labs and offices were moved to newer, more modern buildings. When Los Alamos National Laboratory received \$212 million in funding from the American Recovery and Reinvestment Act in July 2009 for environmental cleanup projects, about \$73 million of the funds were earmarked to decontaminate and demolish 21 of the old buildings at TA-21.

INTRODUCTION

Technical Area 21 (TA-21), also known as Delta Prime (DP) site, is located on an approximately 40.5 hectare (100 acre) mesa top adjacent to the Los Alamos town site. Los Alamos Canyon is directly to the south. The mesa's only connection to the town site is via DP Road (Fig. 1). Adjacent properties include municipal land and private properties in a local commercial zone on DP Road. The Los Alamos municipal airport and State Road 502 (the main entrance to Los Alamos) are located to the north on the other side of DP Canyon.

In January of 1945, a fire occurred in the C-Building shop of the original Los Alamos technical area. The technical area primarily consisted of a cluster of wood framed buildings that were quickly constructed, by the Army Corp of Engineers during World War II, to support the establishment of the laboratory and the Manhattan Project. The new lab was adjacent to Ashley Pond and very close to administrative buildings, housing, and the water supply of the newly formed community. The fire raised concerns that a similar event in one of the other technical area buildings, where experiments with hazardous chemicals and radioactive materials were being conducted, could result in a risk to the community and loss of access to these buildings.

This event led laboratory management to relocate much of their technical and growing production operations away from the immediate town site to a then more remote location. New laboratories and facilities were constructed in a manner that would be more resistant to fire. The construction technique was generally to build on concrete slabs with metal framing and

siding and roofing material of sheet metal. Rock wool was used for insulation, and where necessary supporting structures were constructed of concrete block or poured concrete. The initial phase of construction was completed in 1945 and 1946. Over time some facilities were renovated and in the 1960s over 5,574 m² (60,000 ft²) of new offices, laboratories and additional production facilities were added.

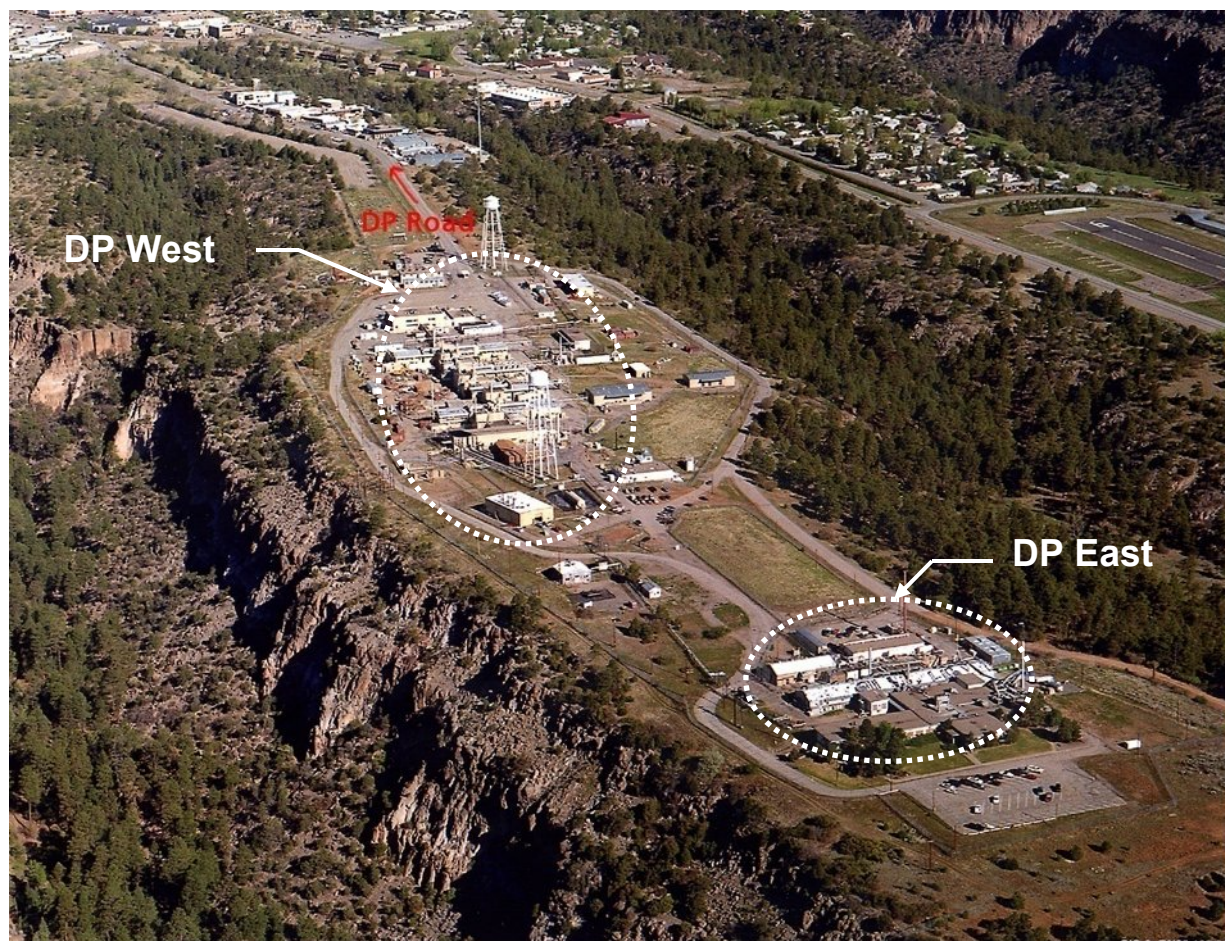


Figure 1. Aerial view of TA 21 circa 1995. DP Road enters TA-21 at the top left of the photo.

TA-21 contained over three dozen buildings and structures that supported the nation's defense program. The DP Site is geographically divided into two areas DP West and DP East. Facilities in DP West were used for plutonium and uranium metals research and production. Facilities in the DP East were initially used for polonium research and production. Later they were used for actinide research and several other small projects. Additionally in the 1960s a five structure complex was added for non-defense related tritium research and production. It was called the Tritium Systems Test and Assembly (TSTA) facility. Some of the buildings had been partially deactivated with systems, equipment, and process materials removed and contamination stabilized. Others had been unused for several years but still contained considerable equipment. A few were still being utilized as recently as 2006. Two wings in the DP West complex had been partially demolished in the late 1990s. None of the remaining TA-21 buildings were ever completely deactivated or placed in a safe shutdown condition.

BACKGROUND

In 2006, the TA-21 Closure Project was established to remediate material disposal areas (buried landfills), clean up over two dozen Solid Waste Management Units (SWMU) resulting from past practices and releases, and demolition of certain buildings and structures across the mesa. The cleanup of disposal units and SWMUs was being performed in accordance with the Compliance Order on Consent (Consent Order) with the New Mexico Environment Department (NMED) and 10 CFR 830, "Nuclear Safety". The building demolition was not subject to regulation by the state under the Consent Order, but was important to gaining access to state regulated SWMUs adjacent to or beneath the buildings.

Between 2006 and 2009, the closure project was supported by annual DOE-EM defense programs cleanup funding and conducted planning, investigation and clean up of material disposal areas and SWMUs. Additionally characterization of the buildings in the DP West area was completed and one attempt was made to procure services to initiate building demolition. However, building demolition was postponed in order to use the funding of other near-term compliance related cleanup activities under the Consent Order. There was also a modest annual effort underway to reduce the tritium inventory in the TSTA facility (i.e., by removing and disposing the highest level tritium containing systems) using DOE-EM non-defense programs cleanup funds.

In early 2009, Los Alamos National Laboratory proposed several projects for the application of funding from the recently passed American Recovery and Reinvestment Act (ARRA). To qualify for this funding the cleanup projects needed to be "shovel ready", be associated with regulatory mandated cleanup, show a significant footprint reduction and skyline change, and most importantly quickly create new jobs. TA-21 Closure Project received ARRA funding to demolish buildings at DP Site and remediate an adjacent radioactive material disposal landfill. Because of the substantial amount of funding (\$212 million) and the short period of performance set by DOE-EM for ARRA work, the closure project was divided up into subprojects with an overarching ARRA management organization. The TA-21 ARRA Decontamination and Demolition (D&D) Project was formed to execute building demolition at the DP Site. The initially proposed scope was to remove all of the buildings and structures contained in the DOE-EM performance management baseline (PMB), including removal of underlying slabs and sub-grade structures and soil cleanup in both the DP West and East areas. There were a small number of other buildings on the mesa that were not associated with SWMUs, not in the PMB, and were the responsibility of the laboratory.

During the startup of the ARRA project, as the various subprojects plans and schedules were being validated and approved by DOE, approximately \$40 million of ARRA building demolition funds were re-obligated to install compliance related groundwater monitoring wells. This caused the overall scope of the D&D project to be reduced. ARRA funding for LANL cleanup was released in July of 2009. The approved baseline included removal of all buildings, sub-grade structures and soil cleanup in the DP East area, and removal of most buildings to their on-grade slabs in the DP West area.

BEING AND STAYING "SHOVEL READY"

In order to be "shovel ready" and meet the ARRA goal of completing all work by the end of fiscal year 2011, the project created a self-performance team utilizing resources from the laboratory's maintenance and construction organizations. The intention was to use this team to prepare and

demolish four non-contaminated buildings while procurements were being put into place to engage the services of subcontractor's experienced in contaminated building demolition. The formation, training, and planning for initial demolition by this LANL self-perform team was supported by a small amount of non-ARRA funds and then transitioned to ARRA funding for the demolition and waste disposal activities.

A \$100 million master task order agreement (MTOA) to provide remedial action and decontamination and demolition services was prepared and proposals were requested from the small business subcontractor community. Eleven organizations responded to the request for proposals and following a competitive evaluation of their bids, four small business contractors were selected on the basis of their technical qualifications. Each of the four pre-selected contractors were able to bid on specific decontamination and demolition (D&D) task orders on a fixed price/fixed unit rate basis. This allowed them to control their profit margins by performing the work more efficiently, and allowed LANL to obtain up to date competitive pricing. It also allowed the work to be broken down into smaller tasks (e.g. equipment removal, hazardous waste abatement, demolition and waste packaging) for efficient sequencing and separated geographically (e.g. DP East, DP West) to optimize execution scheduling.

Anticipating that cost savings would be achieved through the subcontracting process, another procurement strategy employed was to bid some tasks for unfunded optional work. This allowed new work to immediately be available for release if and when the savings were achieved. It had the added benefit of avoiding the additional cost and schedule delays for contractor de-mobilization and re-mobilization.

Prior to receipt of ARRA funds, a deactivation activity was underway in the TSTA facility using a small business already under subcontract. The D&D Project elected to extend this subcontractor's period of performance and continue the building strip-out progress until the MTOA was in place and a subcontract for building demolition was awarded. This supported accelerated schedule performance and allowed the TSTA project to be completed in the first year of ARRA work. This project was among the first DOE ARRA projects completed.

DEACTIVATION AND SAFE SHUTDOWN

The various facilities at TA-21 were in differing states of deactivation and shutdown. Some had equipment removed and radiological fixatives applied to prevent the spread of contamination. Others retained their original operating equipment and supporting systems. All still had electrical energy supplied to them. Several had pressurized liquid systems (primarily fire suppression) still active. A complete baseline of the hazards in each facility did not exist.

Because of the age of these facilities (dating from 1945) the accuracy of existing drawings was always suspect. The D&D Project took specific steps to insure that deactivation, hazardous material abatement and demolition activities could be safely performed. An engineering driven process was put in place that included independent verification to insure that all energy sources (e.g. electrical, mechanical, hydraulic/pneumatic, chemical, and thermal) were removed from each building before any abatement or demolition work was allowed to be performed. Following a review of all available building documents, plans, and drawings, all electrical and mechanical energy was removed from the buildings by air gapping and capping building infrastructure systems. A portfolio was assembled for each building showing the sources of energy and where it was disconnected. Once the physical work was completed, a second independent verification of the isolation was completed.

Once each building was de-energized, a separate, clearly marked, portable temporary power distribution system was installed to support deactivation, abatement, and equipment removal tasks. Only then was subcontracted D&D work allowed to begin.

CHARACTERIZATION

Prior to starting any D&D work, LANL attempted to gather as much process knowledge from the buildings as possible. Based on this process knowledge; radiological, chemical, and physical characterization was performed to the maximum extent that funding allowed.

A characterization study of DP West buildings was performed (circa 2006). This effort involved a comprehensive radiological characterization (fixed, removable, and volumetric surveys and sampling) on all interior and exterior building surfaces and processing equipment (e.g., acid waste system, radioactive waste system, gloveboxes, and exhaust ventilation systems). This characterization effort also included asbestos and chemical sampling (e.g., friable and non-friable asbestos, lead, PCBs, and hazardous metals). Physical hazards and other potential waste stream hazards were also identified such as: confined spaces, stored energy sources, unsafe access ladders, mercury or PCB containing equipment (e.g. PCB containing light ballasts and bulbs; mercury containing thermostats, barometers, and manometers) lead batteries, used equipment oil, aerosol cans, compressed gas cylinders, circuit boards, and tritium containing exit signs.

DP East and TSTA facility characterization data were generated when operations were ceased and buildings were placed into standby mode (or turned over for long term surveillance and maintenance).

All available characterization information was provided to MTOA bidding subcontractors. The winning subcontractors were also directed to complete any characterization efforts required to fill data gaps before initiation of abatement and demolition field work. Robust use of existing characterization information reduced the overall expense of D&D by not duplicating or re-performing characterization where information already existed from previous efforts. Characterization information was a vital ingredient in safely and efficiently conducting the D&D work, from a worker safety, and environmental protection standpoint, as well as a waste management standpoint. Adequate characterization data ensured that worker health and safety controls were properly established, and environment controls were acceptable. Adequate characterization data were also required for proper waste management, and meeting the waste disposal site requirements. The characterization process was a continuous effort that took place at every D&D step. For example, after equipment stripout was completed and before building demolition began, another complete radiological and chemical characterization was completed. And then after building demolition was completed and associated waste packaged, another characterization of under-building soils was performed.

BUILDING DEMOLITION

Building demolition proceeded in two stages. The first stage was to abate any asbestos and hazardous materials (e.g. lead, PCB, acids/acid systems, mercury). Where appropriate, this stage included the removal of radioactive holdup materials in process or HVAC systems and the application of fixatives that would support the demolition of primary structures in open air.

In some cases, partial abatement was more efficient than complete abatement. An example of this would be demolition of a structure that was primarily industrial waste but contained non-friable asbestos in the stucco siding. In this case, considering the small size of the building, it was more cost effective to demolish the building and package the waste with the asbestos commingled with the industrial waste.

In another case, it was possible to remove non-friable asbestos in roofing mastic and segregate it during the structural demolition. Similar methods were used at times for non-radiological areas of some buildings, effectively segregating construction debris into industrial and radiological (Low Level Waste/LLW) waste streams and minimizing costly transport and disposal of LLW.

Once abatement was completed, demolition of the primary structure could proceed using excavators equipped with grapples and/or shear attachments. Most structures were one to two stories in height. Long-reach excavators were used to slowly collapse structures to grade and to strip concrete and masonry from steel framing. The shears were used to separate large pieces of metal from the structure and to size reduce waste for efficient packaging.



Figure 2. Building demolition using excavators equipped with grapples and shears.

Dust mitigation equipment was extensively used during structural demolition to prevent contaminants from escaping the exclusion zone. Remotely controlled fog cannons and fire hoses with fog nozzles were employed with great success. While approximately 16,260 m² (175,000 ft²) of structures demolished were contaminated with radioactive materials, continuous air sampling around the project perimeter demonstrated that no measurable airborne radioactivity left the site.



Figure 3. Dust suppression using a fire hose.

WASTE SEGREGATION, PACKAGING AND DISPOSAL

In addition to competitive contracting, additional cost savings—which amounted to about 8.5 percent of the overall D&D costs—were realized due to efficient segregation of the waste generated during building stripout and demolition. By executing a successful abatement program, the volume of hazardous and mixed low level waste was minimized. Further efficiencies were achieved by minimizing the amount of demolition debris classified as LLW. Several buildings combined operational/laboratory areas as well as administrative areas making demolition debris segregation an option to yield cost efficiencies.

One 3,159 m² (34,000 ft²) building was initially estimated to require disposal as a radiological facility. The assumption was that all demolition waste would be disposed of as low level radioactive waste. By selectively stripping out contaminated equipment, systems, and interior walls from the building, and then performing localized surface decontamination prior to demolition, the entire building shell was able to be classified as industrial waste. In addition, careful characterization of the building's concrete walls and slabs (also confirmed as non-radioactive) allowed a significant amount of this material to be rubbleized and reused as clean backfill for the project. This was done by demonstrating that the remaining structure would meet the State of New Mexico administrative code definition of construction debris and could therefore be buried on-site. Additional costs associated with extra surveys, coring of the slab and analysis of extra samples were overcome by savings achieved by limiting demolition and avoiding additional waste transport and disposal. Overall, the project avoided costs in the vicinity of \$2 million by using this approach.

Aggressive waste characterization and segregation not only minimized waste disposal costs, but resulted in a substantial increase in the amount of clean material that could be recycled, or salvaged. Metal from areas of the building that were never in radiological controlled areas were carefully characterized and segregated before, or during demolition, and packaged and shipped to a local metal recycling facility. Metal recycling included such items as structural support

beams and frames, wall studs, HVAC equipment and ducting, piping systems, wire, metal stairways, galvanized fencing, and tanks. Additionally, several metal items were salvaged for reuse, such as a diesel powered emergency backup generator, two large nitrogen storage tanks, two large air compressors, a large unused training glovebox, and a large HVAC boiler. By the end of the project, over a million pounds of clean metal was either recycled or salvaged during building demolition.

In preparation for the ARRA cleanup activities at LANL, an additional \$100 million master task order agreement (MTOA) to provide waste transportation and disposal services was prepared, proposals requested from the small business subcontractor community, and an award made. This subcontract was used to transport industrial, asbestos containing, mixed low level and low level radioactive waste to disposal facilities in Utah, Idaho, and Colorado.

Additionally, a small amount of lightly contaminated radioactive waste (concrete and masonry) that met the waste acceptance criteria (WAC) for attic space material over a closed operational waste cell, at LANL Technical Area 54, was disposed of locally. This efficiency avoided additional LLW transportation and disposal costs. It had the added benefit to the LANL cleanup program of avoiding costs of trucking in clean fill to fill the waste cell attic space.

BUT WAIT, THERE'S MORE

In addition to the buildings whose demolition was supported by the DOE-EM ARRA cleanup baseline, there were also a half-dozen buildings and structures on the DP Mesa that were the responsibility of the Laboratory (whose removal would ultimately have to be funded by DOE-NNSA). The TA-21 D&D Project presented a proposal to the laboratory NNSA funds manager to remove additional buildings using the (now experienced and already mobilized) small business demolition contractors and efficiencies of the ARRA MTOA. This permitted additional price competition and further mobilization/de-mobilization cost avoidance. As a result, an additional 1,395 m² (15,000 ft²) of non-contaminated building foot print was removed for slightly over \$2 million. Because these additional buildings were uncontaminated, the demolition task order was modified to allow the subcontractor to take economic advantage of equipment salvage and metal recycling where it was appropriate. This further improved the economic efficiency of each task.

With savings realized through competitive contracting, careful waste segregation and recycling, the team decontaminated and demolished an additional three buildings and three ancillary structures, further cleaning up TA-21 and restoring the mesa for potential land transfer and reuse.

RESULTS

Although some D&D of TA-21 buildings was performed in the 1990s, many of the facilities at DP Site remained relatively untouched for nearly three decades following their final operational use. In 2006, there were over three dozen buildings or structures on the mesa to be removed so that soil cleanup could be completed (and the land made available for transfer and reuse). The total footprint of buildings across the mesa was approximately 18,580 m² (200,000 ft²).

The initially approved baseline for the ARRA D&D Project was to remove 22 buildings and structures that included approximately 14,680 m² (158,000 ft²) of footprint. By employing efficiencies during subcontracting, demolition, and waste segregation, the savings allowed an

additional 1,580 m² (17,000 ft²) of footprint to be removed using ARRA funds. Additionally, the lessons learned from this experience were used to apply NNSA funding to the removal of six additional non-contaminated buildings and structures. In the end, 29 buildings and structures, including stacks, cooling towers and tanks, were removed from the mesa. The entire DP East area was cleared of buildings and sub-grade structures and the soils cleaned to residential standards. The total footprint reduction at TA-21 as a result of this effort was in excess of 17,650 m² (190,000 ft²).

The use of a Laboratory self-performance team to start demolition of non-contaminated structures resulted in steady work performance early in the project while subcontracts were being put in place to perform more complicated abatement and contaminated demolition activities. Most importantly, there were no serious worker injuries and the minor injuries recorded were those common to construction type activities. Extensive monitoring along the site boundary demonstrated that no hazardous chemicals or radioactive contamination were released and radiological dose to the public was negligible. The ARRA demolition activities were completed six months in advance of the deadline for employing ARRA funds. Additionally, over 17,585 m³ (23,000 yds³) of building demolition debris was safely removed from DP Mesa.

Figure 4 shows the striking change this effort made to TA-21. All of the major buildings have been removed, unencumbered access to the SWMUs that are required to be cleaned up by the Consent Order with the state of New Mexico, has been achieved, and a significant portion of the mesa has been prepared to support a process that will eventually transfer this land from federal government control for further use.



Figure 4. Overhead view of TA 21 (circa 2011) after building demolition.