

REMEDIATION OF AN UMTRA VICINITY PROPERTY CONTAINING MIXED WASTES

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ABSTRACT

The U.S. Department of Energy (DOE) Grand Junction Office substantially completed remediation of more than 4,000 Uranium Mill Tailings Remedial Action (UMTRA) vicinity properties in 1998. One of the most complex properties involved a drum-recycling operation with lead, organic compound, uranium oxide, and uranium mill tailings contamination. After the hazardous waste present on this site was identified as a health risk to the public, the U.S. Environmental Protection Agency (EPA) designated the drum-recycling site as a Superfund site. EPA, the Colorado Department of Public Health and Environment, and DOE jointly resolved the regulatory issues and mitigated the health hazards at this site. EPA removed more than 27,000 drums from the site and stabilized more than 6,500 cubic meters of lead-contaminated soil; DOE remediated 20,000 cubic meters of radiologically contaminated soil. This cleanup work was performed in multiple phases as wastes were identified, treated, and subsequently removed from the site.

INTRODUCTION

In 1981, the U.S. Department of Energy Grand Junction Office (DOE-GJO) was assigned the Uranium Mill Tailings Remedial Action (UMTRA) Grand Junction Vicinity Properties (GJVP) Project. This project required planning, characterization, design, and remediation of more than 4,000 properties in and around Grand Junction, Colorado.

These properties were contaminated with radioactive uranium mill tailings as a result of milling operations conducted for the U.S. Government during the 1950s and 1960s. Subsequently, the mill tailings were used by the community as backfill in construction projects, as a substitute for sand in concrete and mortar, and as a sandy loam admixture in native soil to enhance the growth of gardens and lawns. Later investigations by the U.S. Environmental Protection Agency (EPA) determined that uranium mill tailings emitted a gas (radon) which presented potential health problems and that remedial action should be conducted. Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) in 1978 that authorized DOE to remediate and to permanently dispose of the radioactive mill tailings that were spread throughout the southwestern United States.

GJO and its contractors were given the monumental task of planning and performing the remedial action of more than 4,000 residences and businesses, the largest such remedial action project of its kind. These properties, some containing hazardous waste

commingled with mill tailings, included heavy and light commercial businesses, private residences, municipal landfills, and vacant land. This project was substantially completed in 1998 when the last truckload of tailings was shipped to the Cheney Disposal Cell. One of the most complex properties in the project involved a drum-recycling operation where lead, organic compounds, uranium oxide, and uranium mill tailings were identified.

SITE DESCRIPTION AND HISTORY

The drum-recycling operation was located on a 15-acre parcel adjacent to downtown Grand Junction. This parcel is bordered by a railroad yard to the north and east, vacant land to the south, and a residential area to the west. The Colorado River is located within several hundred yards of the south end of the site. The drum-recycling operation occupied the northern two-thirds of the site, while a tenant operated an auto salvage and junkyard on the southern one-third.

The facility was in operation from the mid-1950s to January 1991. Facility operators had permits to store low-level radioactive waste and to operate an incinerator. Site structures consisted of one large main building (1,860 square meters) that housed the incinerator and other large equipment and several smaller buildings and sheds. Thousands of drums (estimated as high as 200,000) were stored on the site at any one time. Recycling operations consisted of incinerating partially cleaned drums, followed by bead blasting with lead pellets to prepare the drums for painting. Drums were then spray painted and dried with gas jets.

During the facility's operation during the late 1980s and early 1990s, observations made by different government entities showed that

- The incinerator did not operate at a sufficient temperature to incinerate all wastes efficiently, even when an afterburner was added. Plumes were observed coming from the incinerator stack, and neighbors complained of ash on their vehicles.
- The bead blaster operated without a filter, allowing residue to be deposited in the environment. Lead pellets were found on the ground near the bead blaster.
- Nearby residents had easy access into the site.

DOE and its contractors first entered the site in 1989 to perform a radiological characterization of the property. At that time, a major portion of the site was covered with drums stacked on their sides, as many as five high. Many drums were marked "radioactive" or had Material Safety Data Sheets attached that indicated chemicals and hazardous wastes were stored in the drums. Some areas of the property were barren of vegetation. Workers were observed dumping the residual liquid contents of drums onto the ground.

Both airborne and soil samples were taken in 1989 to determine if there was potential for DOE and contractor personnel to be exposed to hazardous materials (see Fig. 1). Photoionization detector measurements obtained near the incinerator showed volatile organic compounds in excess of 200 parts per million (ppm). Analyses of soil samples indicated the presence of heavy metals, such as lead, and chemical compounds, such as endosulfan, pyrene, and DDT.



Fig. 1. Sampling Soil for Hazardous Waste While Facility Was Operational

In 1990, DOE completed its radiological survey and determined that the majority of the site was contaminated with radium-226 and uranium oxide (yellowcake). Part of the slab under the warehouse building contained elevated levels of radium-226, while most of the equipment and other surfaces in the building were contaminated with yellowcake dust (elevated alpha levels). A large portion of the site was not accessible to the sampling crew because of the stacked drums on the northern portion and piles of junk cars on the southern portion.

DOE's position, because of the mixed waste present at the time, was that it could not remediate the radiological contamination until the hazardous waste was rendered nonhazardous through stabilization, delisting, or other legal means. The Cheney Disposal Cell, located 15 miles south of Grand Junction, was permitted by the U.S. Nuclear Regulatory Commission and Mesa County to accept only radiological waste. DOE's policy was that it did not have the authority through UMTRCA to remediate hazardous waste that was not generated by a DOE operation. Without EPA or another agency's efforts, the radiological hazard on the site would not be remediated.

EPA and the Agency for Toxic Substances and Disease Registry (ATSDR) performed additional studies after reviewing results reported by DOE, Mesa County Health Department, Colorado Department of Public Health and Environment (CDPHE), and the

U.S. Department of Justice to determine if the site posed a threat to human health or the environment. In 1991, EPA and ATSDR determined that the dust emission-control equipment of the bead-blasting operation was not adequate and that the incinerator operation did not provide complete combustion of wastes. ATSDR then issued a Public Health Advisory for the facility and community that stated the operation posed an urgent health hazard to the adjacent neighborhood by potentially exposing the public to lead and other contaminants.

EPA RESPONSE ACTION

As a result of the health hazards present at the site, EPA under its authority in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund), designated the drum-recycling facility as a Superfund hazardous waste site. In October 1991, EPA officially took control of the site. In 1992, EPA initiated an interim remedial action by entering the site and removing more than 27,000 drums. Approximately 125 drums were full of hazardous waste and 30 drums contained yellowcake. A 6-foot high chain link fence was erected to prevent public access to the site. EPA attempted to perform soil remediation but discontinued the effort after it discovered strong odors (mercaptans) emanating from the disturbed soils. EPA covered the disturbed area with clay to act as a vapor barrier and temporarily vacated the site until further sampling could be performed.

Analyses of soil samples collected by EPA showed elevated concentrations of lead, cadmium, chromium, cobalt, mercury, and numerous volatile organic compounds. The organic compounds included mercaptans and the pesticides DDT and phorate. Phorate is a highly toxic organophosphate that can be absorbed easily by the body. Sample analyses of phorate revealed a concentration of 210 ppm; lead was detected in concentrations ranging from 500 to 20,000 ppm (as measured in total lead concentration). EPA evaluated the characterization results and concluded that the elevated lead exceeded the CERCLA health risk standards and consequently would have to be stabilized.

EPA's plan, however, was to remediate the soil and treat to the health risk-based standard of 500 ppm for total lead, not the Toxicity Characteristic Leaching Procedure (TCLP) hazardous waste level of 5 ppm. This standard created a potential problem for DOE because it could not haul the material to the Cheney Disposal Cell unless the waste was no longer regulated as hazardous waste. EPA agreed to treat the soil to the TCLP cleanup level after it determined the treatment method selected would effectively stabilize the lead to both standards.

In 1993, EPA returned to the site to excavate and stockpile 6,120 cubic meters (8,000 cubic yards) of lead-contaminated soil (see Fig. 2). The stockpiles were covered with plastic until a contractor could be procured to treat the waste. In 1994, EPA treated



Fig. 2. Stockpiles of Treated Material

the contaminated soil with a solidification/stabilization process by mixing cement, fly ash, water, and soil in a pugmill. The mix formula, determined through bench-scale tests, was computer controlled to ensure consistency. The resulting grayish soil was stockpiled in 380-cubic-meter (500-cubic-yard) piles. Lead concentrations in representative samples from these piles, analyzed with the TCLP method, ranged from 0.15 to 0.46 milligram per liter (mg/L). In addition to the TCLP tests, EPA collected samples from various stockpiles and ran Multiple Extraction Procedure (MEP) tests for lead. This method is time-phased to determine if the leachate amounts increase during a 9-day period. Leachate contaminant levels measured in the MEP tests ranged from 0.30 to 0.5 mg/L, which were below regulatory levels.

Except for site restoration and several miscellaneous tasks, EPA's planned remedial action activities were considered completed. However, EPA had to return to the site several more times as a result of additional deposits of wastes uncovered by DOE.

DOE REMEDIAL ACTION

Once EPA treated the hazardous waste to a nonhazardous state, DOE could initiate the removal of radiologically contaminated materials under the UMTRA Grand Junction Vicinity Property Program. Under the EPA standard (40 CFR 192), the removal standard for residual radioactive material (RRM) located outside a building was based on the concentration of radium-226. Although the definition for RRM includes "other waste (which the secretary determines to be radioactive) at a processing site which relate to such processing, including any residual stock of unprocessed ores or low grade materials," no

other cleanup standard was established for materials such as yellowcake that may be present from the milling operation. DOE researched the applicability of other established standards and, with agreement by CDPHE, used the NRC cleanup standard, established for "Disposal or onsite storage of thorium or uranium wastes from past operations," of 30 picocuries per gram (pCi/g) above background for total uranium.

Before DOE could remove the treated soils, the issue of Resource Conservation and Recovery Act (RCRA)-listed wastes (organic compounds) had to be resolved. Although EPA had rendered all characteristic hazardous waste to a nonhazardous state, the treatment did not remove all organic constituents. In a meeting of DOE, CDPHE, and EPA representatives, EPA presented the position that insufficient process knowledge was available to categorize the constituents as listed hazardous wastes. Any hazardous waste on the site would only be in the form of a characteristic hazardous waste, such as lead. In February 1994, CDPHE agreed with EPA's determination that wastes on the site be evaluated only to determine if they were characteristic hazardous waste.

DOE's remediation project was performed in five phases as a result of budget limitations, time for EPA to perform its role of treatment and demolition, and time for the tenant to clear the auto salvage site. The first three phases involving the drum-recycling operation included removal of the treated stockpiled materials, removal of the contaminated building and underlying soil, and remediation of all other contaminated soil. The last two phases involved the auto salvage and junkyard.

Remediation of Drum-Recycling Facility (Phases 1-3)

Phase 1 consisted of removing 6,120 cubic meters (8,000 cubic yards) of treated material stockpiled by EPA in February 1994. Although the stabilization process used cement and fly ash to tie up the lead so that it was no longer leachable, it was not designed to solidify the treated soils into a solid mass. When DOE's contractor started to excavate the stockpiles after the material had set for 8 months, the material was much harder than expected. The material had solidified, probably because of the composition of the stockpile, which allowed it to set up over time like a low-grade concrete. Consequently, the contractor performing the work had to use extra equipment to break up the material before it could be loaded into trucks and transported to the Cheney Disposal Cell.

Because the mercaptins identified by EPA were not considered a hazardous waste, they were left untreated. The odor from the mercaptins was a major concern for workers. Although the Occupational Safety and Health Administration permissible exposure limit and detection threshold for available instruments were never exceeded, the strong smell at low concentrations aggravated the workers. Respirators provided only partial protection. People sensitive to the smell were unable to work in the area where the mercaptins were detected. Although the lead concentrations had been treated and were no longer leachable, the presence of lead still posed a potential hazard to workers. Consequently, appropriate personal protective equipment was worn to prevent dermal or respiratory exposures.

In December 1994, remediation work was halted when a solid waste material in the form of small pieces of coagulated paint was discovered mixed with the soil. Because old paint often contained lead, it was sampled for hazardous waste. One of the two samples exceeded the TCLP limit for lead. EPA remobilized to the site and sampled the soil and paint waste stream. The analytical results demonstrated that although the lead concentrations in the paint exceeded the TCLP limit, the waste stream of soil and paint should not be classified as a hazardous waste because the waste-stream values did not exceed the limit.

As a result of removing the radiologically contaminated soil from underneath the piles, DOE removed and hauled 7,020 cubic meters (9,180 cubic yards) of soil during this phase. The total cost of remediation for the phase, including oversight, was \$420,000.

Phase 2 involved the removal of the main building, contaminated concrete foundation, and underlying soil. Only a portion of the concrete in the building was contaminated. To remove just the contaminated concrete would have required installation of extensive shoring to support the structure while the foundation was being removed. Work in the closed environment of the building would have required engineering controls to prevent the spread of yellowcake contamination. DOE studied the alternatives and with EPA's participation decided to remove the entire structure. Because of CERCLA restrictions, EPA could only demolish the building. Once it was razed, DOE could justify hauling the radiologically contaminated building material to the Cheney Disposal Cell.

Unfortunately EPA's subcontractor did not have to be concerned about the final condition or size of the material. DOE's contractor discovered after the building was demolished that materials had to be sized to meet the placement criteria of the Cheney Disposal Cell. This size restriction required extensive double handling to package building siding, to cut steel beams and conduit to less than 10-foot lengths, and to break up concrete foundation materials to less than 1 foot in any dimension.

During excavation of soils underneath the foundation, discolored soils were identified with lead concentrations that exceeded the hazardous waste thresholds. Once again, EPA mobilized to the site and performed treatment. After the 270 cubic meters (350 cubic yards) of soil was treated and no longer considered hazardous waste, DOE was able to haul it off the site. The 6-month project required the removal of 1,550 cubic meters of contaminated building debris and underlying soils at a total cost of \$444,000.

Phase 3 involved removal of the remaining contaminated soils from the northern section of the property, including the asphalt parking lot and areas that extended onto the railroad right-of-way. The total project involved removing 8,900 cubic meters (11,400 cubic yards) of contaminated soils at a cost of \$708,000.

Remediation of Auto Salvage and Junkyard (Phases 4 and 5)

The auto salvage yard (see Fig. 3) was operated by a tenant who had an oral lease arrangement with the property owner. When DOE approached the tenant and owner on how to work around the auto salvage operation, they offered to start moving the cars off the site. After waiting on the salvage yard operator for more than 12 months, the site was finally cleared of enough vehicles so that DOE could perform further assessments. DOE determined that yellowcake contamination was tied primarily to where drums had been previously stored. Historical aerial photos of the site indicated that the auto salvage business crept north over the years onto the former drum storage area. DOE used this information to work with CDPHE to establish a sampling plan for yellowcake contamination on a smaller area than previously assumed. This plan helped reduce laboratory costs because field-screening techniques were not commercially available to identify the presence of yellowcake in soil.



Fig. 3. Auto Salvage Yard Before Remediation

While performing routine grid sampling for hazardous waste, DOE identified soil with strong odors similar to mercaptin. Analytical tests showed that the soil contained phorate at concentrations to 19,000 milligrams per kilogram (mg/kg). EPA was again called in to investigate the deposit and perform tests. EPA conducted 20 different treatability tests but was unable to find a method to treat the phorate to below the CERCLA risk-based standards. EPA then reviewed the regulations to determine if the material could be classified under the “P” list of 40 CFR 261 subpart D, where phorate waste streams are listed. Because the source of the waste was unknown, EPA determined that the deposit could not be a listed hazardous waste and, therefore, did not require treatment.

The grid sampling also indicated another deposit of lead that exceeded the TCLP threshold of 5.0 milligrams per liter. No other indicators were present, such as batteries or

discolored soil. Because of the auto salvage and junkyard operations, any number of sources could exist. EPA returned to the site and treated approximately 150 cubic meters (200 cubic yards) of lead-contaminated soil.

Visual observations of the site indicated large quantities of asbestos containing-materials (ACM) were present, probably left over from boilers and other scrap collected by the tenant. Consequently, DOE was required to remediate a large portion of the site under asbestos controls. On a previous UMTRA vicinity property site, CDPHE granted DOE permission to bulk haul ACM mixed with soil if it was hauled in a covered dump truck and if the material was placed inside a geotextile fabric (commonly referred to as a burrito). CDPHE also approved use of this method for this project.

Phases 4 and 5 involved the removal of 2,400 cubic meters (3,100 cubic yards) of radiologically contaminated materials at a cost of \$585,200.

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Local residents petitioned ATSDR in 1991 to investigate the health hazards that resulted from the drum-recycling operations. As a result of the proximity of people to the site, ATSDR performed analyses of soil in the adjacent neighborhood. These analyses indicated that 94 percent of the samples contained levels of lead similar to background levels for western soils. The lead levels in soil indicated that they did not pose a threat to the public and that the drum-recycling facility was not responsible for the spread of lead off site.

ATSDR, CDPHE, and Mesa County collected blood samples from 287 adults and children living in the adjacent neighborhood. Eleven people had levels between 10–19 micrograms of lead per deciliter of blood. After further monitoring, ATSDR concluded that the blood lead levels were not a public health concern. Because lead levels in blood are indicative of recent exposures, ATSDR did not have enough evidence to assess exposures from past operations. The agency published its findings in November 1996.

RECONSTRUCTION

EPA returned to the site several times to complete the backfill and reconstruction. The site is currently vacant land (see Fig. 4). Because the tenant and the property owners have discontinued their operations, future land use is unknown. The city has prepared a Major Street Plan indicating the long-term need to construct a minor arterial street through the property to alleviate traffic congestion in downtown Grand Junction.



Fig. 4. Site Reconstruction Completed

CONCLUSION

EPA and DOE jointly remediated a complex 15-acre site containing hazardous wastes that posed a threat to nearby residents and the environment. A unique relationship between the agencies was established where EPA performed the treatment of hazardous waste, while DOE remediated the radiological contamination. By working closely with CDPHE, numerous issues of how to classify waste streams were resolved. By working together, both agencies achieved cost savings of several million dollars.

EPA spent \$2.1 million to remove 27,000 drums, to treat more than 6,500 cubic meters of hazardous waste, and to raze a large contaminated industrial building. DOE spent \$2.1 million to remediate and dispose of 20,000 cubic meters of radioactively contaminated material.

ACKNOWLEDGMENTS

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REFERENCES

42 *United States Code*, Uranium Mill Tailings Control Act of 1978, Public Law 95–604, as amended, Section 7901, *et seq.*, and Section 7942.

40 *U.S. Code of Federal Regulations* 192, U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.”

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