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REGION 8**

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Explanation of Significant Differences

**Shattuck Chemical Site
Operable Unit 8
Denver Radium Superfund Site
Denver, CO**

March 2007

U.S. Environmental Protection Agency
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1. Introduction

This Explanation of Significant Differences (ESD) describes the change in the scope of work required to remove and dispose of contaminated material from the Shattuck Chemical Company property of the Denver Radium Superfund Site and its associated cost increase. The 5.9-acre site is located at 1805 South Bannock Street. This ESD details the change in scope and includes site history, selected remedy, basis for the change, support agency comments, statutory determinations, and documentation of public participation compliance. The U.S. Environmental Protection Agency (EPA) is the lead for this ESD.

Under Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended 42 U.S.C. §9601 et seq., EPA is required to publish an ESD when significant but not fundamental changes are proposed to the previously selected site remedy. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), §300.435(c)(2)(1), sets forth the criteria for issuing an ESD and requires that an ESD be published if a remedial action is taken which differs significantly in either scope, performance or cost from the remedy selected in the ROD for the site. This ESD and supporting documents will become a part of the Denver Radium Administrative Record file and information repository as required by the Code of Federal Regulations 40, Section 300.435(c)(2)(i)(A) and 300.825 (a)(2).

EPA will publish a notice of availability and a brief description of the ESD in a major newspaper of general circulation (as required by Code of Federal Regulation 40, Section 300.435(c)(2)(i)(B)).

Comprehensive information on the Denver Radium Superfund Site is available at:

U.S. EPA, Region 8, Superfund Records Center
1595 Wynkoop Street, Denver, CO 80202-1129
(303) 312-6473 or toll free (800) 227-8917
Viewing hours: 8 a.m. to 4:30 p.m., M-F, excluding holidays

2. Site History and Contamination

A 1979 review of old United States Bureau of Mines reports led the EPA to investigate former radioactive ore processing facilities located throughout the Denver area, including the Shattuck Chemical Site. These properties became the Denver Radium Superfund Site, which in October 1981 was placed on the Superfund Interim Priorities List. In September 1983, the site was placed on the National Priorities List.

The Shattuck Chemical Site, Operable Unit (OU) 8 of the Denver Radium Superfund Site, is located approximately 6 miles southwest of downtown Denver, Colorado. The property was the location of the S.W. Shattuck Chemical Company, Inc., which processed a variety of radioactive materials from 1917 to 1984. Mineral ores processed included tungsten and carnotite ores, radium slimes, molybdenum ores and depleted uranium. A summary of the processing history is provided below.

- 1920's - Molybdenum ore processing
- 1930's - Radium slime processing
- 1940's - Uranium and molybdenum processing
- 1950's - Uranium processing
- 1960's - Molybdenum processing
- 1970's and 1980's – Uranium, molybdenum, and rhenium processing

Many of the processed ore residues remained on-site and became intermixed with site soils. Additionally, a detention pond to hold molybdenum slime wastes was located at the northern end of the property. Processing operations resulted in contamination of the site with radioactive elements, including Ra-226, Th-230, various uranium isotopes, and non-radioactive metals such as lead, arsenic, and selenium. The property is zoned for mixed residential, commercial, and light industrial use. Residential areas are located one block south, one block east, and approximately ½ mile to the west. The site is directly east of an active Burlington Northern Santa Fe (BNSF) rail spur and RTD mass transit rail lines. The topography of the surrounding area is relatively flat. The area generally slopes toward the north and west. The site is located within the drainage basin of the South Platte River, which is located approximately 3000 feet to the west. A shallow unconfined aquifer exists below the site, perched on bedrock, and merges with the alluvial aquifer beneath the floodplain of the South Platte River. Groundwater in the area is not used as a drinking water source.

In 1988, the State conducted a remedial investigation (RI) at Shattuck. Further study of the site was completed in 1991. Those studies found that radiological contamination was present in site soils over an area of approximately 230,000 square feet. The contamination was found to extend from ground surface to depths over 14.5 ft-below the surface. Estimated volume of contaminated soil at the site was 38,500 cubic yards. Based on those investigations, a remedy was selected in a *Record of Decision* (ROD) in January 1992. This remedy stipulated that all buildings and facilities be demolished and disposed of off-site. Additionally, contaminated soils were to be stabilized and solidified on-site. Institutional controls (IC), maintenance, and monitoring were also used to supplement the remedy. The remedy was largely completed in September 1998 and created a roller compacted cement/soil monolith of approximately 5 acres. Groundwater contamination present beneath the site was to be addressed by natural attenuation.

Since waste material was left on site, CERCLA requires that five-year reviews be conducted to determine whether the remedy remains protective. A five-year review conducted in 1999 identified a number of concerns relating to the long-term protectiveness of the monolith and the reliability of ICs imposed in the original ROD. Additionally, the State of Colorado, the City and County of Denver, stakeholders, and the local community requested other alternatives to the existing remedy be considered. The combination of technical concerns, requests to reconsider the remedy, and pressure from the surrounding community resulted in the decision to amend the original ROD.

A Record of Decision Amendment, Denver Radium Site, Operable Unit VIII, Denver, Colorado (USEPA, 2000a) was issued on June 16, 2000. The Amended ROD stipulated that the monolith material be removed from the site along with any additionally identified contaminants in excess of cleanup levels specified in the Amended ROD.

3. Selected Remedy

The original ROD was signed in January 1992 and selected on-site stabilization and solidification as the remedy for soils and natural attenuation with monitoring for groundwater. Also, all buildings and facilities on the property were to be demolished and disposed of off-site. Institutional controls, maintenance, and monitoring were also used to supplement the remedy. The original remedial action was largely completed in September 1998 with the creation of a cement/soil monolith on the site of approximately 5 acres. In November 1999, EPA completed a 5-year review of the remedy and identified concerns related to the long-term effectiveness of the monolith and the reliability of the IC's imposed in the original ROD. Additionally, the State, City and County of Denver, stakeholders, and the local community requested other alternatives to the on-site containment remedy. The combination of technical concerns, requests to reconsider the original remedy, and the State's withdrawal of support resulted in the EPA amending the original ROD. The Amended ROD was signed on June 16, 2000 and EPA selected off-site removal to best meet Superfund's evaluation criteria. The amended ROD stipulated that the monolith at OU8 be removed from the site along with any additional identified contaminants in excess of cleanup levels specified in the Amended ROD.

As of September 2006, the remedy selected in the Amended ROD had been completed and all waste material had been removed from the property. In February of 2007 the property became ready for reuse. A sale is pending with a land developer who intends to develop the property for mixed residential and light commercial use. There are currently no restrictions on use or institutional controls, other than groundwater, for the property. The State of Colorado has assumed the responsibility for the long-term operations and maintenance (O&M), including the required quarterly groundwater monitoring. The groundwater survey work for the plume leaving the site has been started by the State, with one round of groundwater monitoring completed. The State will complete three additional rounds of sampling to establish a baseline for the plume.

4. Basis for and Description of Significant Differences

In 1999, EPA conducted a five-year review of the Shattuck Site and found site-specific deficiencies in the solidified material cover design, the structural and chemical integrity, and the compliance program. Based on these findings, EPA could not be assured of the long-term protection of the original remedy and began preparing a ROD amendment to address the deficiencies.

In June 2000, the EPA finalized the Amended ROD that prescribed the total removal of the monolith material from the site, along with any additionally identified contaminants in excess of clean-up levels specified in the ROD amendment.

The Amended ROD updated the remedial action objectives (RAOs) from the original ROD to

reflect EPA CERCLA guidance issued following the finalizing of the original OU 8 ROD (OSWER Directive No. 9200.4-25, "Use of Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites"). The following RAOs changed as a result of the Amended ROD:

- **The action level for Radium 226 changed from 5 Pico curies per gram (pCi/g) above background for surface soils and 15 pCi/g above background for subsurface soils to "5 pCi/g occurring in any six-inch layer of the monolith from its top surface to its bottom surface, including any original soils not incorporated into the monolith which are above the groundwater table."**
- **The action level for Thorium 230 changed from 42 pCi/g to "5 pCi/g occurring in any six-inch layer of the monolith from its top surface to its bottom surface, including any original soils not incorporated into the monolith which are above the groundwater table."**

Based on these changes in the RAOs, the estimated cost provided in the Amended ROD for completing monolith removal at the site was \$26.0 million. The increased actual cost compared to the estimated cost can be attributed to three principle factors, which are as follows:

1) The initial volume of material to be removed and disposed was underestimated in the Amended ROD.

Based on the past remedial action, the Amended ROD projected a total of 165,000 tons of monolith material, underlying soils, and perimeter soils would be generated for off-site disposal by remedial actions at the site. At project completion in September 2006, approximately 243,872 tons of radiological contaminated materials had been transported from the site to the U.S. Ecology disposal facility. The final tonnage included additional radioactive materials from Bannock Street, from the perimeter of the monolith area (including the removal of clean fill used in the original remedy) and material from the molybdenum pond area located at the north end of the site.

Approximately 31,515 tons of molybdenum containing soil were excavated from beneath the area of the former molybdenum ponds found at the north end of the Shattuck property. The site team discovered that the molybdenum concentrations in groundwater were much higher (10 to 100 times the ARAR concentration of 0.1 mg/L) than could be reasonably expected to attenuate without source removal. Also, further complicating the situation, the site team discovered that backfill material used in the molybdenum pond area contained radionuclide concentrations above the cleanup standards established in the Amended ROD. Consequently, it was determined that source removal at the molybdenum pond area was required. This decision was based on three factors:

- i. The need for source control or source removal for the successful attenuation of contaminant plumes;
- ii. Groundwater monitoring data – concentrations of molybdenum ranged from 0.11 mg/L to 17.4 mg/L in contrast to the 0.1 mg/L TBC/ARAR; and,
- iii. The discovery of radionuclide concentrations in soil above the Amended ROD standards.

Shaw Environmental, Inc., in 2003 provided EPA and the U.S. Army Corps of Engineers with a revised estimate of \$54,000,000 to complete the remedial action. At the end of the project a total of approximately 275,387 tons of material from the monolith and molybdenum containing soils were excavated and disposed of at approved off-site facilities at a final cost of \$57,126,558.06, which is within 10 percent of the revised estimate.

2) The average density of the excavated material was higher than expected.

The second factor resulting in an increase in remedial cost at the site was the underestimation of the weight-to-volume ratio of the excavated material. The average density of the excavated monolith material was estimated in the Amended ROD to be approximately 2,600 to 3,000 pounds per cubic yard. The actual density of the material ranged from 3,400 to 3,800 pounds per cubic yard. Consequently, less volume of material could be loaded into each railcar before its maximum weight limit was reached. This increased the number of railcars needed to transport the material, thereby increasing transportation cost.

3) Extreme weather caused unanticipated expenditures.

There were several adverse weather events that caused unanticipated expenditures that added to the overall project cost. During March, July, and December 2003, three separate weather events impacted the Shattuck Site with unforeseen repair and maintenance to the protective structure at the site. In March 2003 a heavy snowstorm left more than 33 inches of wet snow over the Denver Metro Area, which caused serious damage to the movable structure. A fabric link was damaged beyond repair and several steel structural components required replacement or repair. Two high-wind events also caused damage to the protective structure. In July 2003 a wind microburst inflicted serious damage to the structure causing costly repairs and, in December 2003 a second high wind event caused severe damage to one of the fabric links, which required significant effort to reconstruct and stabilize.

5. Support Agency Comments

The Colorado Department of Public Health and Environment (CDPHE) supports the conclusions of this ESD. CDPHE agrees that the increase in costs associated with remedial work at the Shattuck Chemical Company property were mainly due to a 50% increase in soil excavated, transportation and disposal costs, delays associated with blizzard of 2003, and the increase in the cost of the mining structure.

6. Statutory Determinations

Under CERCLA Section 121, EPA must select a remedy that is protective of human health and the environment that complies with ARAR's and is cost effective. Section 121 also states that EPA must select a remedy that uses permanent solutions, alternative treatment technologies, or resource recovery technologies to the maximum extent practicable. In addition, CERCLA prefers remedies which include treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element of the remedy. For sites where hazardous substances, pollutants or contamination remain on-site, EPA must conduct five-year reviews consistent with the CERCLA and the NCP. The purpose of the five-year review is to determine whether the remedy being implemented at a site is protective of human health and the

environment. The five-year review conducted in 1999 identified a number of concerns relating to the long-term protectiveness of the monolith and the reliability of ICs imposed in the original ROD. Subsequently, the EPA developed and finalized an Amended ROD that proposed further remedial actions in order to be protective of human health and the environment. EPA believes that the alternative identified in the Amended ROD for Shattuck Chemical Superfund Site/OU8 Denver Radium was appropriate and the remedy will remain protective of human health and the environment. The selected remedy will continue to comply with federal and state requirements that are applicable or relevant and appropriate to the remedial action.

7. Public Participation Compliance

EPA will publish a notice of availability and a brief description of the ESD in a major newspaper of general circulation (as required by Code of Federal Regulation 40, Section 300.435(c)(2)(i)(B)). A formal public comment period is not required when issuing an ESD. This ESD and all documents that support the changes and clarifications are contained in the Administrative Record of the Shattuck Chemical property, (OU8) of the Denver Radium Superfund Site (under CFR 40, Section 300.435(c)(2)(i)).



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3/12/2007
Date



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