Management and Beneficial Reuse of Overburden Material - Linde Formerly Utilized Sites Remedial Action Program (FUSRAP) Remediation Project – 9319

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ABSTRACT

This paper outlines three separate and distinct situations where the proper management of overburden material allows for the beneficial reuse of overburden material. Beneficial reuse of overburden material at the Linde Project was made possible by a simultaneous combination of physical conditions at the site in conjunction with collaborative planning and cooperation between U.S. Army Corps of Engineers – Buffalo District, New York State Department of Energy and Conservation, the Owner and Shaw Environmental & Infrastructure. Efforts by the project team focused on maintaining compliance with project plan requirements, communicating the plan to all parties, executing the plan safely and efficiently, and emphasizing fiscal responsibility to ensure maximum cost savings.

INTRODUCTION

The U.S. Army Corps of Engineers – Buffalo District (USACE) is responsible for the remediation of Manhattan Engineer District (MED)-related radiologically contaminated materials at the former Linde site. This work is authorized under the Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to investigate, and cleanup or control sites previously used by the Atomic Energy Commission (AEC) and its predecessor, the MED. The primary objective of the Linde site remediation effort is the effective cleanup of the site in accordance with the Record of Decision (ROD) signed on March 3, 2000.

The former Linde site consists of 105 acres located in the Town of Tonawanda, New York. The site is bounded on the north and south by industrial properties and small businesses, on the west by an elementary school, a residential neighborhood and a town park, and on the east by CSX railroad tracks, utility easements, and commercial properties. Praxair Inc. (the Owner) currently is the site owner and employs over 1,300 at the site, which is operated as their worldwide technology center, performing research for their industrial gases business.

DESCRIPTION OF AREAS AND OBJECTIVES

Excavation Area G2

The concept of beneficial reuse was first implemented in Excavation Area G2 (EA-G2). EA-G2 is located adjacent to the Linde FUSRAP site in Tonawanda, New York. The properties include an active railroad line, a dining and entertainment complex, and an operating trucking transportation facility and associated buildings. Contamination in these areas originated during the delivery of uranium ores via the rail line adjacent to the Linde site, and the use of contaminated material as industrial backfill. Based on previous data collection activities Shaw determined the radiological contamination was predominantly located in a black colored lens located at various depths below the ground surface. The objective was to segregate the non-MED impacted overburden, remediate the MED-related radiologically contaminated materials, and backfill.

The existence of a unique combination of characteristics required Shaw to reevaluate and modify many standard protocols for characterization, remediation, and execution of the final status survey process. These protocols were evaluated and modified in an effort to minimize the amount of material requiring disposal.

Spoils Pile Relocation

The spoils pile was located in the southeastern portion of the Linde site. In 1990, the Owner initiated facility expansion and improvement work that involved construction of a new building and site parking lots on the west side of the property. Excess materials that were removed during construction of these facilities were relocated within the area that became known as the spoils pile. From 1990 through the spring of 2005, all excess material generated from landscaping, construction, demolition and excavation activities by the Owner or its subcontractors were placed in the pile. These materials included soil and soil-like material, concrete, steel, wood and asphalt. The in-situ volume of the spoils pile was estimated at 14,000 cubic yards as surveyed in 2003. Development of the property by the owner between 2003 and 2005 resulted in additional material being added to the spoils pile.

Configuration of Linde Site Spoils Pile - May 2005

Relocation of the spoils pile was necessary to allow core sampling to be completed safely as part of Class 2 final status survey activities. The Final Status Survey Plan (FSSP) for the Linde project specifies the means and methods by which data are collected following remedial actions and how those data are evaluated against the site cleanup criteria. As identified by the FSSP, approximately 70 core samples were required to be collected from within the footprint of the spoils pile.

Excavation Area I

EA-I is located in the northwestern portion of the site and required substantial remediation of surface soils and subsurface infrastructure (sanitary & storm sewer systems). Land characteristics present at this portion of the Linde site can be described as “Urban Land” where a high percentage of the ground surface has been covered by asphalt, concrete, buildings or other non-permeable structures. The majority of surficial and near-surface soils (up to 3’ below grade) has been disturbed by historic construction activities and commonly consist of fill materials imported from off-site sources or materials from on-site that have been excavated and relocated. However, subsurface materials encountered at depths of approximately 3’ to 20’ below grade consist of predominantly low-permeability lacustrine (lake deposited) clay which exhibits a distinctive reddish-brown coloration. This material is typically representative of post-excavation surfaces since the clay is usually free of radiological contaminants. Analytical and geotechnical evaluation of this clay determined that it is suitable for beneficial reuse as post-excavation backfill material.

OPERATIONS

Excavation Area G2

The radiological contamination was predominantly in a black colored lens (Figure 1) located at various depths below the ground surface. A characterization activity to confirm the extent of MED-related radiologically contaminated “lens” was an initial step to the operation.

A modification of the existing Class 2 sampling protocol was required due to the irregular land surface, mixed hard-fill, and building demolition debris within the property area (Figure 2).

Figure 1 – “Black Lens”

Figure 2 - Heterogeneous Hard Fill

The modified protocol employed a combination of sampling techniques including test pits, split-spoon sampling, and hollow-stem auguring methods as opposed to exclusive use of split-spoon sampling.
Due to the presence of the commingled contaminants the analytical results provided by on-site high purity germanium detector gamma spectroscopy and previously developed investigation levels were determined to be inconclusive.

Therefore, all characterization samples were sent off-site to a USACE-validated laboratory for alpha spectroscopy analysis. The results from the alpha spectroscopy analysis confirmed that the previously developed investigation levels were inconclusive, Th-230 was the dominant contaminant and the contamination was concentrated in a two to thirty inch thick black colored lens located at various depths below the ground surface.

Based on the information acquired during previous remedial action and characterization events, a method was developed to segregate the soils that exceeded subsurface ROD criteria (black lens material) from soils that did not exceed surface ROD criteria (overburden), allowing the overburden soils to be utilized as post-excavation backfill while ensuring that overburden soils met the New York State Department of Environmental Conservation beneficial use standard (6 NYCRR 360-1.15[b] [8]). The method was developed through the combined efforts of USACE-Buffalo District, New York State Department of Environmental Conservation, and Shaw Environmental & Infrastructure, Inc.

Excavation challenges were met by evaluating gamma count rates relative to background in the area of the dark lens. Elevated count rates and the presence of the black lens provided sufficient evidence to support the existence of MED material in excess of subsurface ROD criteria. This effort resulted in time and cost savings because the excavation of the area could proceed as guided by the Health Physics Technician, while confirmatory alpha spectrometry analytical results were being processed. To support documentation of this effort, daily photographs of the dark lens material were taken, GPS coordinates of its location, thickness, count rate, and overlying material count rate were also recorded. This methodology proved to be extremely successful during the remediation of this area.

Due to the interferences caused by the unique combination of contaminants in the area, final status sampling and the gamma walkover of the unit alone, could not verify the entire unit met subsurface ROD criteria.

To overcome this challenge and verify that the unit met ROD criteria, bias samples were taken on the perimeter benches of the excavation and analyzed by alpha spectroscopy. If these analytical results revealed radiological contamination in excess of subsurface ROD criteria then the impacted perimeter benches were excavated. The floor of the excavation consisted of natural red clay at an elevation below the 1940's elevation for this property. This additional information, along with the final status survey sampling results, was presented in the final status survey technical data packages for this area.

The Final Status Survey Technical Data Package documenting the successful remediation of this unit to met the requirements and expectations of the ROD and was approved by the USACE. The property was restored to pre-remediation grade and function, and was subsequently backfilled with USACE approved backfill material in accordance with the Linde Site Restoration Plan.

The methods and approach elucidated above were subsequently used for the successful implementation of the Final Status Survey process for other MARSSIM Class 1 final status survey units at these adjacent properties

Spoils Pile Relocation

Relocation of spoils pile material commenced in May 2005. Field operations relied on conventional excavation techniques using hydraulic excavators and articulated haulers to excavate, segregate, load and transport soil, soil-like material, concrete and debris from the spoils pile to designated staging areas. Staging areas for each type of material were established near the northeast corner of the Linde site where removal of radiologically-impacted soils and subsequent backfilling had previously been completed. Materials were transported along a prescribed route with each load being escorted to its destination to ensure safe passage.

As specified by the USACE-approved relocation plan, all materials that were removed from the spoils pile were examined for the presence of radiological constituents which exceeded prescribed threshold levels. The spoils pile was divided into 500 cubic yard portions to facilitate the evaluation process. As daily excavation progressed, individual 500 cubic yard "lots" were identified by performing field measurements to establish the area and associated lift thickness that would result in removal of a 500 cubic yard volume of material. For each 500 cubic yard lot, the following activities were performed:

- Prior to initiating relocation operations for an individual lot, a composite sample was collected and analyzed on-site by gamma spectroscopy to quantify levels of contaminants of concern including Thorium-230, Radium-226 and Total Uranium (for this effort, 57 samples were analyzed),
- During active excavation, each bucket of soil or soil-like material was scanned by a Health Physics (HP) Technician,
- Daily gamma walkover scans were performed on newly exposed soil surfaces, and,
- Concrete slabs and large debris were all scanned in the field by the HP Technician.

Scanning of soils was performed with a Ludlum Model 2221 rate meter (or equivalent) and a Ludlum Model 44-10 NaI scintillation detector (or equivalent) on the surface of the material at a rate that does not exceed 1½ inches/sec. Scanning of all other materials was performed with a Ludlum Model 2360 with a Ludlum Model 43-89 100 cm^2 alpha/beta scintillator (or equivalent) at the same scan rate. The probe was held within approximately 2-inches of the surface. The HP Technician utilized the audible output function of the instrument while scanning and paused to determine if an increased count rate was greater than background and sample collection was required.

For soils or soil-like material, scan rates exceeding 18,000 counts per minutes (cpm) required the HP Technician to stop the soil removal activity and establish of a radiologically controlled area (RCA). A hazardous work permit (HWP) was established for areas where the 18,000 cpm scan rate was exceeded.

For non-soil media (e.g., steel, asphalt, concrete), a ten percent scan of each exposed section of material was performed. If a count rate of 2,200 β/min/100 cm^2 was observed, the material was disposed off-site.

Instruments were calibrated properly prior to use per established procedures identified in the project plans. Source checks on all instruments were performed on a daily basis. Appropriate background reference locations were established to develop representative daily background values for the surveys.

Specific values were derived to correspond with each type of material encountered in each survey (i.e., soils, steel, concrete, asphalt, miscellaneous non-soil). The values were used for background subtraction of any potential direct readings for surface contamination and for general scanning surveys. At least 30 random one minute background measurements were obtained daily for each survey instrument as appropriate for each type of material surveyed.

Any materials exceeding the established screening thresholds were immediately segregated and removed for off-site disposal at an appropriately permitted disposal facility. Screening efforts performed during relocation operations resulted in segregation and off-site disposal of 15 cubic yards of soil and approximately 5 cubic yards of concrete debris.

Relocated materials from the spoils pile were placed in designated staging areas located at the northeast corner of the site. Staging areas were established for each type of material (soil or soil-like, concrete or debris) and were sized to accommodate the estimated quantity. The position of staged material did not impede ongoing site work and was delineated to support the eventual off-site removal of the material.

The volume of relocated material was tracked on a daily basis and relied on three processes including; 1) a daily count of the number of loads transported by the articulated haulers, 2) the number of 500 cubic yard lots, and 3) measurements taken on stockpiled material in the staging area. The ex-situ (i.e. post-excavation) volume of material relocated from the spoils pile was estimated at a total of 29,175 cubic yards including:

- 35,000 tons of soil and soil-like material,
- 2000 cubic yards of concrete, and,
- 75 cubic yards of debris.

Final relocation efforts were completed in October 2005. Most areas within the footprint of the spoils pile were configured to the approximate original grade with the exception of an underground utility corridor. Three feet of overburden remained in this area pending physical location of all utilities that may be impacted by excavation.

Relocation of spoils pile materials was performed in conformance with the USACE-approved or endorsed project plans for the Linde FUSRAP site. Primary consideration focused on the safe execution of field operations and implementation of engineering controls to minimize or eliminate potential worker exposure and to ensure that ALARA goals were being met. Job-specific tasks included:

- Preparation of a Radiological Work Permit (RWP) to govern soil relocation activities,
- Establishing a Controlled Area Access location to serve as the single point of entry/exit for authorized personnel,
- Preparation and review of a task-specific Activity Hazard Analysis (AHA),
- Performing daily Area Air Monitoring and Dust Monitoring,
- Completing hand-dig efforts to definitively locate subsurface utilities within the footprint of the spoils pile,
- Providing dust suppression by means of water misting on haul roads, at the point of excavation and at the relocation areas, and,
- Performing periodic inspection of the subsurface utility tunnels located beneath haul roads.

Throughout the 159 calendar days during which spoils pile material was relocated, effective safety management and engineering controls contributed to over 7000 man hours recorded without a lost time accident.

Excavation Area I

Prior to field mobilization, the Linde site Project Team developed an Operational Approach to identify the procedures that would be performed to complete remediation in EA-I. During preparation of this plan, attention was focused on the opportunity to recover a considerable volume of non-impacted native clay and qualify the material for reuse on-site as backfill.

In order for beneficial reuse of the excavated clay to be considered, conditions at the site needed to be conducive for this option to be viable. As remediation progressed, enhanced partnering with the New York State Department of Environmental Conservation (NYSDEC) along with changing site conditions allowed for the option to be incorporated as part of EA-I remediation.

- Since a large portion of the Linde site is covered by asphalt, concrete or buildings, post-excavation backfill material was required to have suitable geotechnical properties in order to support these surface structures once they were restored. Historically, crushed quarry stone (limestone or dolomite) that could be compacted to > 95% of standard proctor was used as backfill. There was little or no need for soil backfill. However, excavation planned for EA-F projected the need for up to 24,000 tons of soil backfill. This area was to be restored as green space.
- The Linde site is an operating industrial facility where space requirements by the property owner had previously limited areas that would be available for interim stockpiling of backfill material. As the project progressed and more areas were remediated, space restrictions were minimized and stockpiles could be placed without interruption to the Owner's daily business.
- The Linde project has involved a collaborative partnership between USACE, NYSDEC, the Owner and the remedial contractor. Through adherence to mutually-accepted radiological surveying and sampling methods, and engineering practices, proper on-site management of non-radiologically impacted materials (soils and debris) by the remedial contractor and property owner has allowed for these materials to be reused beneficially at off-site locations without restrictions. Accordingly, precedent was set for reuse of the clay overburden from EA-I.

In order for site personnel to safely access the base of the excavation once remediation was complete, extensive benching of excavation sidewalls was required to ensure adequate stability. Due to the depth of the excavation, a large volume of material would require removal during formation of the benches. The native clay that comprised the "benched material" was designated for future use as post-excavation backfill and was staged in on-site stockpiles for interim storage.

Field operations for remediation in EA-I followed a phased approach that was developed collaboratively by the remedial contractor, USACE and NYSDEC. The approach ensured that work would be performed safely and in compliance with applicable project plans. Design specifications for remediation, management of non-impacted materials and restoration were established to minimize any disruptions to the Owner's operations and incorporated procedures to alleviate potential concerns from NYSDEC.

The initial phase of remediation involved removal of contaminated soils to a depth of approximately four (4) feet below existing grade. During this phase, excavation was terminated when native clays were encountered. Final Status Survey (FSS) gamma walkover surveys and sampling were then completed in accordance with the USACE – approved Final Status Survey Plan (FSSP). The FSSP was based on protocols included in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

The gamma walkover surveys were performed using a sodium iodide detector with a global positioning system (GPS) enabled data logger. This method allows for post-survey evaluation of the data to identify spatial trending and areas exceeding predefined investigation levels. The sampling locations were spaced on a 100 m^2 triangular sampling grid. The grid was established using a random start location prior to the start of excavation. By pre-establishing the sampling grid, final status survey samples were able to be collected while remediation continued within the same excavation area. This practiced expedited restoration activities.

Sewer Line Remediation

Benching of Excavation Sidewalls

The second phase of operations focused on removal of contaminated soils and sewer line infrastructure associated with 12” sanitary and 24” storm sewers. This effort required excavation to depths of 17’ below grade and required extensive benching of excavation sidewalls to maintain safe working conditions. Benching operations involved removal of non-impacted clay overburden material and placement of the clay in on-site stockpiles.

The final phase of work focused on restoration of the 12” sanitary and 24” storm sewer lines, backfilling of the excavated area and restoration of surface structures.

During benching operations in EA-I, native clay material was removed using conventional excavation techniques and was placed in clean intermodal containers (IMCs) of known volume. The IMCs were transported to the stockpile area by roll-off trucks where the contents were dumped. The material was configured using a bulldozer and compacted in lifts using a smooth drum vibratory compactor. The number of IMCs was recorded to establish a daily volume as the stockpile was constructed. Once excavation and restoration were completed in EA-I, the native clay stockpile was surveyed by a licensed land surveyor. Based in the findings of the volume survey, it was estimated that the clay stockpile contained approximately 3000 tons of material.

CONCLUSION

The unique combination of radioactive and overburden characteristics associated with the adjacent properties, spoils pile relocation and excavation area I presented characterization, remediation and final status survey challenges not previously encountered at the Linde Site. These challenges were met by developing and implementing innovative solutions through the combined efforts and cooperation of the USACE-Buffalo District, New York State Department of Environmental Conservation, and Shaw Environmental & Infrastructure, Inc.

The implementation of the USACE approved approach for reuse of overburden material resulted in approximately:

- 6500 tons of fill material from EA- G2
- 3000 tons of fill material from EA-I
- 35,000 of fill material from the spoils pile,
- 2000 cubic yards of concrete, and,
- 75 cubic yards of debris.

This approach has not only reduced the amount of material disposed of as radiological material but also reduced that amount of backfill required to restore the excavation areas, accounting for a savings of approximately $8 million in transportation, disposal and backfill costs in the area. In addition, the ability to utilize non-impacted overburden as post-remediation backfill will benefit the project during future remedial actions.