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Formerly Used Sites Remedial Action Program (FUSRAP) W. R. Grace Feasibility Study (FS) Alternative Development Process Challenges And Successes

N. Fatherly
U.S. Army Corps of Engineers – Baltimore District
10 S. Howard St., Baltimore, Maryland, 21201

M. O'Neill, A. Glemza
EA Engineering, Science, and Technology
15 Loveton Circle, Baltimore, Maryland, 21152

ABSTRACT

Monazite sand processing was conducted at the W. R. Grace Curtis Bay Facility (Baltimore, Maryland) in the mid 1950s under contract to the Atomic Energy Commission (AEC), for the extraction of source material in the form of thorium, as well as rare earth elements. The processing was conducted in the southwest quadrant of a five-story building (Building 23) in the active manufacturing portion of the facility. Building components and equipment in the southwest quadrant of Building 23 exhibit residual radiological activity remaining from the monazite sand processing. Waste materials from the processing operations (termed gangue) were disposed in the non-manufacturing portion of the facility, in the area referred to the Radioactive Waste Disposal Area (RWDA). Approximately 19,880 cubic meters (m^3) of radioactive gangue was buried within the RWDA. Waste was believed to be buried at various depths up to 2.7 meters (m), and possibly as deep as 7.6 m.

The RI and a supplemental investigation have been completed for the RWDA and adjacent boundary areas. A Feasibility Study (FS) to address residual radioactivity in soils at the RWDA is in the process of being finalized. The chemical-specific Applicable, Relevant, and Appropriate Requirement (ARAR) was selected for the FUSRAP contaminants, and Remedial Goals (RGs) were calculated for the cleanup. The RGs were developed based upon guidance provided in the selected ARAR, 10 Code of Federal Regulations (CFR) 40, Appendix A, Criterion 6(6). This standard is designed to provide an acceptable level of protection to the average member of a critical group who may be exposed to radium in soil for a given scenario. Scenarios, critical group members, and RGs were established in consultation with stakeholders. Dose assessment calculations were performed in accordance with the ARAR to establish derived concentration guideline levels (DCGLs) for each radionuclide in the ^{232}Thorium (^{232}Th) and ^{238}Uranium (^{238}U) chain for both surface and subsurface soils. A sum of the ratios calculation (also called the unity rule) will be utilized (with the DCGLs) to assure compliance with the benchmark doses associated with the radium standards.

Six alternatives (including no action) were considered in the FS and included the following technologies: soil washing, segregation, capping/covering, excavation/disposal, and site restrictions. A benchscale study was conducted by USACE to assess the efficacy of soil washing at the site. Results of the study showed reduction of radiological activity in soil. Segregation can be implemented using traditional sampling/analytical routines or automated (gate)

segregation and it is likely to reduce the waste stream by at least 30%, while providing a more complete characterization of the soil with a particularly high level of confidence.

Challenges for the FS phase of the project included: managing stakeholder input and expectations, defining separate and distinct alternatives for the FS in accordance with the CERCLA process, and selecting the most appropriate ARARs. The challenges were handled successfully, and USACE is finalizing a robust document acceptable to the stakeholders, which will allow USACE to meet the program milestone.

INTRODUCTION

The W.R. Grace Curtis Bay Facility is an active manufacturing facility (approximately 110 acres) located on an industrialized peninsula in Baltimore, Maryland. The facility was placed into the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1984 due to the presence of residual radioactivity from monazite sand processing operations conducted by the site owners in the 1950s, while under contract to the Atomic Energy Commission (AEC). FUSRAP was established in 1974 to identify and decontaminate sites where radioactive contamination remained from activities carried out under contract to the AEC. USACE is the lead Federal agency for investigations and remedial actions at FUSRAP sites. As required by Congress, USACE complies with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP) in conducting cleanup activities at FUSRAP sites.

Monazite sand processing was conducted in the southwest quadrant of a five-story building (Building 23) in the active manufacturing portion of the facility. Waste materials from the processing operations, termed gangue, were disposed in the non-manufacturing portion of the facility, in the area referred to the Radioactive Waste Disposal Area (RWDA). USACE has conducted remedial investigations (RIs) at Building 23 and the RWDA to assess the nature and extent of radiological impact. RI results indicate that remedial response actions are necessary and appropriate for both areas. A Feasibility Study (FS) for Building 23 was completed in 2004 and a Record of Decision (ROD) was issued by USACE in 2005. Since completion of the ROD for Building 23, USACE and the property owner voluntarily entered into a partnership Charter agreement to address the manner in which the Corps and the site owner will conduct themselves during the identification and remediation of FUSRAP material at the site. Currently, USACE is finalizing a FS to address residual radioactivity in soils at the RWDA. Six alternatives (including no action) are considered in the FS and include the following technologies: soil washing, segregation, capping/covering, excavation/disposal, and site restrictions. Challenges encountered during development of the FS included: managing direct stakeholder input and expectations, selecting the most appropriate Applicable, Relevant, and Appropriate Requirements (ARARs) for the site, and defining separate and distinct alternatives for the FS in accordance with the CERCLA process.

HIGHLIGHTS OF THE FEASIBLITY STUDY

The key FUSRAP contaminants of concern (COC) in surface and subsurface soils at the RWDA and adjacent boundary areas include Thorium-232 (Th-232) and its decay progeny. Radium-226

(Ra-226) and its decay progeny may also be present; however the Th-232 decay series also must be present at elevated levels to be classified as FUSRAP waste. Of note, other W.R. Grace processing wastes (not related to the monazite sand processing under contract to the AEC) may have been disposed in the RWDA and surrounding areas. These non-FUSRAP process wastes, which may include metals (or other chemicals) and naturally occurring radioactive material, are not eligible for remediation under FUSRAP unless they are commingled with the key FUSRAP COCs.

USACE selected the following chemical-specific ARAR for the FUSRAP contaminants in soils: 10 Code of Federal Regulations (CFR) 40, Appendix A, Criterion 6(6). This standard is designed to provide an acceptable level of protection to the average member of a critical group who may be exposed to radium in soil (above background concentrations) for a given scenario, and it also allows establishment of cleanup criteria for radionuclides other than radium, when present. Dose assessment calculations were performed to establish derived concentration guideline levels (DCGLs) for each radionuclide in the Th-232 and U-238 chains for both surface and subsurface soils. In accordance with the ARAR, a sum of the ratios calculation (also called the unity rule) is utilized with the DCGLs to assure compliance with the radium standard. Laboratory results and gamma walkover survey data and Environmental Visualization System (EVS) software were used to estimate the plan areas and volumes of soil exceeding cleanup levels. Initial estimates indicate that potentially 48931.51 cubic meters of soil are impacted with FUSRAP contaminants. In addition to the chemical-specific ARAR, USACE also identified location-specific and action-specific ARARs and To Be Considered (TBC) guidance which may affect or restrict remedial and site activities.

General response actions (GRAs) were selected that will achieve, either alone or in combination with each other, the cleanup goals for the site. For each GRA, specific technologies and process options were identified and screened against the criteria of effectiveness, implementability, and cost. The following technologies were retained during the screening process: soil washing, segregation, capping/covering, excavation/disposal, and site restrictions. USACE conducted a bench scale study to verify the efficacy of soil washing on RWDA soils since literature research showed that viability of the technology is highly influenced by matrix characteristics, such as soil particle sizes. The bench scale testing, which utilized a strong acid flushing solution to mobilize contaminants from excavated soils, showed general reduction in radionuclide concentrations. USACE also visited a site (Tulsa, OK) that was undergoing remedial action for radionuclides using a relatively new soil segregation technology (gate segregation) to evaluate it viability for implementation at the RWDA site.

The retained technologies and process options were then assembled into the following remedial alternatives: Alternative 1 – No Action; Alternative 2 – Partial Excavation, Off-Site Disposal, Regrading, and Installation of Soil Cap; Alternative 3 – Regrading and Installation of Soil Cap; Alternative 4 – Excavation and Off-Site Disposal; Alternative 5 – Excavation, Segregation and Off-Site Disposal; and Alternative 6 – Excavation, Segregation, Soil Washing and Off-Site Disposal. Costs were developed using the cost estimating software *Remedial Action Cost Engineering and Requirements* (RACER). The alternatives were screened against effectiveness, implementability, and cost. All six of the alternatives passed the screening process, so they were further evaluated in detail using evaluation criteria established by the NCP. Finally a

comparative analysis of the alternatives was performed to identify the advantages and disadvantages of each alternative relative to each other.

CHALLENGES ENCOUNTERED DURING DEVELOPMENT OF THE FS

Managing Stakeholder Input and Expectations

Unlike many FUSRAP sites, the W.R. Grace Curtis Bay Facility is not a government-owned property. It is an active chemical manufacturing plant, with processing activities being conducted within Building 23 and adjacent to the RWDA. As such, there have been plant access issues, as well as areas that are inaccessible at the two sites, which occasionally hampered FUSRAP activities at the site. In general, however, USACE and the site owner were able to coordinate RI and plant activities.

One of the biggest challenges that USACE faced during development of the FS was when the site owner was identified as a Potentially Responsible Party (PRP) for the residual radioactivity remaining in Building 23 and the RWDA in the middle of drafting the FS document for RWDA. As a result, both parties re-evaluated their position relative to the following issues (1) the desired level of active participation in the project, (2) the selection of remedial goals and obtaining closure for the sites and (3) the identification of legal considerations that had to be solved to protect the interests of both parties.

As a result, USACE and site owner were no longer coordinating efficiently and communications became strained and unproductive. This became a significant and substantial road block to project progress. To begin resolving their differences, USACE and the site owner agreed to retain a mutually acceptable facilitator to attend joint meetings, evaluate and critique the current lines of communication and identify mutual goals. Due to the cooperation of both parties mediation proved to be highly successful endeavor and lead to the regeneration of the USACE/site owner relationship now including the site owner as an active participant in the process. The resulting cooperation and rebuilt relationship between USACE and the site owner led to the creation of a non-binding partnering agreement, and steps were taken to streamline USACE and site owner interaction during the RI/FS process. Two significant changes were made. First, the site owner became an active partner in the development of technical documents, instead of receiving documents only after they were finalized. Second, instead of conducting all meetings with every technical, legal, and management team member in attendance, breakout groups were formed based on discipline and met separately from each other (i.e. technical group, legal group) with specifics agendas set and coordinated by the USACE and in cooperation with the site owner Project Manager. The USACE and site owner Project Managers coordinated the groups, assigned actions items for each group and attended all meetings. Meeting minutes and agendas are generated for every meeting. Some constraints could not be dispensed with such as FUSRAP as program funding cycles and guidance, CERLCA/NCP requirements and site owner's operation and development of the site.

The site owner has more recently expressed interest in actively participating in remedial action activities. Therefore, USACE and the site owner are currently finalizing a settlement agreement to support cooperation between the parties. Although work at the site is not yet complete and

other obstacles may arise, USACE has effectively managed the site owner's input and expectations, mainly by acknowledging owner concerns and providing avenues for the owner to participate in the FUSRAP process.

Selecting the Most Appropriate ARARs

Response actions at FUSRAP sites are subject to the provisions of CERCLA and the NCP. Section 121 of CERCLA provides that if any hazardous substance is going to remain at a site after a response action, the response action must require a level or standard of control for the hazardous substance that at least attains a legally applicable or relevant and appropriate requirement (ARAR). Applicable requirements are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those substantive environmental protection requirements, promulgated under Federal or State law which, while not applicable, address problems or situations similar to those encountered at the CERCLA site and are well suited to the particular site.

The RI conducted at the RWDA provided the data needed for developing and evaluating effective remedial alternatives to address residual radioactivity at the site, and made a preliminary identification of ARARs. The ARARs are currently being refined as part of the FS process.

Selection of a chemical-specific ARAR was not initially straightforward due to the regulatory history at the site. As mentioned previously, the RWDA and adjacent boundary areas contain residual activity due to monazite sand processing/milling operations for thorium source material in the mid-1950s by the site owner, under a license from AEC. That license is no longer in effect. The NRC has never issued a license for the site, and there has not been a decommissioning undertaken at the site. In addition, processing operations ceased prior to the enactment of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 and although the processed material would be similar to 11(e)(2) byproduct material, it is not under the jurisdiction of the NRC[1]. After considerable discussion and evaluation of these factors and the lack of precedent USACE, in agreement with the site owner, identified the following chemical-specific ARAR to be relevant and appropriate for the RWDA: 10 CFR 40 Appendix A, Criterion 6(6). This ARAR is not "applicable" to the RWDA remedial action since there is no active license for the site, but the requirement is "relevant" in that the milling operations, while ongoing, were similar to operations that would occur at a thorium mill. The requirement is also "appropriate" in that it deals specifically with soil, and incorporates the dose contribution from all radionuclides present at the site into the standard.

Challenges were encountered during selection of ARARs. As noted previously, the W.R. Grace facility is an active manufacturing plant, which is normally subject to numerous procedural requirements, including permit requirements. However, in a CERCLA response action, only

[1] NRC has characterized this type of material as "residual radioactive material resulting from the process of ores before the enactment of UMTRCA".

substantive environmental standards associated with potential remedial activities are identified as ARARs. Pursuant to CERCLA and the NCP, an exemption applies to procedural requirements, including requirements to obtain permits, for response actions on the CERCLA contamination site and in very close proximity to that site. USACE has the responsibility, as lead Federal agency, to identify and select ARARs as per CERCLA guidance.

Defining Separate and Distinct Remedial Alternatives

For the RWDA FS, USACE and the site owner wanted to investigate alternative technologies in addition to the "dig and haul", to address residual radioactivity and to integrate them, if possible, into remedial alternatives. Due to the physical and chemical characteristics of the monazite sand, the following technologies were identified to be potentially implementable in the FS: soil washing, segregation, capping/covering, excavation/disposal, and site restrictions. For two of the technologies, soil washing and segregation, limited information was available about effectiveness; therefore, USACE conducted some investigative field work to assess whether they should remain in the screening matrix and be included in remedial action alternatives.

USACE conducted a bench-scale study to assess whether soil washing would be an effective technology for the site. If implementable and cost efficient, soil washing would lower radiological activity in the soil to achieve cleanup criteria, which would reduce (or eliminate) the volume of soil ultimately requiring off-site disposal (or other action). Literature research showed that contaminant removal efficiency is highly influenced by matrix characteristics, such as soil particle size. Therefore, soil washing was conducted on actual site soils. The bench-scale testing, which utilized a strong acid flushing solution to mobilize contaminants, showed general reduction in radionuclide concentrations. Thus, the technology was retained in the FS screening matrix, and costs for a full-scale system were estimated to allow it to be evaluated against other selected technologies.

Segregation is a physical separation process that can be implemented using traditional sampling/analytical routines or newer automated techniques (gate segregation). Segregation provides a more complete characterization of the soil, which increases the likeliness of identifying soil that is below cleanup criteria. Soil that is identified can be physically separated from the waste stream, and thus reduce the amount of soil requiring disposal (or other action). USACE visited a site in Tulsa, OK with a similar radiological waste stream that was undergoing remedial action using the gate segregation technology. The main goals of the visit were to evaluate the technology's success at the site and assess whether it would be a viable technology for the RWDA site. The gate segregation technology was successful at identifying and segregating soils below the cleanup goals at the Tulsa site. Based on those positive results and the similarity of the RWDA's contaminants, the segregation technology was retained in the FS screening matrix for the RWDA.

Another challenge facing development of the remedial action alternatives (and their associated cost estimates) was the uncertainty about potential impact in the boundary areas of the RWDA. Historical documentation suggested that all monazite sand processing wastes were buried within a four-acre area, which was later surveyed and fenced. Thus, the RI was mainly focused on the RWDA. However, based on results of the RI, which showed residual radioactivity at the

fenceline, and discussions with the site owner, additional field investigation was deemed necessary in the boundary areas of the RWDA. The challenge, though, was to limit the amount of money spent further investigating the site, so that more resources would be available for remedial action. Therefore, a gamma walkover survey was conducted over the entire boundary area, but soil sampling was only performed in targeted areas. Sample results were used to assess contamination in the targeted areas and to project potential contamination across the rest of the boundary area based on gamma walkover results. The goal of the additional surveying and sampling was to provide more assurance about the nature and extent of contamination at the site and provide better information during development of cost estimates for each remedial action alternative.

Based on the information obtained during the alternative technology review and the additional field investigation, the identified technologies and process options were assembled into the following remedial alternatives:

Alternative 1 – No Action
Alternative 2 – Partial Excavation, Off-Site Disposal, Regrading, and Installation of Soil Cap
Alternative 3 – Regrading and Installation of Soil Cap
Alternative 4 – Excavation and Off-Site Disposal
Alternative 5 – Excavation, Segregation and Off-Site Disposal
Alternative 6 – Excavation, Segregation, Soil Washing and Off-Site Disposal.

The alternatives were developed to take advantage of the distinct technologies, which provide different methods and costs for addressing the waste. After an extensive screening analysis, all six of the alternatives were retained, and each will be considered during the remedial alternative selection process. Although extra work was entailed, the additional resources used to review alternative technologies and collect data promoted the development of a comprehensive FS document.

SUMMARY

Conducting the W.R. Grace FUSRAP site FUSRAP process has been challenging from a project management perspective, due in part to the nature and extent of impact at the site (residual radioactivity; active processing building and disposal area) and incorporating site owner involvement in the process. Through the use of mediation and mutual commitment to the project by both parties, USACE and the site owner were able to find agreement on fundamental issues and set a firm foundation for achieving successful remedial action and site closure using a “forward thinking” approach.

Currently, USACE is finalizing the RWDA FS to address contamination in soils at the RWDA. ARARs have been identified and selected as per CERCLA guidance. Although obstacles were encountered, the challenges were handled successfully, and USACE is finalizing a robust document acceptable to the site owner, the regulators, and the public, which will allow USACE to move forward successfully in the FUSRAP program.