

**Formerly Used Sites Remedial Action Program (FUSRAP) W. R. Grace Building 23  
Remedial Action—Challenges and Successes - 12247**

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**ABSTRACT**

Monazite sand processing was conducted at the W. R. Grace Curtis Bay Facility (Baltimore, Maryland) from mid-May 1956 through the spring of 1957 under license 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 ca. 100 year old, five-story, building (Building 23) in the active manufacturing portion of the facility. Building components and equipment in the southwest quadrant of Building 23 exhibited residual radiological activity remaining from the monazite sand processing. U.S. Army Corps of Engineers (USACE) conducted a remedial investigation (RI) and feasibility study (FS) and prepared a Record of Decision (ROD) to address residual radioactivity on building components and equipment in the southwest quadrant of Building 23. The remedy selected for the southwest quadrant of Building 23, which was documented in the ROD (dated May 2005), was identified as “Alternative 2: Decontamination With Removal to Industrial Use Levels”. The selected remedy provided for either decontaminating or removing areas of radioactivity to meet the RGs. Demonstration of compliance with the selected ARAR was performed using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and other appropriate guidance, as well as appropriate dose modeling codes where necessary. USACE-Baltimore District along with its private industry partner worked together under the terms of a 2008 Settlement Agreement to implement the remedial action (RA) for the southwest quadrant of Building 23. The RA was conducted in two phases: Phase 1 was completed to improve the building condition for support of subsequent remedial action and decrease scope uncertainty of the remedial action, and Phase 2 included decontamination and removal activities to meet the RGs and demonstration of compliance with the selected ARAR. Challenges encountered during the RA include: coordination with stakeholders, coordination between multiple RA contractors, addressing unique structural challenges for Building 23, nonradiological hazards associated with the RA, weather issues, and complex final status survey (FSS) coordination. The challenges during the Phase 1 RA were handled successfully. The

challenges for the Phase 2 RA, which is anticipated to be complete by late-summer of 2012, have been handled successfully so far. By fall of 2012, USACE is expecting to finalize a robust RA Closure Report, including the Final Status Survey Report, which summarizes the RA activities and documents compliance with the ROD.

## **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 from mid-May 1956 through the spring of 1957, while under license 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 ca. 100 year old, 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 as 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 indicated that remedial response actions were necessary and appropriate for both areas. A feasibility study (FS) was completed for Building 23 in 2004 and the RWDA (2008). The Record of Decision (ROD) for Building 23 was issued by USACE in 2005 to address residual radioactivity on building components and equipment and in the underlying soil. A ROD for RWDA was issued by USACE in 2011 to address residual radioactivity in soil.

In 2008, the United States and its private industry partner entered into a Settlement Agreement to resolve a claim filed by the U.S. government in the private party's voluntary reorganization proceedings in bankruptcy court and to define the roles of the parties during implementation of the remedial action (RA) for the southwest quadrant of Building 23 and all other FUSRAP Material (as defined in the Settlement Agreement). Among other things, the Settlement Agreement specifies that the site owner is responsible for management of RA contracts except the Final Status Survey contract which is exclusively funded and administered by USACE, and it details tasks and responsibilities of USACE and the private industry partner.

## **SITE OVERVIEW**

The southwest quadrant of Building 23, which is five stories and has an approximate

plan area of 2,200 square meters (m<sup>2</sup>) for the first floor, is generally partitioned from the remainder of the building by walls of corrugated steel sheet. The building consists of mainly steel I-beam construction, with corrugated steel sheeting and concrete floors and a concrete roof. Prior to remedial activities that were conducted from 2009 onward, the flooring in Building 23 was a mixture of old and new reinforced concrete, with steel plating and steel grating occupying parts of the second, third, fourth, and fifth floors. The first floor is a concrete slab, overlying soil.

## **NATURE AND LOCATION OF THE CONTAMINATION**

Building 23 contained residual radioactivity due to monazite sand processing/milling operations primarily for the extraction of source material in the form of thorium-232 (Th-232), as well as the extraction of rare earth elements. Monazite sand has naturally occurring radiological components, which include uranium-238 (U-238) and Th-232 and their decay products. Building components (primarily concrete floors and ceilings, steel beams and columns, and walls), and equipment in the southwest quadrant of Building 23, along with the soil beneath the southwest quadrant, exhibited residual radiological activity in excess of naturally occurring levels. The highest activity associated with the residual radiation was located on the fourth and fifth floors.

During the RI, more than 1.9 million radiological measurements were collected on building surfaces within the southwest quadrant of Building 23. Based upon the results, a total of nine radiological areas of concern (AOCs) were identified. A Baseline Human Health Risk Assessment (BHHRA) was completed for the southwest quadrant of Building 23 to evaluate the potential radiation exposures and potential risks to members of the general public if Building 23 were released in its current condition and used for industrial purposes without additional cleanup or occupancy controls to limit radiological exposures for use of the structure. The BHHRA included conservative assumptions related to exposure scenarios (such as the residual activity associated with the monazite sand processing and the length of time receptors may be exposed). The greatest risks calculated in the BHHRA (one order of magnitude above the acceptable risk ranges established by U.S. EPA) were associated with AOC 8 (fourth floor) and AOC 9 (fifth floor) for each of the industrial worker scenarios. Based on the RI sampling results and calculated potential risk associated with AOCs 8 and 9, USACE determined that a remedial response was necessary to protect the public health and welfare and the environment from actual or threatened releases of hazardous substances into the environment.

## **REMEDIAL GOALS**

The monazite sand processing in the southwest quadrant of Building 23 was conducted from mid-May 1956 through the spring of 1957 by the property 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<sup>1</sup>. After considerable discussion and evaluation of these factors and the lack of precedent, USACE identified the following chemical-specific applicable or relevant and appropriate requirement (ARAR) to be relevant and appropriate for Building 23: 10 CFR 40 Appendix A, Criterion 6(6). This ARAR is not “applicable” to Building 23 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/structures, and incorporates the dose contribution from all radionuclides present at the site into the standard.

The remedial goals (RGs) for building components are based on the selected ARAR and were developed using RESRAD and RESRAD-BUILD computer modeling codes with site-specific modeling parameters, where available. Two steps were necessary to develop RGs that satisfy the requirements of 10 CFR 40, Appendix A, Criterion 6(6), for a building or structure. These steps included:

- determining the benchmark doses associated with 5 picocuries per gram (pCi/g) [0.185 becquerel per gram (Bq/g)] of radium-226 (Ra-226) and radium-228 (Ra-228) within surface soils (first 15 cm) and 15 pCi/g [0.555 Bq/g] of Ra-226 and Ra-228 within subsurface soils (below 15 cm), and
- developing derived concentration guideline levels (DCGLs) for building surfaces in disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>) that are equivalent to the benchmark dose for Ra-226 and Ra-228 developed above, which includes the total disintegrations associated with the decay of multiple radionuclides and their decay progeny present in Building 23.

A benchmark dose was calculated for Ra-228 in soil using the RESRAD benchmark modeling software<sup>2</sup>. Where site-specific values for input parameters were not available, the default values provided in RESRAD were used. The Industrial Worker scenario was selected as the most appropriate exposure scenario for Building 23, as it closely resembles the current and expected future use of the building. The resulting benchmark dose from exposure to Ra-228 for an industrial scenario was calculated to be 7.37 millirem per year (mrem/yr) [0.0737 mSv/yr]. Modeling using RESRAD-BUILD was then performed to determine the radiological activity on building surfaces that would result in a dose of 7.37 mrem/yr [0.0737 mSv/yr] for the Industrial Worker scenario. Based upon the modeling, the RG for building components in Building 23 was to reduce surface activity on building component surfaces to below 1,234 disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>), with the additional requirement that the alpha and beta components of the total activity, 740 dpm/100 cm<sup>2</sup> for alpha activity and 494 dpm/100 cm<sup>2</sup> for beta activity, are also met. These RGs were values to be achieved above component background levels for each type of material in accordance with the

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<sup>1</sup> NRC has characterized this type of material as “residual radioactive material resulting from the processing of ores before the enactment of UMTRCA”.

<sup>2</sup> The most conservative (lowest) benchmark dose in the industrial worker scenario comes from exposure to Ra-228.

guidance provided in MARSSIM. RGs for localized areas of elevated surface activity also needed to be met in order to achieve the remedial action objective.

## **REMEDY SELECTED FOR THE SOUTHWEST QUADRANT OF BUILDING 23**

Alternative 2, Decontamination With Removal to Industrial Use Levels is the selected remedy.

The selected remedy consists of:

- Application of cleanup goals derived in accordance with MARSSIM from the selected chemical-specific ARAR, 10 CFR 40, Appendix A, Criterion 6(6).
- Decontamination using chemical or mechanical decontamination technologies of the concrete floors and sections of the ceilings above the concrete floor areas of the fourth and fifth floors (AOCs 8 and 9). Where decontamination is assessed to be ineffective, impractical, or not cost effective, building components will be removed and replaced, as practical.
- Decontamination of the walls and structural steel with surface activity above RGs on the fourth and fifth floors, using chemical or mechanical decontamination technologies. If post decontamination surveys indicate radiological activity above criteria, structural steel and walls will be decontaminated again and resurveyed. This iterative approach would continue until surface activity levels meet the RGs. Where decontamination is assessed to be ineffective, impractical, or not cost-effective, building components will be removed and replaced, as practical.
- Removal of floor tiles in the laboratory, break room, and motor control room in select areas on the second and third floors (AOCs 4 and 7). A radiological survey would be conducted on the concrete surface below. If surface activity levels are above RGs, the floor surfaces would be decontaminated using chemical or mechanical decontamination technologies. Where decontamination is assessed to be ineffective, impractical, or not cost-effective, building components will be removed and replaced, as practical.
- Removal of the wooden floored platform (AOC 10) and abandoned-in-place piping and equipment in AOCs 8 and 9.
- Completion of a Final Status Survey (FSS) in accordance with MARSSIM.

The selected remedy provides for either decontaminating or removing all areas of radioactivity to meet the RGs. Where decontamination is impractical or undesirable, removal will be undertaken to ensure RGs are met. However, in any small area where residual radioactivity may potentially exceed RGs, but the area is inaccessible for verification that RGs are met and/or removal is impractical or undesirable, a dose assessment specific to the conditions presented by the known, or estimated, residual activity in that small area will be conducted to determine whether the dose from the remaining radioactivity meets the benchmark dose established by the ARAR.

## **REMEDIAL ACTION ACTIVITIES**

The RA for Building 23 was conducted in two phases. Beginning in early 2009, an environmental remediation contractor (Phase 1 Contractor) was contracted to perform preliminary RA work to improve the building condition for support of subsequent remedial action and to decrease scope uncertainty for the full-scale remedial action. The work consisted of the following:

- Preparation of work planning documents;
- Installation of fencing and plastic barriers to prevent unauthorized access into the work area and to control dust migration from the southwest quadrant to other areas of the building;
- General area cleaning necessary for general housekeeping for work areas, for control of dust, and to support radiological survey and pilot testing tasks;
- Removal and replacement of a portion of the ground floor slab that was not in a condition to adequately support heavy equipment/material loads (necessary for full-scale RA activities);
- Soil sampling beneath the ground floor slab to assess the nature and extent of impact of radiological constituents and select chemicals;
- Hazardous materials survey to identify asbestos-containing material (ACM) that would require removal or control and to support waste characterization activities and materials handling methodologies during full-scale implementation of the remedial action;
- Pilot decontamination testing to determine the ability of various decontamination methods to remove both fixed and removable radiological contamination from building surfaces while preserving the structural integrity of those elements. The methods used for decontamination varied from nonabrasive techniques, primarily intended for loose or removable contamination, to more aggressive methods, which were more likely to be effective for fixed contamination;
- Lateral radiological assessments within two meter boundaries around known radiologically-impacted areas to minimize any uncertainties about the extent of impact within the southwest quadrant;
- Abandoned equipment characterization to assess the nature and extent of impact and determine the appropriate disposal pathways;
- Additional inspection of one Area of Concern (AOC-10) to identify/quantify building components and potential impact that may need to be addressed during the full-scale remedial action;
- Establish radiological reference data for all materials slated for decontamination or removal and background levels for all areas within the southwest quadrant of Building 23; and
- Coordinate with facility electrical and mechanical personnel to identify and properly demarcate (1) all line(s) that are still in service, or lines that need to remain in service and will require re-locating; (2) lines no longer in service that can be removed; and (3) lines in service that can be removed from service.

Given the amount of uncertainty associated with the Phase 1 RA work, the contract was set on a time and materials (T&M) basis. Phase 1 RA fieldwork was completed in June 2009.

Phase 2 RA activities, full-scale remediation activities in accordance with the ROD, were conducted utilizing a different environmental remediation contractor. Contracting and planning document development for the Phase 2 RA were completed in 2010, and fieldwork began in January 2011. The Phase 2 RA contractor conducted the following general work activities:

- Preparation of work planning and design documents;
- Maintenance of existing fencing and plastic barriers;
- General cleaning (mainly dust removal) in the southwest quadrant;
- Establishment of background measurements
- Installation/modification of fall protection/arrest systems and material transfer systems;
- Miscellaneous material and equipment removal;
- Active utility relocations;
- Removal of wood, miscellaneous components, and structural steel (as necessary) in the AOC 10 area;
- Decontamination and/or demolition and/or reconstruction, as required, on the first, second, third, fourth and fifth floors, the roof, and structural elements, walls, and ceilings at each level (Floors 1 through 5);
- Waste management, transportation, and disposition; and
- Demobilization/closure reporting

Given that uncertainty was greatly diminished due to Phase 1 RA activities, the contract was set as firm fixed price for all the Phase 2 RA work, except for management of the contents of a tank within AOC-10 since there was minimal information regarding the contents. Phase 2 RA fieldwork is anticipated to be completed by late-summer of 2012.

At completion of RA activities by the Phase 2 RA contractor (but prior to full demobilization), the FSS will be conducted by an independent radiological consultant, contracted directly by USACE, for verification that the southwest quadrant of Building 23 will be released in accordance with the selected ARARs and remedial goals provided in the ROD. During implementation of the RA, independent verification surveys are being conducted by the Maryland Department of the Environment.

## **CHALLENGES ENCOUNTERED DURING REMEDIAL ACTION**

This was the first USACE FUSRAP site where a private party is conducting the remediation, and thus this project team had the opportunity and challenges to try something new. As background, USACE was performing the work for a number of years with the site owner providing access. Cost allocation was never raised. The issue of who was going to pay arose when the U.S. Department of Justice filed a claim, in the voluntary reorganization proceedings initiated by the site owner, for 100% reimbursement for past and future costs associated with the FUSRAP work. This filing altered the expectations of the parties and creating an allocation issue that required resolution. After a period of negotiations a Settlement Agreement was reached that, amongst other matters defined a fair allocation between the U.S. and the private party,

the roles and responsibilities of the private party and USACE in implementing further remedial actions and established a tiered dispute resolution process. This created a new scenario for USACE: providing oversight rather than contracting for the work. USACE's only major contracting role was to provide for the FSS, to keep it independent from the rest of the work. During negotiations and since, the working relations associated with remedial activities between the site owner and USACE have been cooperative and productive; this was fortunate since there were many challenges that were faced during RA implementation, and these challenges were faced effectively due to the good relationship between USACE and the site owner.

The following challenges were encountered during remedial action activities:

- Complexity of the RA work (working at elevated heights, extraction of building components, precision of demolition activities, etc.)
- Complexity of the building – age, irregular floor configurations, no complete as-built drawings
- Working environment – facility security, active production areas in other Building 23 quadrants
- Contracting mechanisms
- Permit process – radioactive license reciprocity, Baltimore City demolition/construction permits
- Work protocols – the need to compare USACE, facility, and OSHA protocols and then work under the most stringent protocol
- Implementation of Settlement Agreement – dual oversight (private [contracting] party and USACE)
- Coordination between FSS and RA contractors
- Implementation of the FSS

One of the biggest hurdles at the beginning of both the Phase 1 and Phase 2 RA work was making sure that the contractors understood the unique issues associated with the work. For example, Building 23 is an active processing building at the facility. One of the primary goals during RA work was to not impact facility workers or production in the other quadrants of Building 23. To accomplish this, the Phase 1 RA contractor constructed security fencing and plastic barriers so that non-RA workers did not accidentally enter the work area and so that dust (or other RA wastes) did not impact valuable product that was being manufactured by the facility, and facility workers were briefed so that they understood the nature of the work being conducted. Continued maintenance of the security fencing and plastic barriers was carried out by the Phase 2 RA contractor. Frequent maintenance of the plastic barrier was required due to effects of wind on the plastic when bay doors were open (a regular occurrence since it is an active manufacturing building).

The physical layout of the building was a challenge for the Phase 1 and 2 contractors. Building 23 is a ca. 100 year old building, which has undergone many retrofits over the years which are not completely documented on available drawings. Each floor within the southwest quadrant varies in size (lateral extent) and materials of construction (old concrete, new concrete, grating, steel plate, wood, etc.). In addition, there were several



areas that required extra caution due to their age (e.g., degraded areas of flooring). Although there are building plans available (dated 1999), they are not as-built drawings, so there was some uncertainty about structural and utility elements within the building. In addition, to truly become familiar with the building and the work to be conducted, on-site observations are required to put the building and work into context. USACE and the site owner worked together and spent considerable effort to ensure that each contractor understood the peculiarities of the building. Multiple site visits by contractor representatives, with site owner and USACE personnel that were familiar with the building, were conducted to ensure that the contractors had an understanding of the building structure and the nature and extent of residual radioactivity within the southwest quadrant – both during the bidding process and through the implementation of the RA.

Another major challenge associated with both Phase 1 and Phase 2 RA contractors was coordination. Consistent with the Settlement Agreement: the site owner implemented the contracts for the RA work; both the site owner and USACE had specific review and approval authorities; USACE was the waste generator of record and thus was intimately involved in waste transport and disposal (i.e. executing shipping papers); and USACE retained final approval authority for closing the site. The ability to accurately define the schedule for final status survey and waste shipment activities was one of the more challenging logistical aspects of the work for all parties.

Select challenges that were specific to each Phase of the RA are discussed below.

### **Phase 1 RA**

The Phase 1 RA contractor was working under a T&M contract, with a not to exceed budget. At the time, this was thought to be the most effective contracting vehicle since the work to be performed was not easily quantifiable for a “lump sum” mechanism. One of the problems associated with T&M contracts is being able to assess whether the work is being conducted as efficiently as possible. Unless a contractor has a documented history of good work practices, rigorous oversight is key to making sure that the contractor is doing quality work, while staying within a reasonable budget and abiding by all health and safety requirements. During performance of the Phase 1 RA, both USACE and the site owner provided oversight personnel to verify that work was being conducted appropriately. The work was completed safely, however the period of performance was longer than anticipated and this phase of the project ended over budget by a substantial amount. The budgetary overrun was, in part, contributed by the timeliness of invoice submittals and the lack of a requirement to provide earned value budget status reports (that would otherwise have provided an early indication of the impending overrun).

### **Phase 2 RA**

The Phase 2 RA contractor was working under a fixed price contract for the majority of the work that was required. There was still some uncertainty, and mechanisms were in

place within the contract to allow change orders for reasons including unknown conditions. One of the problems associated with a fixed price contract is potential loopholes created if a scope of work (SOW) is not well written. These loopholes can lead to change orders. The SOW for Phase 2 RA was well thought out and very detailed, yet there were still issues with many requests for change orders. This necessitated additional work for both USACE and the site owner to review and evaluate the nature of the change orders. While some of the change orders were appropriate, others were not.

In addition, field oversight during implementation of a fixed price contract should be less rigorous than what is required for a T&M contract. This was not the case for the Phase 2 RA work. The level of oversight was actually greater for Phase 2. In part, this was due to multiple health and safety issues that arose during implementation of the RA and the concern that many key RA demolition components were not being thoroughly planned prior to implementation.

Planning documentation was a challenge during the Phase 2 RA. The work plans were not as specific about implementation as USACE might otherwise require, as the contractor wished to maintain flexibility in the approach ultimately implemented for various tasks. The contractor assured both the site owner and USACE that work control packages (WCPs), developed during implementation of the RA to provide specific instructions to the work crew for definable features of work, would be beneficial since they would be prepared utilizing the most up-to-date information from the field. While this would seem to be an advantage, it turned out not to be as effective or cost efficient for the site owner and USACE. Turnaround time for review and comment was required relatively quickly, with little lead time before notification that the documents were ready for review.

As Phase 2 RA work was being conducted, many issues hindered the contractor's progress. The lack of progress by the contractor during the initial components of the RA work (preparation of planning documents) resulted in less time for the contractor to complete the required fieldwork in order to meet the project schedule, and not incur damages specified in the contract. For any project, loss of field time due to inefficiency can be problematic since it minimizes a contractor's ability to respond to typical challenges in the field. An unanticipated issue that arose during RA implementation was associated with asbestos containing material (ACM). During fieldwork, ACM was identified in several areas in the southwest quadrant. In some of these areas (especially AOC-10), ACM could not have been identified in advance by the contractor. USACE and the site owner are currently evaluating contractual implications for unanticipated ACM.

Many FUSRAP sites, including this site, are located on the east coast and require transport of material by a combination of rail and/or highway thousands of miles to disposal facilities in the west. Identifying the infrastructure capabilities supporting each disposal facility as well as the RA site (rail, truck, or vessel) were important factors in determining the methods for disposal. Originally, the contractor was going to use rail

(gondolas) as the primary transportation method. However, during RA implementation, the contractor realized that the rail method was not effective for “light loads”. As such, after consideration of possible waste disposal facilities and coordination issues for waste packaging and handling, the use of both rail and truck shipment was conducted by the contractor to maximize cost effectiveness and minimize shipping disruptions associated with coordination with USACE as waste generator (and thus signatory to shipment papers).

The coordination of multiple contractors under separate contracts is always a challenge, especially if the contractors need to work closely together to make the project succeed. USACE was responsible for contracting an independent FSS contractor. The site owner was responsible for contracting the RA contractor. Given that the FSS contractor is responsible for independently verifying that the building meets the remedial action objectives, only limited coordination is allowed between the two contractors. As such, USACE and the site owner facilitate coordination and agreements between the two contractors. Significant delays and schedule changes associated with the RA contractor’s work became problematic and tedious for USACE, since it was directly responsible for keeping the FSS contractor ready to conduct FSS within a short notification window.

The FSS at Building 23 is unique and challenging. The chemical-specific ARAR for Building 23 is 10 CFR 40 Appendix A Criterion 6(6). The potential exposure route is inhalation of contaminated dust to the reasonably maximally exposed individual, an industrial worker. The remedial goal for building components is to reduce surface activity to less than 1,234 dpm/100 cm<sup>2</sup> (740 dpm/100 cm<sup>2</sup> for alpha activity and 494 dpm/100 cm<sup>2</sup> for beta activity based on secular equilibrium) above background levels. The comparatively low DCGL for beta activity means that the possibility for false positive measurements is pronounced. The natural variation in background building materials beta readings is comparatively large compared to the beta DCGL. Consequently, other sources of error such as sampling error and the accuracy and precision of the measuring equipment must be controlled and minimized.

The selected remedy consists of demolition and removal of impacted building materials. Complete demolition and replacement of the building was calculated during the feasibility study to be cost prohibitive. While the selected remedy met the shared objectives of the site owner and the Government, including protection of workers, members of the public and the environment, and the safe remediation of the southwest quadrant of the building for industrial reuse, the landowner had some unique objectives. Of paramount importance was keeping manufacturing operations unimpeded in the remainder of the building during remediation. Part of the roof of the building had to be removed while the remainder of the plant continued active operation, which meant that the building interior needed to be protected from rainwater intrusion. To accommodate this requirement, the FSS was split into two parts; one for the roof and one for the interior, in order to allow the roof to be replaced and surveyed on an expedited basis. The FSS team worked just behind the remedial action contractors in some areas. In

some cases, further construction would have made some surfaces inaccessible to FSS had this iterative approach not been adopted.

The 4th and 5th floors were demolished as part of the remediation activities, so scaffolding and aerial lifts will be raised in some places through five floors, to give survey technicians access to the structural beams on the 5th floor ceiling for survey. Protocols have been developed to survey irregular surfaces, such as diamond-plate steel flooring and steel grates.

## **SUMMARY**

During the ongoing RA at Building 23, there have been and still are many challenges both technically and from a project management perspective, due in part to the nature and extent of impact at the site (residual radioactivity within an active processing building), dual oversight by the property owner and USACE, and site-specific challenges associated with a complex RA and multiple contractors.

Currently, USACE and its industry partner are overseeing the completion of RA field activities. RA closure documentation for the remediation of Building 23 to address residual contamination in building materials will be reviewed/approved by USACE and its industry partner upon completion of the field activities. USACE and its industry partner are working well together, through the Settlement Agreement, to conduct a cost-efficient and effective remedial action to address the legacy issues at Building 23. This cooperative effort has set a firm foundation for achieving a successful RA at the RWDA using a “forward think” approach, and it is a case study for other sites where an industry partner is involved. The collaborative effort led to implementation of an RA which is acceptable to the site owner, the regulators, and the public, thus allowing USACE to move this project forward successfully in the FUSRAP program.