Remediation Issues and Solutions with Co-Located Chemical and Radiological Contaminants - 11296

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ABSTRACT

In 2009 remediation of areas of a no longer operational fuel cycle facility used for government contract work was initiated. Radiological contaminants consisted primarily of high enriched uranium (HEU). Other radionuclides encountered during the clean-up included Co-60, Cs-137, Ra-226 and Th-232. As a result of historical operations and practices conducted at the Site, remediation activities encountered the noted radionuclides co-located with limited chemical contaminants.

Chemical contaminants included lead, cadmium, mercury, polychlorinated biphenyls (PCBs) and perchloroethylene (PCE). Materials regulated under the Toxic Substances Control Act (TSCA) that were encountered and remediated included asbestos containing materials (ACM) and materials contaminated with PCBs. The State Department of Environmental Protection (DEP) regulations as well as the Federal United States Environmental Protection Agency's (USEPA) regulations governed the remediation of the non-radiological contaminants.

The cleanup criteria to reach closure for the chemical constituents at the Site are regulated by the USEPA under the Resource Conservation and Recovery Act (RCRA), and the DEP under their remediation regulations.

This paper discusses processes, problems and solutions associated with clean-up of co-located radiological and chemical contaminants. Emphasis is placed on mixed waste avoidance and minimization, discovery and handling of drums with suspect chemicals, the impact of USEPA's requirements for remediation of PCBs in building materials, and the impact of enriched uranium accountability on the over-all clean-up process.

INTRODUCTION

The co-location of chemical and radionuclide contaminants requires a shift in the common approach to a contaminated site remediation. For sites where the focus is both chemicals and radionuclides, a different planning and safety approach to remediation is needed to both protect the worker and reduce potential waste disposal costs. The specific site under consideration for this project had in addition to the presence of mercury, cadmium, lead, perchloroethylene (PCE), petroleum aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and asbestos, uranium contamination of various enrichments. The need to ensure license limits of special nuclear materials (SNM) were not exceeded further complicated the methods of performing the remediation. In addition, all materials were remediated in a manner consistent with the Comprehensive Environmental Reclamation, Compensation and Liability Act (CERCLA).

Integrated work approaches involving the traditional elements of Integrated Safety Management were used to complete the remedial activities. Work plans were developed for the different project remediation areas, worker input to the planning process was obtained, workers were trained prior to conducting the work tasks, and after initial execution of the work feedback to the process was used to revise the work plans and improve future work tasks.

In performing the remediation work it was essential to ensure that the project goals and relevant regulatory requirements were being satisfied. Appropriate elements of Occupational Safety and Health Administration (OSHA) and the State Health Department requirements were incorporated into the safety program and work plans. The site was under the jurisdiction of the Nuclear Regulatory Commission (NRC) with two licenses that governed the conduct of radiological operations with special emphasis on control and accountability of SNM materials. While not having formal jurisdiction over site remediation operations, the site owner had an agreement in principal to satisfy the State Department of Environmental Protection's Radiological Division concerns and requirements. Environmental controls and chemical remediation goals/standards were governed by United States Environmental Protection Agency (USEPA) statutes, State regulations and guidelines, State Department of Health Statutes (principally PCB and asbestos remediation), and local permit requirements.

Because of the co-location of chemical and radiological contaminants the demolition of structures and the excavation and removal of contaminated soils had major impacts on waste disposal costs for the projects. Efforts to minimize the generation of "mixed wastes" were employed.

Initial Site Preparation and Mobilization

The need to adhere to NRC SNM requirements required the construction of a facility to store and safeguard SNM materials prior to off-site disposal at a licensed facility. This facility, named the Controlled Access Area (CAA), was built to meet NRC security requirements but consideration for waste storage, handling, processing and transport were incorporated into the design.

Based upon previous site remediation work, it was expected that piping and tanks would contain chemical contaminants in addition to radioactive materials. A less than 90 day RCRA storage area (LT-90) was established within the CAA to temporarily store hazardous or mixed waste generated prior to off-site disposal at a licensed facility. Additionally a separate process area for segregating potentially mixed waste sludge from the interior of pipes and tanks was established to limit the potential for contamination of the CAA surface and protect the workers from any truck traffic during waste shipping campaigns.

Work Plans

Work plans were developed for the major project remediation task items including the following:

- Interior Tank Removal
- Building Demolition
- Sub-slab Pipe and Utility Line Removal
- Pipeline Excavations
- Landfill Excavations

Each of these work plans had unique aspects that required the incorporation of special controls and monitoring requirements due to the presence or potential presence of hazardous materials. While a Job Hazard Analysis (JHA) was developed for each specific job task, safety requirements were also incorporated into the plans. This action was taken to provide a more comprehensive understanding of how the work needed to be executed including potential hold points that may occur when specific action levels were exceeded.

The data used for developing work plans came from four principal sources:

- Site Historical Information
- Radiological Characterization Data – both former and current
- Chemical Characterization Data – both former and current
- Electromagnetic Surveys of Areas

The Site Historical information as described in the Historical Review Report and Historical Site Assessment Reports provided information on where materials such as drums and chemically contaminated soils may be discovered during removal activities. Where needed, additional characterization work was performed to verify historical information or to expand upon the existing data base of information prior to implementing any work activities.

Historical radiological data was used principally to plan for the means of removing and containerizing the demolition debris or soils. Because of the presence of enriched uranium materials and the need for strict inventory controls, a gram quantity estimate was often needed prior to removal of any materials. The site had obtained acceptance from the NRC of the methodology of removing less than 1,080 picocuries per gram (pCi/g) of U-235 contaminated debris and soils into shipping containers without the need for maintaining a gram inventory. The 1,080 pCi/g concentration limit is based upon the Department of Transportation (DOT) fissile exempt criteria and reduced the need for inventory control for almost all operations.

The historical chemical characterization data sources were similar to that of the radiological characterization data and provided a platform for planning work activities. Additional building surveys were performed to determine potential impacts of PCBs in paint and caulking material, to identify asbestos containing building materials, and to identify universal waste materials. As will be describe later the PCBs in paint and caulk had some interesting twists due to recent policy changes by the Region I EPA and DEP during the time the remediation work was being performed.

A geophysical survey employing a high resolution metal detector and an electromagnetic profiler was performed in areas suspected of containing drums to identify potential buried drums. These surveys proved most useful in ruling out some suspect areas, and were successful in identifying two areas of previously unidentified drums.

Excavation Approach

There were essentially three types of excavations being performed during the remediation:

- Removal of soils above known pipelines not suspected to contain radioactive materials or chemical contaminants;
- Excavation of near surface to several feet below surface radiologically contaminated soils; and
- Excavation of areas where drums and significant amounts of debris were present within the soils.

The excavation activities in the debris areas required the institution of special controls and surveillance. Excavation work in these areas was conducted using both traditional radiological survey meters and photoionization detectors (PIDs) to check for potential volatile organic compounds. Workers were instructed to halt work and evaluate the site conditions whenever significant soil staining or odors were encountered.

Where asbestos containing material was suspected or had actually been encountered; only workers who met the State Health Department asbestos worker certification requirements were allowed to conduct removal operations. Support personnel such as Health Physics (HP) technicians were given training to meet the OSHA requirements for asbestos workers.

Whenever a drum was encountered, work was halted and the following sequence employed to ensure worker safety:

- A visual inspection of the drum was made to determine if there was bulging of the drum.
- If no bulging was identified, the area soils were scanned using both radiological survey meters and a PID. A visual scan of the area was also conducted help evaluate if any material may have been released from the drum.
- A combustible gas meter was employed to ensure no source of flammable/combustible gases was present.
- The drum, if intact, was opened using non-sparking tools and the internal atmosphere monitored using a PID, combustible gas meter, and mercury vapor detector.
- Before moving any drums, samples of the drum contents and surrounding soil were collected and analyzed for radionuclides and to determine the gram quantity of U-235 present in the material. Approval from the SNM Manager was then required prior to removal of the drum from its location of discovery. Special precautions were taken to secure and prevent spillage of liquids if any were present from the drum.
- Finally the area was marked using stakes and the location was recorded using GPS to allow for further sample collection from the underlying soils.

Drums were segregated from soil excavated from the area and the contents where characterized to determine the proper disposal methods. Soil samples were also collected from the drum grave to determine if any radiological or chemical contamination was present in the soil that would require soil excavation and disposal.

Pipe and Manhole Removal

The project included the removal of over 10,000 linear feet of buried piping and removal of over 25 manhole structures. Due to the potential presence of both chemical and radiological materials the following process was employed to ensure worker safety during buried piping and manhole removal:

- The area excavated around the pipe or manhole was examined for soil staining, cracks in the pipe, and evidence of leakage (visual and/or olfactory).
- Prior to opening the pipe for sampling, a PID and combustible gas meter reading were obtained from inside the pipe. If penetration into the pipe was needed for sampling, non-sparking tools were used to create a small sample port in the pipe.
- Once the pipe was determined to be safe for segmentation, for piping suspected of containing significant quantities of uranium, radiological samples were collected approximately every twelve linear feet" of pipe and gram quantity of U-235 was determined.
- The interior of the pipe was visually inspected to determine if water or elemental mercury was present. If no water was present a mercury vapor detector was used to evaluate the presence of mercury within the pipe.
- Once the gram quantity of U-235 was known for each pipe segment, any water in the pipe (if present) was removed and stored in a temporary holding tank for analysis, treatment (if needed), and disposal.
- Piping containing potentially chemically contaminated material (e.g. sludge) were removed and stored in the CAA LT-90 for later handling to characterize the sludge for disposal.
- Piping that did not contain any sludge material and had a U-235 concentration less than 1,080 pCi/g were placed directly into a waste container. Piping with greater than 1,080 pCi/g materials were then mixed in with sufficient low level radioactive soils or debris to reduce the overall shipping concentration to less than 1,080 pCi/g.
- The soil areas under pipes where cracks or evidence of leakage were present was marked, a GPS location was recorded, and further chemical and radiological sampling was performed to determine if any additional soil remediation was required.

Tank Removal

The remediation effort for this project includes removal and disposal of ten 200-gallon and four 5,000-gallon steel tanks previously used for processing of radioactive waste water from the various site processes. All of the tanks are located within buildings.

Early in the project planning it was decided that entry into the tanks to sample and remove contents was not an efficient or safe operation even if all confined space entry requirements were followed. Instead an alternative handling methodology was developed where the tanks would be removed from the building, and transported to the CAA where an opening would be cut large enough for an individual to walk into the tank. The opening of the tank through normal torch cutting methods proved problematic when the paint samples from the tanks were analyzed and the results showed high concentrations of PCBs, lead and cadmium. A paint stripper was then used to remove paint from the area to be torch cut and the removed material was collected for characterization and disposal.

A special air supplied respiratory system was provided to personnel torch cutting the tanks and negative air pressure using high efficiency particulate air (HEPA) units were incorporated into the enclosure for worker safety. This turned out to be a useful engineering control as the concentration of mercury in the air exhaust would increase as the tank cutting was being performed and then immediately drop to background upon the completion of the cutting.

Because both historical data and visual observations indicated the potential for mercury to be present in the waste treatment lines and tanks, sludge and debris were removed from the tanks and placed into drums for characterization and disposal. The tanks were then re-sealed and shipped “whole” to the disposal facility for sizing. This approach was both a more cost effective disposal option and also safer method of operation for site workers.

Waste Handling

As previously noted potential or known pipes, drums, tanks, etc. were stored in the CAA LT -90 and eventually processed before disposal in a shipping container. A special waste processing area was established based upon experience gained during previous work performed at the site.

The processing area was used principally to remove the sludge from the inside of a pipe, manhole, tank or drum. Additionally the processing area was used to remove the lead collars at the pipe unions to further reduce the volume of “mixed waste” generated during the project.

Special Consideration – PCBs in Building Materials

In accordance with USEPA requirements for PCBs, PCB concentrations in excess of 50 parts per million (ppm) require disposal in accordance with the Toxic Substances Control Act of 1976 (TSCA). Typically PCBs can be found in caulking and paints used in buildings prior to 1970.

USEPA has recently issued guidance about PCBs in building materials. The new USEPA policy still considers the paint and caulk to be “Bulk Product Waste” but any materials such as the substrate below the caulk or paint would be considered a remediation waste and would need to be treated in accordance with TSCA.

Several buildings at the project site have caulking and/or paint with concentrations of PCBs greater than 50 ppm, while a few buildings had caulking and/or paint with PCBs concentrations of greater than 1 ppm. Fortunately, only one site building that was radiologically contaminated also contained caulking and/or paint with PCBs.

The USEPA required that building substrates and surrounding soils be sampled for PCBs and removed and disposed of as PCB contaminated as necessary based on the analytical results. If sample results indicated PCB concentrations were less than 50 ppm TSCA action level, the Site was required to notify the landfill where disposal would take place that the debris contained PCBs at concentrations less than 50 ppm.

The USEPA further required the submittal of sampling and removal control plans that must be approved by USEPA Region prior to conducting demolition. Overall, the additional oversight by EPA of the PCB removal process added significant time, effort and cost to the project.

Determination of Final Area Status

Because the acceptable residual soil concentrations for chemicals and radiological materials are developed in a different manner and regulated by different agencies it was important to try and recognize those differences to minimize the sampling and analysis needed for determining when an area would meet release criteria for both chemicals and radionuclides.

Sampling and analysis for radionuclides at the site was performed in accordance with MARSSIM statistical techniques while chemical sampling chemical cleanup criteria was outlined in the Post Demolition Sampling Plan. To the maximum extent possible chemical confirmation sampling was performed at the same locations as that of the MARSSIM FSS samples.

Because of the on-site spectroscopy system radionuclide identification and quantification a determination as to whether an area met NRC release criteria was typically made within 24-hours. Results from chemical confirmation sampling typically required five to ten-day turnaround time for sample results.

Two options were often employed to minimize the time an excavation area was left open. The first was to perform the chemical sampling well in advance of the Final Status Survey sampling. This was done for locations where there was a high degree of confidence that no radioactive materials above the DCGL were present. The decision was a professional judgment based upon the in process radiological survey results and the nature of the area where remediation had taken place. The second option was to backfill the excavation prior to receiving confirmation sampling results (backfill at risk) by placing a bottom surface marker (typically plastic sheeting or snow fencing). This option was employed in areas where based upon historical information, there was a limited likelihood of chemical contaminants and surveys during excavation (both visual and with chemical surveillance equipment) indicated no chemicals were present. At the present time the professional judgment used for either option has been 100% accurate and no re-excavations or re-sampling have been needed.

SUMMARY

When conducting a clean-up of a site, planning of the work is of the utmost importance in order to safely and effectively complete the project. A thorough review of available site historical data, review of pertinent regulations, and regulatory guidance documents plays an integral part of the planning process. The preparation of task specific work plans assists in breaking down the overall project scope into manageable tasks. Proper planning will help the project execution to remain on schedule and budget, and will help provide a high level of safety to site workers.