RADIOLOGICAL IMPACT ON CHEMICAL WASTE REMEDIATION (OR IS IT THE OTHER WAY AROUND?)

R. C. Woodard
TLG Services, Inc.

J. F. Conant, E. M. Hammick, R. K. Knauerhause
ABB Business Services

ABSTRACT

A 600-acre site that has a Nuclear Regulatory Commission (NRC) license is being redeveloped. Objectives for redevelopment include meeting current regulatory criteria for unrestricted use. Certain areas of the site are contaminated with low levels of uranium at high and low enrichments. The low enriched uranium is regulated by NRC license; the high-enriched uranium is legacy waste from operations performed under government contracts in the 1950's. The United States Army Corps of Engineers (USACE) is responsible for the high-enriched uranium under the Formerly Utilized Sites Remedial Action Program (FUSRAP). Furthermore, certain areas of the site are contaminated with low levels of non-radioactive chemical contaminants; these are being remediated under the Resource Conservation and Recovery Act (RCRA), to comply with United States Environmental Protection Agency (EPA) and State Department of Environmental Protection (DEP) remediation standards.

One Area of Concern (AOC) at the Site is contaminated with polynuclear aromatic hydrocarbons (PAH) at a level that exceeds the State remediation standards. Several options are normally available for remediation of low level PAH concentrations, as it is a carcinogen, but not a hazardous waste. Options include removal to an appropriate landfill, removal to an asphalt batching plant, or capping the area and imposing deed restrictions on the land. However, the RCRA contamination issue is exacerbated by the presence of very low levels of uranium contamination.

The preferred action for the PAH remediation is to remove approximately 9,200m^3 of contaminated soil to an appropriate landfill or asphalt batching plant. This solution eliminates having to cap the area, and does not trigger land use or deed restrictions on any redevelopment of the property. However, the low level uranium contamination precludes implementation of this solution. The uranium contamination levels are well below anticipated DCGLs for the site, but fails statistical testing when compared to the background reference area. Therefore, at present, remediation of this AOC would mean disposal of a large quantity of soil as low level radioactive waste, or establishing alternate disposal criteria by application to the NRC.

This paper discusses the chemical and radioactive contamination problem in the AOC, and the remediation options currently available to site management. The options are examined to identify the best course of action currently available. The paper concludes with a discussion of the path forward for continuing redevelopment efforts for the AOC.

INTRODUCTION

The goal of the remediation effort is to release the site for unrestricted use. This decision was made to take advantage of the burgeoning industrial base in the surrounding area. The subject site encompasses approximately 600 acres located in an industrial zoned, mixed land use area. Surrounding lands are used for agricultural, business, and light industrial purposes. The site is in close proximity to an airport and has convenient access to major highways and a nearby railhead; these factors contribute to making the site a valuable asset. The owner wishes to capitalize on the expanding business base by offering the land for sale without any restrictions. Restrictions concerning land use invariably diminish value of the property, thereby disallowing the owner to recover the true asset value.

Activities at the site commenced in 1955 with construction of buildings to support contracts granted by the Atomic Energy Commission (AEC). This work consisted of research, development, and manufacturing of nuclear fuel for the United States Navy nuclear power program. These activities continued until 1960, at which time the contracts were terminated. However, from the early 1960's to 2000, the owners performed research, development, engineering, production, and servicing of nuclear and fossil systems for the commercial industry. Over the years of active use, the processes used at the site generated both low level radioactive waste (LLRW), and hazardous chemical wastes.

The hazardous chemicals remaining on site are regulated by the US Environmental Protection Agency (EPA) through the Resource Conservation and Recovery Act (RCRA), and the State Department of Environmental Protection (DEP). The site entered into a Voluntary Corrective Action (VCA) program in 1997. As part of the voluntary program, areas of concern (AOC) where releases of chemicals may have occurred were identified.

Radioactive materials are regulated by the NRC and the ACE. The NRC is the responsible agency for materials generated as the result of licensed commercial nuclear activities after 1961. Nuclear activities conducted under contract to the AEC involved higher enrichments of Uranium than used for commercial fuel. Areas of the site with higher enriched materials are designated as part of FUSRAP, under the auspices of the ACE. The State DEP has no direct regulatory role because the State is not an "Agreement State". However, DEP regulation of radioactive cleanup is accomplished "de facto" via radioactive material limits contained in the State land transfer act.

AREA OF CONCERN 10 (AOC 10)

Description

The area that is the subject of this paper is identified as AOC 10. The area was originally used as a disposal area for miscellaneous fill and construction debris. A building was constructed in this area as a test facility for trash incineration, but was only used for one year. From 1969 to its demolition in 2001, the building was used by the facility maintenance group.

Other historical uses include the following:

- Fire Training Area – reportedly used a half of a 55 gallon drum to hold flammable oils which would be ignited and used to practice fire suppression techniques.

- Vehicle Maintenance Area – located near the building, raising the potential for contaminants including waste oils, fuels, solvents, and metals.

- Auxiliary Storage Tanks – three tanks used to hold kerosene and diesel fuel

- Dry Well – located near the northeast corner of the building, this dry well received drainage from the shop sink. There may also have been solvents disposed of from other buildings.

Chemical Contaminants

One of the contaminants of concern (COC) found in AOC 10 are polynuclear aromatic hydrocarbons (PAHs). These compounds occur naturally in some petroleum products such as asphalt and fuel oil; they are also created during combustion of carbon-based compounds. Typically, PAHs are found in areas where coal ash or asphalt fragments are deposited, or areas that collect the runoff from automobile parking lots. Environmental sampling data shows PAH levels in AOC 10 ranging from 1.2 mg/kg to 5.8 mg/kg. While these levels are generally low, they are above the State DEP cleanup criteria. The levels are too low to consider the material a hazardous waste; however, it is chemically contaminated soil, which requires treatment or disposal.

REMEDIATION OPTIONS FOR PAH IN SOIL

The PAHs are the only chemical contaminate in AOC 10 soils that exceed the cleanup standards. There are several options for remediation of PAH contaminated soils, and these are described in the following sections.

Excavation and Disposal

The most common method to dispose of excavated PAH contaminated materials is to send it to a landfill. Permits may be required to allow this disposal; however, since this material is not a hazardous waste, it is often used as cover material at municipal solid waste landfills. Disposal cost for this option is approximately $600,000.

Asphalt Batching

Another method commonly used to deal with low levels of PAH contamination is to use the soil in asphalt batching. PAHs are naturally found in the tar used to make asphalt, so using the contaminated soil as the aggregate in the asphalt mixture allows recycling of the contaminated soil, rather than disposal. Typically the contaminated soil is hauled off-site to an asphalt batching plant where the contaminated soil is screened and mixed with other soil as required to make the asphalt base. The asphalt can be used anywhere since the contaminated soil is incorporated into the asphalt matrix. Costs are comparable to solid waste landfill disposal.

Asphalt batching can also be performed on-site. Because of high mobilization costs, this option is only cost effective if there are large quantities (15 to 40 thousand cubic meters) available for treatment. Mobilization costs are high because of extensive environmental permitting required before startup. It also requires an on-site use for the asphalt generated, since asphalt batched on-site does not generally have a market.

Thermal Treatment

Thermal treatment is another option for the PAH contaminated soil. Thermal treatment uses heat to burn off the PAHs remaining in the soil. The soil is treated in batches, and once treated the material can be returned to the ground. Thermal treatment units are available for to treat soil on-site or off site. Like asphalt batching, on-site thermal treatment is only cost effective for large volumes of soil because of high permitting costs before startup.

In-Situ Capping

Another alternative for the PAH contaminated soil is to cap it. The contaminant levels are low enough that according to State regulations, a two-foot soil cap put in place would be a sufficient barrier to prevent human contact. Since AOC 10 is located next to a wetland, local wetland permits would be required before allowing placement of the cap. However, the most significant effect (for the site owners) is that an environmental land use restriction (ELUR) would be placed on the land. The ELUR restricts use of this area to avoid disturbing the cap, and follows the land deed whenever the land is sold. The ELUR could be removed in the future; however, the soil would need to be cleaned up at that time in order for this to occur.

Soil removal and disposal/treatment options are relatively inexpensive and easily available for PAH impacted soils. This would make it difficult - if not impossible - to convince a local government Wetlands board that capping is the preferred option, especially if the only reason capping is the preferred option, is the presence of radiological materials.

RADIOLOGICAL IMPACTS ON AOC 10

Recent Characterization Investigation (2002)

A comprehensive characterization sampling program was conducted in AOC 10 (2002). Soil surface samples, and subsurface samples were obtained and shipped off-site for analysis. The off-site laboratory analyzed each sample for uranium isotopes (alpha spectroscopy), and for byproduct radionuclides Co-60 and Cs-137 (gamma spectroscopy).

A reference area of approximately 94 acres located at the extreme NE corner of the site is separated from the rest of the site by a town road. A total of 37 surface soil samples were taken at this area, and analyzed off-site to replicate the analyses performed on the AOC 10 samples. The total uranium in the background samples ranged from 0.04 Bq/gm to .12 Bq/gm. For the byproduct materials, no Co-60 was detected (MDA 0.05 pCi/gm); Cs-137 results ranged from .003 Bq/gm to .063 Bq/gm, which is consistent with environmental background.

Results from the AOC 10 sampling showed a range of total uranium from 0.028 Bq/gm to 31.2 Bq/gm. The maximum value was obtained from a sample boring of 3 feet located near Test Pit 1012. No Co-60 was detected in any of the samples; Cs-137 ranged from 0.001 Bq/gm (MDA), to 0.013 Bq/gm. The analysis results for Co-60 and Cs-137 were within the range of background values from the reference site.

Derived Concentration Guideline Level (DCGL)

The site has calculated a Derived Concentration Guideline Level (DCGL) from a standard model in the RESRAD code. The model used is the resident farmer scenario; the DCGL derived from this analysis is 20.6 Bq/gm total uranium for any enrichment. This DCGL is currently under review by the NRC; approval is expected in Q1 of 2004.

Remediation Options

The analysis of soil samples taken in AOC 10 shows that only one sample is greater than the DCGL level of 20.6 Bq/gm. Therefore, radionuclide remediation of AOC 10 would be limited to the area surrounding Test Pit 1012, where the sample was collected. A Final Status Survey (FSS) would be conducted, and assuming there are no surprise issues, AOC 10 would be released for unrestricted use (radiologically). However, unrestricted release is thwarted by the chemical issues concerning PAH levels. Therein lies the conundrum presented to the site management.

THE CHEMICAL-RADIOLOGICAL CONUNDRUM

Regulatory Contrariety

The levels of PAHs in AOC 10 require that the soils be remediated to acceptable levels. The chemical remediation options are reanalyzed now that the radiological conditions are known.

The preferred method for remediation is excavation of the PAH impacted soils/materials followed by transfer and disposal to a landfill. This is cost effective and accordant with the site strategy concerning unconditional release. However, AOC 10 also has radioactive contamination in the form of various enrichments of uranium. Of the plethora of samples taken to date, only one sample has been reported as greater than the DCGL limit of 20.6 Bq/gm. The catch is that DCGL's are values that allow the licensee to leave the soil where it is (i.e. stays in the ground, at it's original location), not a value that allows the licensee to release the material for off-site disposal. In fact, there is currently no established level for release of volumetric radioactive materials, and therefore precludes licensees from releasing any material containing any amount of radioactivity greater than background.

The Wilcoxon Rank-Sum Test is a nonparametric statistical method for testing the null hypothesis that samples come from two populations with the same distribution. In this case, the test is applied to the samples taken at AOC 10, and those taken at the background reference area.

If the two high activity samples are removed from consideration (assume they are cleaned up and disposed of as LLRW), the test can be applied to the two sets of data. The null hypothesis is that the samples come from two populations with the same distribution, meaning the AOC 10 samples would be statistically similar to the background samples. Proving the null hypothesis would allow AOC 10 to be declared "non-contaminated" with respect to radioactive materials. This would allow remediation for PAH to progress without restriction.

Unfortunately, when the data was analyzed with the Wilcoxon Rank Sum Test, the null hypothesis was clearly rejected, thereby indicating that AOC 10 has radioactive contamination that is slightly above background. To summarize the conundrum:

- PAHs contamination of AOC 10 requires remediation; the preferred method is excavation and disposal in a landfill

- Disposal in a landfill is prohibited due to the low level uranium contamination in the soil; if excavated for disposal, it would have to be treated as LLRW, and disposed of at a licensed facility.

- Other than two small areas, the radiological contamination measured at AOC 10 is well below the DCGL of 20.6 Bq/gm, meaning that it poses virtually no hazard to future generations who may use the land; however, the PAH levels are above the remediation standard for the State.

- PAH levels above the standards require remediation; thermal treatment, asphalt batching, and landfill disposals are not options. In-situ capping requires a deed restriction be placed on the land, a situation that is counter to remediation strategy, and would not be preferred by local authorities.

- Treat the AOC 10 soils as LLRW, and dispose of it in a licensed facility.

- Petition the NRC for alternate disposal criteria.

Economics 101

It is estimated that AOC 10 has 9200m^3 of soil that would have to be disposed of at a LLRW facility. Assuming a \$2650.00/m^3 facility charge, the cost of disposal would be \$25 M. This does not include the cost of excavation, containers, and shipping to deliver the material to the LLRW facility; this would add a minimum of \$2 M to the total cost. Clearly, sending this soil to a LLRW facility when the levels of radioactive material are barely distinguishable from background is not practical, not is it in the best interest of the public.

THE PATH FORWARD

The strategic plan for resolving the situation with AOC 10 is to do nothing immediately. Fortunately, the State regulations do not invoke a time limit as to the cleanup of the PAH contamination, only that it must be done. In the meantime, rulemaking for volumetric contamination release limits is slowly working its way through the NRC. The NRC decision concerning release of volumetrically contaminated materials will determine the path forward for remediation of AOC 10. If this rule is not issued, the only other recourse is to pursue an alternative disposal amendment to the license that allows a volumetric release limit specific to the license. There is no other remedy available to a licensee, except to pay the exorbitant cost to dispose of materials in licensed facilities.

The best solution to this conundrum is for the NRC to issue a rule that addresses the volumetric release of materials contaminated with very low levels of materials. Licensees facing a potential $27 M bill for cleanup of a relatively small area of very low levels of contamination will be in no hurry to accelerate decommissioning activities.