U.S. Army Corps Of Engineers Waste Experiences: More Than You May Think.

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ABSTRACT

U.S. Army Corps of Engineers (USACE) works with other federal, and state agencies through several different programs on numerous Hazardous, Toxic, and Radioactive Waste (HTRW) sites. Formerly Utilized Sites Remediation Program (FUSRAP), Formerly Used Defense Sites (FUDS), EPA Superfund, Installation Restoration, Army Deactivated Nuclear Reactor Program, and many other programs present hazardous, radioactive, and mixed waste issues. While the USACE has a reputation of excellent dirt movers, little is discussed of our other waste management experiences.

This paper discusses some of the challenges facing the Health Physics (HP) staff of the USACE. The HP staff is currently organized as one team, the Radiation Safety Support Team (RSST), comprised of 15 individuals at 6 locations across the country. With typical RSST missions including HP consultation to USACE activities world wide, many waste challenges arise.

These challenges have involved radioactive wastes of all classifications and stability. Sealed and unsealed sources; instruments and dials; contaminated earth and debris; liquids; lab, reactor, and medical wastes are all successfully managed by the USACE. USACE also develops, evaluates, and utilizes waste treatment approaches.

Types of radioactive waste at HTRW sites include: Low Level Radioactive Wastes (LLRW) (class A, B, C, and greater than C), 11e.(2), Transuranic (TRU), Mixed, and Naturally Occurring (NORM/TENORM).

INTRODUCTION

U.S. Army Corps of Engineers (USACE) works with other federal, and state agencies through several different programs on numerous Hazardous, Toxic, and Radioactive Waste (HTRW) sites. Programs that present HTRW issues include the following:

- Formerly Utilized Sites Remediation Program (FUSRAP),
- Formerly Used Defense Sites (FUDS),
- Environmental Protection Agency (EPA) Superfund,
- Installation Restoration,
- Deactivated Army Nuclear Reactor Program
- Support for Others

While these programs present much of the large scale contaminated earth and rubble waste that USACE is known for dealing with, they also present waste disposal challenges involving all types, classes, and stability of materials.

There are a variety of materials destined for off-site disposal from HTRW sites. The following discussions focus primarily on the radiological waste streams and challenges including:

- Low Level Radioactive Wastes (LLRW)
- 11e.(2)
- Naturally Occurring (NORM/TENORM)
- 91b.
- Transuranic (TRU)
- Mixed Wastes

There may also be hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA) either separate from the radioactive materials or commingled.

Finally, there may be solid waste, which is neither regulated radioactive waste nor hazardous waste.

WASTE CHARACTERIZATION

The USACE characterizes each radiological waste stream to establish regulatory requirements and disposal options. In order to determine what types of materials are present at HTRW sites USACE assembles and reviews: historical information on operations at the site related to both the past processing work in support of the Federal Government and to other site processes which may have involved releases of contaminants; and analytical data from site investigations. Together, the historical process information and the investigation data allow proper characterization of the materials present at each site.

MATERIAL AND DISCUSSIONS

Low Level Radioactive Waste (LLRW)

As presented in 10 CFR 61, LLRW is used here to mean "wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste)."

LLRW is broken into 4 classes of material based on activity and stability requirements. These classes are:

1. Class A, stable or unstable, relatively innocuous waste (waste with activity less than 0.1 times the table 1 value or less than the column 1 value in table 2 in 10 CFR 61.55 or isotopes not listed in either table). Specifically, *"Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). If Class A waste also meets the stability requirements set forth in 10 CFR 61.56(b), it is not necessary to segregate the waste for disposal."*

2. Class B, higher activity wastes that should be stable for proper disposal (waste with activity greater than column 1 but less than column 2 of table 2 in 10 CFR 61.55). Specifically, *"Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56".*

3. Class C, higher activity wastes that should be stable for proper disposal (waste with activity greater than 0.1 times the table 1 value but less than the value or greater than the column 2 but less than column 3 of table 2 in 10 CFR 61.55). Specifically, *"Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56."*

4. Greater than Class C, higher activity waste (waste with activity greater than the table 1 value or greater than the column 3 of table 2 value in 10 CFR 61.55), which is unacceptable for shallow land disposal. Specifically, *"waste for which form and disposal methods must be different, and in general more stringent, than those specified for Class C waste."*

Note: States and Compacts may add additional considerations or radionuclides in their definitions of LLRW.

USACE experience with LLRW includes all classes.

Class A material is most frequently handled at FUSRAP and EPA Superfund Sites and is typically in the form of source material contaminated earth and rubble. Source material is defined in 10 CFR 40 as "(1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof."

USACE does however handle class A wastes other than source material. At several HTRW sites class A byproduct material is characterized, packaged and disposed of. Byproduct material is defined in 10 CFR 20 as "(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and (2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute ''byproduct material'' within this definition." Note that paragraph 2 of this definition is excluded from the definition of LLRW. These paragraphs come from paragraphs 11e1 and 2 of the Atomic Energy Act (AEA). Paragraph 2 material is referred to as 11e2 material.

Site 1. At a Department of the Army installation in Texas the USACE characterized Tritium and Carbon-14 contamination in medical research facilities. Characterization of contaminated materials was performed with waste minimization in mind. This meant that extra care was taken to delineate contaminated portions of materials. Rather than just marking large areas of walls or floors as contaminated individual contaminated spots down to 100 square centimeters were delineated. While this increased characterization survey time it resulted in minimization of wastes. Contaminated areas were marked with paint or chalk. The marked areas were then physically removed (such as pipes and floor tiles) or cut out of the walls (contaminated drywall) prior to building demolition. USACE recognized the fact that the installation had a radioactive waste inventory and disposed of material annually through the DOD LLRW system. Rather than contracting for material disposal separately, USACE requested and was granted permission to add the contaminated material to the installation radioactive waste inventory. This allowed the facility to use its existing disposal options and not incur additional disposal or administrative costs.

Site 2. At an EPA Superfund (USACE supported) site in Texas, class A, B, and C material consisting of contaminated debris is containerized and shipped to licensed disposal sites. The debris is contaminated primarily with Cs-137 at levels as high as several curies per cubic meter and Am-241 at hundreds of nanocuries/gram. In addition some of the material is also contaminated with Sr-90 and other isotopes. Special precautions are required to be taken to protect site workers during the waste handling procedures. Dose rates exceeding a Gray/hour are common in several areas of the site. These special precautions posed a significant challenge to project personnel. Work was broken down to specific tasks and each task was discussed and rehearsed as necessary prior to beginning a series of tasks. Emphasis was placed on worker protection and exposure monitoring.

Casks and liners for materials at these contamination levels had to be located and scheduled in advance. Due to the shipping cask certification requirements, delays in project execution were encountered, due to issues such as a broken bolt or a missing nut. Additionally, custom cask and storage container shielding designs may be required to ensure adequate shielding for the Cs-137 materials.

Another challenge that faced the project team was the storage of greater than class C material. Government funding constraints (budgeting over fiscal years) and limited availability of storage facilities are currently being worked through.

The multi contaminant fraction of waste at the site required a complex characterization strategy. To properly characterize the waste into classes it was necessary to inventory and characterize individual items and develop a spreadsheet designed to utilize the unity rule for exempt, Class A, Class B, Class C, and Greater than class C materials. The classification rules in 10 CFR 61.55 were applied when mixtures of table 1 and 2 (10 CFR 61.55) radionuclides were encountered. Since multiple radionuclides and multiple units were required (nanoCi/g and Ci/cubic meter) this was accomplished by simplifying the spreadsheet to an individual item data entry form.

Exempt concentrations of certain isotopes were provided by the state, which allowed certain materials to be disposed of at RCRA facilities. A 1st cut calculation was determined based on the exemption and all material failing the test was then put through the LLRW class A unity rule test. The test was then repeated for Class B and C concentration limits if required. Approaches utilized the basic unity rule equation:

$$\left[\left(\frac{ConcentrationNuclide1}{ClassConcentrationLimitNuclide1}\right)+\left(\frac{Conc.Nuclide2}{ClassConc.LimitNuclide2}\right)+\left(\frac{Conc.Nuclide"i"}{ClassConc.Limit"i"}\right)......\right]\leq 1$$

The class segregation and disposal practice is utilized at several HTRW sites.

Not only does segregation provide for increased disposal options it is necessary for proper disposal given multiple contaminant sites and various facility waste acceptance criteria. This is illustrated by the USACE experience at this site. Some of the materials dealt with contained Ra-226 as well as LLRW. Segregation of this material was required since of the three currently available commercial disposal options only one could accept Ra-226 and Class A, B and C Cs-137 wastes. Waste exclusively comprised of Ra-226 sources were disposed of in the North West Compact as LLRW, since the compact and the disposal site state regulations consider Ra-226 in their LLRW regulations. Two drums of class C Ra-226 wastes were disposed of from the site.

Volume reduction approaches are utilized by the USACE to manage LLRW. Multiple glove boxes were initially characterized as greater than class C at the site. USACE successfully implemented a glove box decontamination process which reduced the glove boxes to a less than class A waste and produced a reduced volume of greater than class C material. Insitu gamma spectrometry using the Canberra ISOCS and direct alpha reading surveys were designed and tested to determine decontamination effectiveness. The class A boxes are to be disposed of in a commercial facility while the greater than class C material is to be isolated in a temporary storage location until disposal options are available.

Site 3. At a FUDS project in New York City class A and B material consisting of Sr-90 contaminated debris and soil was remediated. Class A material was segregated from the class B material and shipped for disposal. Class B material was shipped to a treatment facility. At the treatment facility the Class B component of the material was stabilized and packaged for disposal. The segregation process resulted in decreased disposal costs as there are more disposal options for class A material.

11e.(2) Byproduct Material

The designation "11e.(2)" refers to the AEA paragraph that defines byproduct material as "The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes."

Site 4. Thousands of cubic yards of 11e.(2) material are shipped annually for disposal in licensed 11e.(2) facilities from a FUSRAP site in New Jersey. The material consists of contaminated earth and debris. Although several licensed disposal cells exist for 11e.(2) materials only 3 facilities have expressed interest in commercially receiving the material for disposal or re-processing. USACE or its contractors currently have contracts with these three facilities. To date only one of the facilities has been used to dispose of material from the NJ site.

The 11e.(2) material is excavated from private and government owned properties and loaded into lined gondola cars for transport to the disposal facility. A treatment study was conducted in 2000 to determine if the volume of material could be reduced by either coarse particle fraction removal (gravel separation) or activity segregation. Although potentially viable the wide range of gravel fractions and soil types at the site limited the effectiveness of the treatment approaches. Additionally the excavation and transportation approaches tended to reduce the effectiveness of activity segregation. It is unlikely that treatment will be considered due to these limiting factors.

Naturally Occurring or Technically Enhanced Radioactive Material (NORM/TENORM)

USACE ships tens of thousands of cubic yards of TENORM contaminated earth and debris annually. TENORM is handled at several EPA Superfund, FUSRAP, FUDS, and Installation Restoration Sites.

In addition to contaminated earth and debris several sites have involved Gages, Dials, and other NORM containing aircraft and vehicle components. At FUDS and Air Force bases USACE has removed historical Radioactive Material Disposal sites. These 1950s era disposal sites, referred to as "pipe sites", were a common Air Force disposal method for Ra-226 containing components as well as other isotopes typically found in electron tubes. The sites consist of several concrete (culverts) or steel (oil well casing) pipes buried vertically with concrete or welded bottoms, joints, and lids. USACE has handled several of these sites and historical implementation of these sites is relatively well documented. Given this, rather than risk personnel exposure, USACE typically removes these tubes intact, performs characterization using gamma spectrometry, over packs, and disposes of the tubes intact. This has proven to be a safe and cost effective approach.

Site 5. At a pipe site in Texas concrete waste tube intact excavation and packaging proved difficult. Soil excavation occurred in 1-foot lifts in order that the tubes could be inspected and to allow for characterization of the soils at each stage of the excavation. Due to the weight of the burial tubes, special methods were required to relocate the tubes from their initial positions to a staging area where they could be characterized. The structural integrity of the tubes was of particular concern for any tubes that were twelve feet in length and thirty-six inches in diameter. The solution was to spread the weight of the concrete over the surface of the tube using angle iron and concentric metal banding. This method allowed the steel to carry a portion of the shearing stress and to prevent the two sections of pipe from separating during the removal process. Characterization of the disposal tubes was accomplished using a combination of gamma spectroscopy and activity mapping methods. Once packaged the tubes were sent to two separate disposal facilities based on activity concentrations and facility waste acceptance criteria.

Military Application and Research Materials (91b)

91b refers to the material identified under Section 91b of the Atomic Energy Act of 1954 (42 U.S.C. Section 2121). This section authorizes the transfer of SNM and atomic weapons to the Department of Defense for use in the national defense and for defense utilization facilities. Section 110b excludes these defense utilization facilities from licensure by the NRC. Additionally, 91b material is excluded from the definition of LLRW.

Site(s) 6. USACE currently holds 3 Department of the Army reactor permits. The reactors are under the 91b exclusion. The three reactors were placed in "safe store" status in the 1970's. USACE is responsible for maintenance, decommissioning, and disposal, of the remaining reactor components and associated contamination. At the Alaska facility USACE has recently finished a removal action that involved excavation and disposal of contaminated soils and pipe from a liquid waste disposal pipeline. The action resulted in approximately 1000 cubic yards of Cs-137 and Sr-90 contaminated waste. Efficient characterization of the site was difficult due to the concern over the Sr-90 contamination. Field screening for Sr-90 contaminated soil was accomplished using a correlation to Cs-137 and lab samples.

Although exempt from the definition of LLRW the material was treated as such and disposed of accordingly. Transportation from AK to the disposal site in Washington posed a unique challenge in that we could not transport it through Canada. The material was trucked to a marine terminal where it was loaded onto a barge for transport to a port in Washington. The transportation and disposal action occurred without incident.

USACE is currently evaluating complete decommissioning and disposal of the facilities.

Transuranic (TRU)

TRU are isotopes with atomic numbers greater than 92 (Uranium), thus "trans-uranic". These are typically a byproduct of plutonium production and reprocessing of spent fuel. Am-241 is the most commonly used transuranic and it poses significant disposal challenges. Although excluded from the definition of LLRW, transuranics are included in the waste classification tables in 10 CFR 61.55 discussed earlier.

USACE currently utilizes sealed sources and gage devices containing Am-241. Rather than dispose of these sources USACE licensees transfer them back to the manufacturer. When these sources are encountered as a part of remediation activities on a DOD site USACE coordinates with the Army's Operations Support Command for disposal. Typically, sources with higher activity than can be commercially disposed are encountered as waste. USACE has worked with the Department of Energy Los Alamos National Lab orphaned source program to transfer sources.

Site 2. Earth and debris contaminated with Am-241 have been handled safely and effectively by USACE at several sites. Currently USACE is assisting EPA with characterization, segregation, volume reduction, and disposal of materials contaminated with Am-241 in powder form. Class C and greater than class C materials are currently being temporarily stored at a commercial facility licensed to do so.

Mixed Wastes

Mixed wastes are wastes that are both hazardous and radioactive. Includes hazardous waste identified in 40 CFR 261 (F-,K-, P- and U- listings) and/or characteristic waste with residual radioactive material that is NRC regulated. USACE currently has a contract for mixed waste disposal, as well as utilizes several commercial firms for treatment and disposal of mixed wastes. Typically treatment involves removal of a material's hazardous characteristic.

Site 7. USACE treated lead contaminated material at a FUSRAP site in New York. The analytical data indicated the presence of a characteristic HW (D008, Lead) commingled with Depleted Uranium (source material and unimportant quantities of source material levels, less than 0.05% by weight). Waste material is segregated based on the levels of uranium and the material is placed into a treatment system onsite that stabilizes the lead and therefore removes the HW characteristic. At the completion each stockpile is re-sampled to ensure the treatment objectives have been met. All waste material must still comply with the applicable land disposal restrictions identified within 40 CFR 268, including 40 CFR 268.7, 40 CFR 268.9, 40 CFR 268.40, 40 CFR 268.48, and 40 CFR 268.49, which relate to notification and treatment requirements. Underlying hazardous constituents in waste being shipped offsite are expected to meet all applicable treatment standards in 40 CFR 268.48 and/or 40 CFR 268.49, such that the waste qualifies for direct land disposal without additional treatment.

CONCLUSION

The U.S. Army Corps of Engineers works with other federal, and state agencies through several different programs that present a wide range of radioactive waste challenges. These challenges provide USACE with experiences and abilities to complete its projects in the safest, most timely, and cost-effective manner. USACE continues to execute hazardous, toxic, and radioactive waste cleanup projects with a goal of pursuing the protection of human health and the environment during remediation and through proper disposal.

REFERENCES

1. Nuclear Regulatory Commission - SECY-98-284 – Transfers of Material Containing Less Than 0.05 Percent by Weight Source Material under 10 CFR.51(b)(3) and (b)(4), and 40.13 (a).

2. Nuclear Regulatory Commission - SECY 99-259 – Exemption in 10 CFR Part 40 for Materials Less Than 0.05 Percent Source Material – Options and Other issues Concerning the Control of Source Material.

3. NRC Regulatory Issue Summary 200-23, Recent Changes to Uranium Recovery Policy (November 13, 2000)

4. Title 10 Code of Federal Regulations, Department of Energy, parts 20,40,& 61.

5. Title 40 Code of Federal Regulations, Environmental Protection