# MIXED WASTES MANAGEMENT DURING DECOMMISSIONING AT A DOD DEPLETED URANIUM-CONTAMINATED FACILITY

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## ABSTRACT

The Army Materials Technology Laboratory in Watertown, Massachusetts, is being decommissioned prior to closure. Waste generated during decommissioning will include potential mixed waste from industrial operations using depleted uranium. Mixed waste has been identified in areas where electroplating was done. Residue from a process that used powdered beryllium has been determined not to be a hazardous waste and so not to be a mixed waste. Most of the mixed wastes will be stabilized on-site to meet Land Disposal Restrictions and will be sent to the mixed waste disposal facility at Envirocare in Clive, Utah.

## INTRODUCTION

During the course of its long history, the Army Material Technology Laboratory (MTL) in Watertown, Massachusetts, produced a number of potential mixed radioactive and hazardous wastes. Because the base is scheduled for closure, as part of the Base Realignment and Closure Act, the status of this waste needs to be resolved. This paper provides an overview of how mixed waste issues were handled at MTL and contains guidance on treatment and disposal.

MTL covers part of what was formerly the Watertown Arsenal, which was established in 1816. Development work using depleted uranium (DU) started in the 1950s. Depleted uranium was forged, pressed, heat-treated, plated, machined, and tested. In addition, waste DU was incinerated. Other development, testing, and manufacturing were conducted at the facility, some of which involved the use of hazardous chemicals.

After the Department of Defense (DOD) announced that MTL would be closed, the Toxic and Hazardous Materials Agency (THAMA), at Aberdeen Proving Ground, Maryland, scoped an investigation of the facility to determine what remedial actions would be necessary. THAMA contracted Roy F. Weston, Inc. (WESTON®) to prepare a Remedial Investigation/Feasibility Study and a Decommissioning Plan. Remediation of the radiologically contaminated buildings is currently being conducted; cleanup of chemical contamination in buildings and in the soil will be done in 1993-94.

WESTON's investigation identified a number of materials that, because of sampling results or process knowledge, would upon disposal potentially be mixed waste. These materials were contained in an electroplating shop, and a machine shop where both DU and beryllium were machined. Various other areas were identified as sources of potential mixed waste during decommissioning. These potential mixed wastes are:

- Liquids, solids, and sludges from an electroplating process that used cyanide.
- Glove boxes, ventilation systems, and other equipment contaminated with both beryllium and DU.
- Painted walls that are radiologically contaminated.
- Sediments and debris from sewer lines, pits, and sumps that contain both DU and toxicity characteristic leaching procedure (TCLP) metals such as cadmium, mercury, or lead.

In the course of developing guidelines for managing these materials during decommissioning, the following questions were identified as critical:

1. Are all the above materials hazardous wastes? In particular, is the beryllium-contaminated equipment a hazardous waste?
2. What are the Land Disposal Restrictions (LDRs) for the wastes? In particular, how does an LDR apply to construction debris waste?
3. If treatment is required, can it be done on-site? If so, what permits are required? If not, is there any off-site facility that can provide treatment for mixed wastes?
4. Are there available mixed waste disposal facilities? If so, where?

Each of these issues will be discussed in the following paragraphs.

## HAZARDOUS WASTE CATEGORIZATION

Two large volume potential mixed wastes are the electroplating shop wastes and beryllium contaminated equipment wastes. The electroplating process was used to plate DU and other metals. Because the plating process used cyanide, the waste from the process is a listed waste, specifically, a F006, F007, or F008 waste code. Although the determination of the waste code for these materials would seem straight forward, there was uncertainty in some cases as to whether or not the waste was generated by a process that used cyanide or by some other electroplating process. In addition, some of the wastes also exhibited the characteristic hazardous waste constituents of toxicity, corrosivity, or ignitability.

The issue of beryllium-contaminated equipment also was not clear-cut. Beryllium and DU were both handled in gloveboxes, which were ventilated by a vacuum system consisting of cyclone separators, filters, and blowers. The beryllium was handled in both large piece and powdered forms. Commercial beryllium dust is a listed waste (P015) if "it is a commercial chemical product, off-specification product, container residue, or residue resulting from a spill of the commercial chemical product (40 CFR 261.33)."

It was initially thought that the equipment might need to be categorized as P015 waste because commercial grade beryllium dust was used. However, the U.S. Environmental Protection Agency (EPA) advised MTL that the beryllium-contaminated waste was not a listed hazardous waste (1). The P015 listing in 40 CFR 261.33(e) applies only to the powdered metal when it has not been used in a process prior to disposal. Because the powdered beryllium in this case had been used by being processed in the glove box, the residual formed after use was not a listed waste. Likewise, beryllium dust formed by processing solid beryllium was not a listed waste.

EPA stated in its letter that "the beryllium-contaminated equipment could still be a characteristic hazardous waste." However, the Department of Energy (DOE) Albuquerque Operations Office stated that because beryllium dust readily oxidizes when exposed to air, it is not explosive. This being true, it does not exhibit the characteristic of reactivity (2). Therefore, beryllium-contaminated equipment is not a Resource Conservation and Recovery Act (RCRA)-regulated hazardous waste. MTL is currently investigating whether beryllium is a hazardous waste under Massachusetts regulations.

## LAND DISPOSAL RESTRICTION

The LDR contained in 40 CFR 268 (the "Land Ban") requires that hazardous waste meet certain conditions before it can be placed in a land disposal facility.

Under the Land Ban, there are three types of treatment standards. The first and second types refer to concentration-based treatment standards. These are the Constituent Concentrations in Waste (CCW) and Constituent Concentrations in Waste Extract (CCWE). The CCW describes the concentration of the constituent of concern in the entire waste. The CCWE alludes to a laboratory procedure, whereby the waste is placed in an acidic solution, and the constituent of concern is leached, or extracted, into the aqueous phase. The CCWE standard refers to the concentration in this aqueous phase. The third type of treatment standard refers to the specific method of treatment (e.g., stabilization). It does not require that specific concentration standards be met.

Most of the MTL wastes had concentration-based standards. Therefore, any treatment that meets these concentration standards is suitable. However, two waste codes – D001, Ignitable, and D002, Corrosive – have specified methods of treatments. The D001 wastes have a specified treatment depending on the level of total organic carbon (TOC). If the TOC is less than 10%, the specified technology is deactivation or the removal of the hazardous characteristics of the waste due to ignitability. If the TOC is greater than 10%, the specified treatment is fuel substitutions, incineration, or organic recovery. The TOC for MTL waste is believed to be less than 10%, although not all wastes have been analyzed for TOC. For D002 waste, the specified technology is deactivation or the removal of the hazardous characteristics of the waste owing to its corrosivity.

The Land Ban requirements may be difficult to achieve or carry out; they will be discussed in more detail in the next section. It was initially unclear as to how demolition waste could be disposed of. Some wastes, such as painted walls or sewer lines, were found to be both radioactive and to contain elevated levels of toxic metals. Removal of this material could produce a large amount of "debris" waste, which would be difficult to treat.

Demolition wastes, consisting of solid material that is mostly larger than a 60-mm particle size, is defined as debris in final regulations issued by EPA (18 August 1992) in the *Federal Register* (3). If this debris contains (or is contaminated by) a listed hazardous waste, it is hazardous debris. If it contains a characteristic hazardous waste, then the debris would be a hazardous waste if the debris itself exhibited a hazardous characteristic such as TCLP or ignitability. These EPA regulations stipulate the treatment requirements for hazardous debris in order that it can meet the LDRs. Because of concern about available treatment capacity for hazardous debris, a 2-year national capacity variance from the LDRs was granted, covering the period from 8 May 1990 to 8 May 1992. When the new hazardous debris rule was promulgated (18 August), the variance was extended for 1 year (8 May 1992 to 8 May 1993) on a case-by-case basis; however, no application (i.e., regulatory approval) was required for the extension. Rather, the owner/operator must only comply with generic requirements, the most important of which is to prepare a written plan that describes how sufficient capacity will be obtained. Therefore, until 8 May 1993, it will be possible to dispose of mixed waste hazardous debris without prior treatment under the Land Ban regulations.

After 8 May 1993, debris waste will require treatment. Examples of treatment methods are presented in the EPA regulations on debris waste (3), but treatment methods are not specified.

## WASTE TREATMENT/DISPOSAL

### Treatment Location

The LDR requires treatment for most of the mixed waste at MTL. However, treatment of hazardous waste generally can be done if the facility has a RCRA permit for waste treatment. MTL does not have a RCRA Part B permit. Alternatively, waste can be treated off-site. As will be discussed later, there is very limited waste treatment capacity available outside the DOE.

However, no permits are required to perform treatment at MTL because the site is being remediated under the Installation Restoration Program (IRP) established by the DOD. The IRP is the DOD equivalent of EPA's Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA)/Superfund program. MTL is not on the National Priorities List (NPL), but the Army has stipulated that CERCLA procedures will be followed for the remedial activities at MTL. This includes preparation of a Remedial Investigation/Feasibility Study and Record of Decision. Inclusion on the NPL is not necessary for the lead agency (in this case the Department of the Army) to take action under CERCLA (40 CFR 300.425).

Because the actions at MTL are being carried out under the National Contingency Plan (NCP), no permit will be required. This is specified in the Superfund Amendment and Reauthorization Act (SARA), Section 121e, which states that no permits are necessary if the removal or remediation is conducted entirely on-site under the NCP. Even though a permit is not required, the lead agency must still comply with the substantive requirements of the regulations. Therefore, treatment and storage of mixed waste at MTL will be conducted in such a way that the applicable requirements are met.

However, the option of on-site treatment is not available in general to mixed waste producers. Off-site treatment may

be the only viable option, unless the facility has or can obtain a RCRA Part B permit for treatment of hazardous waste.

The option of off-site treatment was pursued as an alternative to on-site treatment. There are a very limited number of options for off-site mixed waste treatment. Although the DOE has a substantial capacity for mixed waste treatment, that capacity is not currently available to non-DOE generators. During private conversations, DOE officials stated that this condition may change but not for at least a year or two.

There are currently two options for off-site treatment of MTL waste: NSSI in Houston, Texas, and Diversified Scientific Services, Inc. (DSSI) in Kingston, Texas. NSSI is licensed to perform a variety of mixed waste treatment procedures such as solidification, neutralization, and filtration on certain types of hazardous waste.

DSSI is a mixed waste industrial boiler facility that can accept only liquids. The facility can accept the following waste codes: D001, D004 through D043, and F001 through F005. The facility was shut down because of a fire and is not accepting any waste until mid 1993.

The boiler design requires that the feed stream have a heat content greater than 5,000 British thermal units per pound (Btu/lb). If the waste's heat value is too low, it is possible that the waste can be blended with other material to raise the heat value. The maximum acceptable water content is 10%. The waste can not contain any solids larger than 1/32-inch or the feed nozzle will clog.

### Waste Disposal Location

The biggest question during remediation planning was where would radioactive and mixed waste be disposed of. The remediation of radiologically contaminated portions of MTL was accelerated in an attempt to dispose of all waste before the end of 1992. It was not possible to meet that deadline. However, the low-level waste (LLW) disposal facility at Barnwell, South Carolina, has been given permission by the State of South Carolina to accept LLW from Massachusetts on an interim basis, and LLW from MTL is going to Barnwell. Mixed waste at MTL will be sent to Envirocare's facility in Clive, Utah, or if it can be treated first to render it a nonhazardous waste, it will go to Barnwell.

### Waste Treatment Evaluation and Recommendation

The waste treatment options were evaluated based on the following criteria:

- Is the treatment technically feasible for the physical state of the waste?
- Is the treatment permitted or required by the LDR? For some waste codes, the LDR stipulates specific treatment technologies or types of technologies.
- Are the treatment technologies available? The Army's goal is to dispose of the mixed waste as quickly as possible because of the uncertainty regarding availability of waste disposal facilities and because of the need to prepare the facility for closure. Only two facilities with limited resources for mixed waste treatment are available now.
- Are there any permit or regulatory approval requirements? There is no requirement for a RCRA permit because the facility is being remediated under CERCLA regulations. However, the Nuclear Regulatory Commission (NRC) has stated that mixed waste treatment beyond stabilization will require NRC approval. The local municipal sewer authority may require a permit before treated liquid waste can be discharged to the sanitary sewer.
- Will the treatment of the waste open the Army to excessive environmental liability? The two facilities that are currently licensed to treat mixed waste, NSSI and DSSI, have limited experience and they are still proving their ability to process the waste in compliance with regulations.
- What is the cost of the treatment method?

The requirement for immediate action means that established treatment methods are preferable. Innovative, unproven technologies that may require significant development time were not considered. In addition, there are small quantities of a wide variety of wastes; therefore, it is impractical to optimize treatment methods for each wastestream. Although optimizing the treatment method may result in lower treatment cost or waste volumes, the development costs would most likely offset any savings in treatment cost for the small quantities of material at MTL.

Although it would be simpler to manage the waste by sending it to an off-site treatment facility, this option is limited because there is only one facility with both the required RCRA permit and NRC license. On-site treatment is possible without a RCRA permit although it may require NRC approval. There is limited space available to perform on-site treatment. Purchasing or renting processing equipment to treat a small amount of waste is generally not cost-effective. Any equipment that is purchased or rented would need to be decontaminated after the waste is processed.

Using existing or new equipment to process the waste followed by release to the municipal sanitary sewer is an attractive option because the LDRs would not apply and this reduces disposal costs; however, the ability of on-site treatment methods to meet sewer discharge limits is uncertain. Processing methods will need to be developed for each wastestream. Also, release to the sanitary sewer may be impossible because of volume restrictions at the wastewater treatment plant.

Therefore, stabilization was recommended for all wastes except "debris" wastes and a few other exceptions because it is a simple, conservative treatment method that can be done on-site.

The stabilization process is summarized in the following list:

- Sample wastestreams.
- Conduct cup solidification test of wastes or blended wastes to determine the proper protocol for stabilization.
- Determine if waste meets waste form requirements.
- Prepare a Process Control Program giving direction for waste stabilization.
- Stabilize waste materials, either on-site or at a licensed treatment facility.
- Ship to an appropriate waste disposal facility.

The waste can be stabilized either on-site or off-site. NSSI in Houston, Texas, is the only facility currently licensed to accept mixed wastes for off-site solidification. NSSI can accept waste and store it prior to treatment.

Prior to stabilization, the selected stabilization vendor will sample the waste materials and prepare stabilization specimens to determine the proper additive formulation. For Class A radioactive waste, which is the waste at MTL, the solidified product must be a free-standing monolith with no more than 0.5% of the waste volume as free liquid. The waste must also meet the TCLP requirements of 40 CFR 261 and 40 CFR 268 (4).

Each disposal facility has a list of allowable solidification agents. The vendor should use agents that are appropriate to the intended disposal site.

Depending on the EPA waste code of the untreated waste, the stabilized waste form will be either a mixed waste or a low-level radioactive waste. If the waste was a hazardous waste owing to the characteristics of ignitability, corrosivity, reactivity, or toxicity, and the waste form no longer exhibits these characteristics, it is no longer classified as a hazardous waste and can be disposed of as LLW at Barnwell.

Stabilization should be suitable for most or all of the nondebris waste. The liquid ignitable waste is a candidate for treatment at DSSI except that this facility is currently not accepting waste. In addition, the heat value Btu/lb must be measured to determine if it is greater than 5,000 Btu/lb. However, if ignitable liquid waste TOC is greater than 10%, then treatment by fuel substitution, incineration, or organic recovery is specified.

The decommissioning process may produce large volumes of decontamination liquid that could potentially be a mixed waste, most likely because of contamination by toxic metals. This liquid waste, if generated, could probably be treated by filtration and the liquid could be discharged to the sewer, with the proper permits from the municipal sewer authority.

A summary of the recommended waste treatment and disposal methods is contained in Table I.

## REFERENCES

1. Letter from Rick Brandes, EPA, to Robert Chase, MTL. 2 November 1992.
2. Letter from John Themelis, DOE, to T.B. Hyde, DOE. 2 October 1990.
3. EPA, 57 FR 37194, *Federal Register*. 18 August 1992.
4. NRC, Technical Position on Waste Forum, Revision 1. January 1991.

**TABLE I**
Recommended Waste Treatment/Disposal

| Waste | Treatment/Disposal |
|---|---|
| Electroplating waste, liquid, metals | Stabilization<br>Envirocare facility |
| Electroplating waste, liquid, low pH | Neutralization/stabilization<br>Envirocare facility |
| Electroplating waste, liquid, ignitable | Stabilization |
| TOC < 10% | Envirocare facility |
| TOC > 10% | Chemical Treatment |
| Electroplating waste, solid, non-ignitable | Stabilization<br>Envirocare facility |
| Electroplating waste, solid, ignitable | Stabilization<br>Envirocare facility |
| Equipment contaminated with beryllium dust | Not a mixed waste<br>Barnwell |
| Dry waste, TCLP metals | Stabilization<br>Barnwell facility |
| Liquid waste, ignitable | Stabilization<br>Barnwell facility |
| Liquid waste, low pH | Neutralization/stabilization<br>Barnwell facility |
| Mercury-contaminated waste | Stabilization<br>Barnwell facility |
| Decontamination waste, dry debris | No treatment if before 8 May 1993<br>Envirocare facility |
| Decontamination waste, dry, non-debris | Stabilization<br>Barnwell facility |
| Decontamination waste, wet, low volume | Stabilization<br>Barnwell facility |
| Decontamination waste, wet, high volume | On-site treatment and release to sewer |
| Lead waste | Decontaminate<br>Commercial decontamination facility |