WASTE SEGREGATION PROCEDURES AND BENEFITS[1]

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ABSTRACT

Segregation is a critical first step in handling hazardous and radioactive materials to minimize the generation of regulated wastes. In addition, segregation can significantly reduce the complexity and the total cost of managing waste.

Procedures at Sandia National Laboratories, Albuquerque require that wastes be segregated, first, by waste type (acids, solvents, low level radioactive, mixed, classified, etc.). Higher level segregation requirements, currently under development, are aimed at 1) enhancing the possibilities for recovery, recycle and reapplication; 2) reducing waste volumes; 3) reducing waste disposal costs; and 4) facilitating packaging, storage, shipping and disposal.

INTRODUCTION

Segregation is a critical first step in handling hazardous and radioactive materials and wastes to minimize the generation of additional regulated wastes and to ensure worker safety during pickup, transport and storage of wastes. In addition, segregation can significantly reduce the complexity and the total cost of managing waste and facilitate maximum protection of personnel and the environment.

Sandia National Laboratories, Albuquerque, New Mexico (SNL, Albuquerque) is operated by Sandia Corporation, a prime contractor of the U.S. Department of Energy. SNL, Albuquerque performs research and development and design activities related to weaponization of nuclear explosives, nuclear weapons training, quality assurance of nuclear weapon stockpiles, alternative energy and nuclear waste repositories.

The activities at SNL, Albuquerque generate hundreds of unique waste streams annually. Approximately 85% of the chemical wastes are generated in less than 55-gallon quantities.

Procedures at SNL, Albuquerque require that wastes be segregated, first, by waste type and hazard class (acids, solvents, low level radioactive, mixed, classified, etc.). Higher level segregation requirements, currently under development, are aimed at 1) enhancing the possibility for recovery, recycle and reapplication; 2) reducing waste volumes; 3) reducing waste disposal costs; and 4) facilitating packaging, storage, shipping and disposal.

A section on definitions provides a common basis for discussion. Separate segregation procedures for hazardous materials, for radioactive materials and for minimizing mixed wastes are then presented. Finally, segregation considerations for facility designs are discussed.

Examples illustrate the benefits of segregation.

DEFINITIONS

Because of the complexity of the pertinent regulations and the fact that they are frequently amended, some effort is required to determine whether a material is regulated. The Material Safety Data Sheet, which should be supplied by the manufacturer of a chemical, can provide preliminary guidance on the hazards associated with it. The following definitions are taken directly from the applicable statutes and regulations. Because SNL, Albuquerque is a DOE facility and not regulated by the Nuclear Regulatory Commission, the definitions for the various types of radioactive wastes are limited to those that apply to DOE.

HAZARDOUS MATERIALS

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Hazardous materials are listed in Title 49, Code of Federal Regulations, Part 171.8 (49 CFR 171.8) and in 49 CFR 172.

HAZARDOUS SUBSTANCES

1) A material and its mixtures or solutions that is identified by the letter "E" in Column (1) of the Hazardous Materials Table, 49 CFR 172.101, when offered for transportation in one package, or in one transport vehicle if not packaged, and when the quantity of the material therein equals or exceeds the reportable quantity. 2) Any substance designated pursuant to Section 311(b)(2) of the Federal Water Pollution Control Act. 3) Any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act. 4) Any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but

not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress). 5) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act. 6) Any hazardous air pollutant listed under Section 112 of the Clean Air Act. 7) Any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to Section 7 of the Toxic Substances Control Act.

Hazardous substances regulated by the U.S. Environmental Protection Agency are listed in 40 CFR 302.4 and 40 CFR 355, App. A & B.

HAZARDOUS WASTE

Any material that is subject to the hazardous waste manifesting requirements of the Environmental Protection Agency specified in 40 CFR, Part 262 or would be subject to these requirements in the absence of an interim authorization to a State under 40 CFR, Part 123, Subpart F. Characteristics that make waste hazardous are ignitability, corrosivity, reactivity, and toxicity as determined by the Toxicity Characteristic Leach Procedure (TCLP).

Additional solid wastes are defined as hazardous by some states, such as California, whose regulations are more stringent than federal regulations.

LOW LEVEL RADIOACTIVE WASTE (LLW)

Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel or 11e(2) by-product material as defined in DOE Order 5820.2A.

HIGH LEVEL RADIOACTIVE WASTE (HLW)

The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

TRANSURANIC (TRU) WASTE

Waste that is contaminated with alpha-emitting transuranium radionuclides (atomic number greater than or equal to 92) with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

MIXED WASTE (MW)

Waste that is both radioactive (LL, HL or TRU) and hazardous. Mixed wastes at SNL, Albuquerque are regulated by both EPA and DOE.

CONVENTION

There is not an exact correspondence between the terms "hazardous material" and "hazardous substance", nor between these terms and the constituents that are responsible for solid wastes being classified as hazardous wastes. For simplicity, however, the term "hazardous material" will be used in this document in a generic sense to refer to hazardous materials, hazardous substances and hazardous wastes. For the purposes of segregation, this approach is conservative.

"Radioactive waste" will be used similarly to refer to LLW, HLW or TRU waste.

The more specific terms will be used only where they are needed for clarity.

PROCEDURES FOR HAZARDOUS MATERIALS

The Environmental Protection Agency (EPA) has issued treatment standards for the disposal of hazardous wastes. Waste identification and characterization are essential to be in compliance with these standards. In general, the more treatment standards to which a waste is subject, the more difficult and costly it is to dispose of the waste.

As a general rule, personnel at SNL, Albuquerque are advised to avoid commingling of hazardous materials or of hazardous materials with nonhazardous materials to the greatest extent possible. At a minimum, hazardous wastes must be segregated according to waste type. Under no circumstances should incompatible materials be combined. In addition, generators are directed to provide log sheets for bulked wastes listing the quantities and the description of wastes including any possible contaminants.

SOLVENTS

Individual solvents should be kept segregated to reduce disposal costs and to enhance the possibility for recovery, recycle and reapplication. For example, acetone is readily recovered from waste acetone streams if these streams do not contain large quantities of other solvents that would diminish the effectiveness of distillation.

Costs of disposal for acetone contaminated with various other materials are shown in Table 1. If the acetone is contaminated with unknown materials, it must first be sampled at a cost of approximately $2000. If the acetone contains one toxic metal, it must be incinerated in a specially permitted facility. Furthermore, at the TSDF both the scrubber water and the ash must be collected, sampled and possibly treated to ensure that the metal contaminent will not migrate through the environment after the ash is disposed. The cost of such treatment depends on the type and the level of the contamination. Typically, the costs for treatment are several times higher than the cost of disposal of a simple, uncontaminated solvent waste.

CHLORINATED SOLVENTS

Chlorinated solvents should be kept segregated from solvents that are not chlorinated. In many cases, waste solvents that are not amenable to recycle can be used for kiln fuel if they do not contain chlorinated compounds. Currently, the only means for disposal of mixtures containing chlorinated solvents is incineration in specially permitted facilities. Such disposal is expensive (see Table 1) and not without environmental drawbacks.

FLUORINATED SOLVENTS

Likewise, fluorinated solvents should be segregated from nonfluorinated solvents. Waste streams contaminated with fluorinated solvents present the same management issues as those contaminated with chlorinated solvents. There is, however, a good market for recycling fluorinated solvents.

CORROSIVES

Acids and bases must be segregated to avoid the potential for release of heat and hazardous gases. The acids and bases can be used in certain circumstances to neutralize one another provided neither is contaminated with other regulated materials such as toxic metals.

OXIDIZERS

Oxidizers and solvents (or other carbon sources) must be segregated to avoid the potential for fire. Furthermore, some oxidizers can be used in other processes. For example, the nitrate salts used as a heat transfer fluid in the solar program at SNL, Albuquerque has been reapplied to a metal refinishing operation where the oxidizer is consumed. The cost of disposal for SNL was only the transportation instead of transportation plus several dollars per kilogram for incineration.

SULFIDES AND CYANIDES

Sulfides and cyanides must be segregated from acids to avoid the release of toxic gases.

CLASSIFIED MATERIALS

Currently, there is no option for disposal of hazardous wastes that are also classified. The wastes must either be declassified in some manner or have the hazardous waste removed from the classified part. For this reason, contaminating classified material with hazardous materials should be avoided, if possible. Future component designs should specifically incorporate the ability to segregate hazardous materials from the classified parts if hazardous materials cannot be avoided.

PROCEDURES FOR RADIOACTIVE WASTES

Presently, SNL, Albuquerque has no disposal option for radioactive wastes and must temporarily store them in a retrievable manner. Even when disposal options become available, space will be limited. It is extremely important, therefore, to minimize the volume of radioactive wastes. To this end, radioactive wastes must be segregated from nonradioactive wastes.

A crucial point to remember is that any handling of radioactive or mixed waste involves exposure to radiation. Characterization, segregation and minimization must be performed as early as possible in the process to eliminate the need for repetitive handling.

WASTE CHARACTERIZATION

The first step in radioactive and mixed waste segregation is characterization of the waste as to type and constituents. Separate disposal options and waste acceptance criteria will apply to LLW, HLW, TRU wastes and MW. Commingling of different types of radioactive and mixed wastes violates DOE orders and could result in the mixture failing to meet any applicable criteria for disposal.

CLASSIFIED AND ACCOUNTABLE NUCLEAR MATERIAL

It is anticipated that disposal of DOE radioactive wastes will be only at DOE facilities. Because these facilities have security systems designed to protect classified material, classified radioactive wastes do not face the same constraints as do classified hazardous wastes. Managing radioactive wastes that contain accountable quantities of nuclear materials, however, does require significantly increased security. Segregation of radioactive wastes involving accountable nuclear material from that which does not is especially important.

LIQUID WASTES

Liquid radioactive and mixed wastes must be neutralized and solidified before long-term storage or disposal. Because all sampling and solidification procedures for radioactive liquid wastes involve potential for personnel exposure and different waste types require different solidification techniques, it is important to know what is in the wastes, to segregate the wastes according to type and to minimize the quantities.

PARTICULATES

Because particulates must be stabilized, it is necessary that waste containing fine particles, such as filters, be segregated from other waste types and forms.

COMPACTIBLE WASTES

The Radioactive and Mixed Waste Management Facility (RMWMF) at SNL, Albuquerque has two compactors, one for radioactive waste and one for mixed wastes. Segregating compactible material, such as decontamination debris, from hardware will contribute to a significant reduction in the overall volume of waste. The segregation should be accomplished up front by the generator to avoid the personnel exposure that would be associated with segregation prior to compaction.

REMOTE-HANDLED RADIOACTIVE WASTES

Remote-handled radioactive wastes (i.e., those that have an external surface dose rate >200mR/hr) must be segregated from wastes that are not remote-handled. SNL, Albuquerque does not have the capabilities to repackage or otherwise process remote-handled wastes. A facility for the characterization and repackaging of remote-handled wastes has been requested.

PACKAGING CONSIDERATIONS

Additional segregation and packaging of radioactive wastes consistent with package limits listed in Table 2 are strongly recommended.

UNKNOWN WASTES

Like other DOE facilities, SNL, Albuquerque has a legacy of historical wastes, many of which contain unknowns. These wastes must be managed as remote-handled or special case wastes until equipment and facilities are available to assay the wastes. Under no circumstances should these unknown wastes be commingled with current waste streams.

MINIMIZING MIXED WASTES

The present inventory of wastes that are both radioactive and hazardous represents a difficult national treatment and disposal problem. Treatment (e.g., incineration) to render the wastes nonhazardous is opposed by some members of the public because of perceived risks of release of radioactive and hazardous materials to the environment. Isolation for the purpose of managing the health risk associated with the radioactive material is complicated by the presence of chemical components and the possibilities of container failure, enhanced migration, and gas-releasing chemical reactions. In addition to the political and technical difficulties in managing mixed wastes, there is the problem of dual, and sometimes conflicting, regulation by multiple agencies. Clearly, avoiding the creation of mixed wastes is paramount.

RADIATION AREA

If at all possible, use of any hazardous material in a radiation area should be avoided. Contamination of only a few parts per million can result in an otherwise radioactive waste being categorized as a mixed waste.

EQUIPMENT

Processing any hazardous material (e.g., lead) in the same equipment used to process radioactive material (e.g., depleted uranium) should be avoided. The cost of additional equipment must be balanced against the cost of managing all of the waste as mixed waste. Furthermore, decontamination of equipment should be performed after each distinct operation to avoid the possibility of cross contamination.

LEAD SHIELDING

Lead used for shielding should be protected to avoid contaminating its surfaces with radioactive material. Nonradioactive lead can be recycled in most cases.

LEAD SOLDER

Equipment containing lead solder should be protected from contamination with radioactive material to avoid the generation of mixed wastes.

SUBSTITUTION

Nonradioactive, nonhazardous materials should be substituted for radioactive or hazardous materials. One example is the substitution of a nonhazardous liquid scintillation cocktail for the older hazardous types. Another example is the use of a non-ionic soap instead of a solvent for cleaning hardware if transferrable radioactive contamination is present. Both examples eliminate potential liquid mixed wastes.

SEGREGATION CONSIDERATIONS FOR FACILITY DESIGNS

Much can be done to minimize wastes by the design of facilities to accommodate control, characterization and segregation of wastes early in the waste generation process. For example, providing individual stacks for each operation allows specific design of filters and scrubbers for the highest possible efficiency without interference from other pollutant streams. Likewise, individual drains with dedicated catch basins assure that an accidental release does not contaminate an entire drainage system.

Designing berms into a facility can play a significant role in containing spills, thereby minimizing spill cleanup and decontamination debris.

One of the best ways to support proper segregation is to design adequate material handling areas in a facility. Separate areas should be provided for the different classes of materials and types of waste to prevent their commingling.

The Radioactive and Mixed Waste Management Facility (RMWMF) was designed with careful attention to waste minimization principles.

Before reaching the RMWMF, wastes are characterized, segregated and minimized at the generator locations following guidance from waste management personnel. At the RMWMF, the various categories of wastes are treated according to different protocols and segregated throughout the rest of the waste management process.

An example of waste segregation and minimization is the use of dedicated compactors for LLW and MW to prevent the creation of additional quantities of MW. In addition, the RMWMF was designed to provide distinct staging and storage areas to facilitate segregation of waste types. Finally, operations and associated personnel training at the RMWMF stress the importance of waste segregation and minimization.

SUMMARY

Proper segregation of materials can help reduce the both the amount of waste generated and the cost and the complexity of managing the waste. SNL, Albuquerque is developing an extensive segregation program for its radioactive, mixed and hazardous wastes. Several elements of the program have been implemented with clear benefits.

Table 1. Acetone Disposal Costs

Contaminant	Disposal Option	Cost
Unknown	Sample	$2000/container
One Toxic Metal	Special Incineration	$????/gal
Trace Halocarbons	Special Incineration	$ 5.00/gal
>10% Non-halocarbons	Kiln Fuel	$ 1.00/gal
<10% Non-halocarbons	Recycle	$ 0.00/gal

Table 2. General Package Limits for Radioactive Waste

Package Content	Package Requirement	General Packaging Description
DOT Radioactive Material Limits		
<0.002 μCi/g	3222 Waste package guidelines	Minimum of double bag with tag describing waste contents and exposure rates.
>0.002 μCi/g Total activity of radionuclides does not exceed A_1 or A_2*	SNL, Albuquerque on-site transportation manual requirements	DOT (49 CFR) equivalent safety packaging Type A Material package equivalent required - Appropriate inner containers to prevent leakage. Cushioned - securely closed.
>0.002 μCi/g meets Limited Quantity/Instruments and Articles 49 CFR definition.	SNL, Albuquerque on-site transportation manual requirements	DOT (49 CFR) equivalent safety packaging. Strong, tight packages that will not leak any contents during conditions normally incident to transportation.
DOE Transuranic Limits		
<100 nCi/g alpha, transuranics (>20 yr halflife)	3222 Waste package guidelines	Package as low level waste. Comply with NVO-325 for off-site movements.
>100 nCi/g alpha, transuranics (>20 yr halflife)	3222/DOE guidance, WIPP Waste Acceptance Criteria (WAC)	Complies with all requirements.
DOE Exposure Rate Limits		
<5 mrem/hr @30 cm	DOE 5480.11 Posting required as specified	Package labeling required to meet DOE 5480.11 specifications and/or storage in posted radiological area.
>200 mrem/hr	49 CFR Special case - Contact 3222 for guidance	General Packaging Description packaging must be overpacked to limit exterior exposure to <200 mrem/hr.
High Activity Concentration Limits		
>10 CFR Class C limits	Greater confinement disposal packaging Special case - Contact 3222 for guidance	Packaging must meet DOT (49 CFR) criteria at a minimum.

NOTE: mrem - mR for gamma-emmiting radionuclides.
* Concentration limits as defined by DOT (49 CFR)

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