NEW LAND DISPOSAL RESTRICTIONS ON CONTAMINATED SOIL AND DEBRIS, AND NEWLY IDENTIFIED TOXICITY CHARACTERISTIC ORGANICS*

William B. Fortune and Jean C. Schumann
U.S. Department of Energy
Washington, D.C.

William E. Fallon
Pacific Northwest Laboratory
Washington, D.C.

Janet W. Badden and Edward H. Smith
Westinghouse Hanford Company
Richland, Washington

ABSTRACT

The applicability of the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (LDR) program to radioactive mixed wastes (RMW) has been clarified through U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) rulemakings and notices. However, a number of waste management concerns involving RMW and RMW-contaminated soil and debris continue to exist with respect to achieving compliance with LDR provisions and treatment standards. Consequently, DOE has become increasingly proactive in its participation in the LDR rulemaking process and in the identification of LDR compliance issues associated with its RMW inventories. Both data and recommendations from across the DOE complex were collected and transmitted to EPA in response to proposed requirements that would implement LDR for contaminated soil and debris, and certain newly identified toxicity characteristic (TC) organics. Much of this information focused on concerns related to the application of proposed regulatory approaches to RMW streams. Highlights from the information included in these DOE responses are presented.

INTRODUCTION

Historically, there has been a lack of clarity regarding the applicability of RCRA to RMW. Some clarification was provided on July 3, 1986, when the EPA published a notice in the Federal Register (51 FR 24504) establishing that RMW was subject to RCRA and requiring States to petition EPA for authorization to regulate RMW. However, this notice also stated that, pending an interpretation of the definition of "Byproduct Material" by the DOE, EPA would regulate RMW on a case-by-case basis. Thus, for many DOE facilities, uncertainties remained regarding the subset of their radioactive waste that should, or ultimately would, be classified as RMW. Despite these uncertainties, in response to the proposed LDR Framework Rule that was published in January 1986 (51 FR 1602), DOE raised several areas of potential concern relative to the application of LDR requirements to RMW. These concerns included: a.) the need for EPA to consider whether treatment technologies have been demonstrated for RMW, b.) the need for EPA to consider radioactive issues in conducting technology risk assessments, and c.) difficulties in applying the toxicity characteristic leaching procedure (TCLP) to RMW. However, at that time, DOE did not conduct an in-depth evaluation of the impact of the LDR program on RMW management because of remaining legal uncertainties regarding the applicability of RCRA to RMW.

These uncertainties were largely resolved on May 1, 1987, with DOE's publication in the Federal Register (52 FR 15937) of a final rule (the so-called "Byproduct Material" interpretation) that clarified the definition of RMW, and reiterated that RMW is waste that contains both a radioactive component subject to the Atomic Energy Act (AEA) and a hazardous component subject to RCRA. Before promulgation of this rule, DOE's RMW generally had been managed in accordance with DOE Orders designed to implement AEA requirements. Thus, prior to 1987, the treatment, storage and disposal (TSD) of DOE RMW had not generally been conducted in accordance with RCRA regulations. Moreover, before promulgation of this rule, little information had been systematically collected regarding the quantities and hazardous characteristics of RMW throughout the DOE complex, nor about the capability of existing DOE facilities to manage RMW in compliance with EPA's current and pending RCRA regulations.

Following issuance of the "Byproduct Material" interpretation in 1987, DOE began evaluating the extent of RMW compliance problems across the DOE complex. This is an ongoing process, and DOE is continuing to develop, evaluate, and implement RMW management strategies throughout the complex in efforts to achieve LDR compliance. It is also important to note that most of the RMW characterization data that have been collected since the "Byproduct Material" interpretation reflect preliminary process knowledge, rather than analytical results. However, DOE is continuing to refine and expand both its process knowledge and its ability to analyze RMW in the laboratory.

As a result of the "Byproduct Material" interpretation and DOE's subsequent, ongoing assessment, a number of RCRA compliance issues have emerged relating to DOE's RMW

* Prepared by the U.S. Department of Energy with the support of Pacific Northwest Laboratory (Under Contract DE-AC06-76RLO 1830)

inventories and management practices. The impact of the RCRA LDR program on RMW management is a case-in-point.

The basic framework for the LDR program was established with the enactment of the Hazardous and Solid Waste Amendments of 1984 (HSWA). However, when Congress enacted HSWA, the ramifications of ultimately regulating RMW under the same regulations that would be promulgated for nonradioactive hazardous wastes were not fully considered. Likewise, with the development of prohibitions on land disposal for hazardous waste in the initial LDR rulemakings, consideration apparently was not given as to whether or not there were technologies or adequate available treatment capacity for RMW. To some extent this was because of uncertainty as to whether RMW was subject to RCRA regulation. But to a greater extent, it was because of a lack of data describing RMW characteristics and inventories. The first two LDR final rules (those for spent solvent and dioxin wastes and California List wastes) were published in the Federal Register in 1986 and 1987, respectively. Neither of these final rules specifically addressed RMW.

As DOE's understanding of LDR applicability to RMW has progressed, its efforts to identify and evaluate actions to achieve LDR compliance have progressed correspondingly. Since the initial LDR rulemakings, DOE has become increasingly proactive in its participation in EPA's rulemaking process for establishing restrictions applicable to the remaining scheduled wastes (i.e., First-, Second-, and Third-, hazardous wastes), as well as for newly identified and listed wastes, and contaminated soil and debris. During the past several years, the DOE Office of Environmental Restoration and Waste Management (EM) has collected considerable data and information on RMW, including types and volumes generated, physical and chemical characteristics, and treatment methods and capacities. In addition, the DOE Office of Environment, Safety and Health (EH) has developed formal, consolidated responses to LDR-rulemaking notices published by EPA in the Federal Register. In developing these consolidated responses, EH requests input from DOE's Field Organizations and Program Offices. Substantial characterization, treatment, and capacity data have been provided as a component of DOE comment packages in response to proposed LDR rulemakings, in accordance with compliance agreements, and as part of a DOE case-by-case extension petition. Such informal and formal information exchange between EPA and DOE regarding the applicability of the LDR program to DOE's RMW inventory is continuing.

In 1991, EPA published two Advance Notices of Proposed Rulemakings (ANPRMs) that, among other topics, addressed potential LDR treatment standards for contaminated debris (56 FR 24444-24465), and for contaminated soil and newly identified TC organics (56 FR 55160-55189). DOE considers RMW-contaminated debris and soil as among its most intractable problems relative to LDR treatment standards and compliance.

To prepare comprehensive, consolidated DOE responses to these two ANPRMs, EH requested that DOE's Field Offices, Program Offices, Project and Area Offices, and other organizations review the ANPRMs and provide comments and recommendations regarding the potential impact of the proposed requirements on their operations and facilities. As part of a cooperative effort between EH and EM, DOE organizations were also requested to submit documents or data describing inventories, characteristics, and treatment technologies for contaminated soil, debris, and TC organics. Summaries and copies of documents and data found to be most applicable to the ANPRMs were transmitted to EPA as part of DOE's consolidated responses. To ensure that the consolidated responses were as current as possible, DOE organizations were also asked to review and, if necessary, update the information on their low-level, high-level, and transuranic RMW streams that was currently found in DOE's Waste Management Information System (WMIS) database.

The remainder of this paper highlights some of DOE's perspectives, concerns, and recommendations regarding the application of the LDR program to its RMW inventory, with particular emphasis on RMW-contaminated soil and debris, and TC organics. It should be noted that on January 9, 1992, EPA published a proposed rulemaking on LDR for newly listed wastes and contaminated debris (57 FR 958-1042). This January 9, 1992, proposed rule follows and corresponds to the ANPRM published in May 30, 1991 (56 FR 24444-24465). Some of the comments and suggestions discussed below that DOE submitted in response to the May 30, 1991, ANPRM are reflected in the January 9, 1992, proposed rule. DOE plans to submit comments to EPA in response to the January 9, 1992, proposed rule. EPA has indicated its intention to promulgate a final rule (that addresses contaminated debris and the newly listed wastes covered by the January 1992 proposed rule) by May 1992.

CONTAMINATED SOIL AND DEBRIS

Contaminant Levels and Health-Based Standards

As discussed in the two ANPRMs cited above, EPA's "contained in" policy states that contaminated media (i.e., debris, soil, groundwater, sediments) containing RCRA wastes must be managed as if they themselves were hazardous until the media no longer contain the hazardous waste or until the hazardous waste is delisted. This raises the question of when a contaminated media can be considered to no longer contain the hazardous waste. EPA has not provided definitive guidance on this point; however, some guidance has previously been offered. In a discussion specifically addressing the "contained-in" interpretation in EPA Superfund LDR Guide #5, (Determining When Land Disposal Restrictions are Applicable to CERCLA Response Actions, OSWER Directive 9347.3-05FS, July 1989), EPA states that any mixture of a non-solid waste and a RCRA-listed hazardous waste must be managed as a hazardous waste as long as the material contains (i.e., is above health-based levels) the listed hazardous waste. This implies that if the listed hazardous waste is present below health-based levels, the mixture need not be managed as a hazardous waste.

However, EPA proposes to establish LDR treatment standards as the threshold for determining when a contaminated media no longer contains a listed hazardous waste. DOE agrees that LDR treatment standards are generally appropriate as "contained-in" thresholds. However, there is one instance in which an LDR treatment standard may not be appropriate as a "contained-in" threshold. That is in situations when an LDR treatment standard is lower than an appropriate health-based level. In such instances, the *contaminated* soil or debris should not be considered to contain a listed

hazardous waste where the contaminant(s) of concern (a) have been treated to below the appropriate health-based levels, or (b) are already below appropriate health-based levels in the untreated contaminated soil or debris.

EPA's proposed approach for codifying the "contained-in" policy is sound. However, the proposed approach may require treatment of all contaminated soil and debris (including those with hazardous constituent concentrations below health-based levels) in order to achieve LDR treatment standards, and as a criteria which must be met in order for them to be deemed clean and no longer subject to Subtitle C requirements. EPA has recognized the application of health-based standards as being protective of human health, and, in fact, uses health-based standards in evaluating delisting petitions. With this in mind, it would seem that the treatment of hazardous waste, and especially RMW, to best demonstrated available technology (BDAT) treatment standards that are below health-based levels is unnecessary to protect human health and the environment.

Finally, it should be noted that in its January 9, 1992, proposed rule, EPA outlines an approach that would allow a site that manages contaminated debris to request a case-by-case determination by EPA as to whether toxic constituent levels are below levels that should be under Subtitle C control. EPA states:

> "The rule, if adopted, would thus codify the contained-in principle that the Agency currently applies on a case-by-case basis. If toxic constituents are not present at levels that could pose a hazard to human health or the environment (and if the debris does not exhibit a characteristic), the debris would be excluded from the definition of hazardous waste."

Adoption and codification of the "contained-in" policy within the existing RCRA regulations would allow those RMW that pose only a minimal threat to human health and the environment to be managed outside of the RCRA Subtitle C program but within the provisions of State and local regulations, the AEA, and applicable DOE Orders. This approach would allow valuable cleanup funds to be directed towards remediation or closure of those waste management units having the greatest potential to adversely affect human health and the environment. If such an approach is not taken, limited hazardous waste landfill space will continue to be used for the disposal of environmental media (i.e., soil, sediments) and debris that contain essentially de minimis levels of hazardous constituents.

Treatment Technology Categories for RMW-Contaminated Soil and Debris

Contaminated soil and debris both present a wide diversity of matrices, contaminants, constituent concentrations, and other variable properties. Considering this diversity, DOE believes that generators and managers of these wastes should be afforded the flexibility to select the most appropriate treatment option for their specific contaminated soil and debris waste streams. Such flexibility could be provided by identifying the demonstrated and available treatment technologies appropriate for specified treatability groups of soil and debris. Such technologies would likely fall within the three general categories of treatment that EPA has proposed for contaminated debris: i.e., destruction, immobilization, and extraction. The treatment category "destruction" could include chemical, biological, or thermal treatment. The treatment category "immobilization" could include technologies such as in-situ or ex-situ vitrification or soil stabilization technologies. Finally, the treatment category "extraction" could include treatment technologies such as chemical extraction, washing, dechlorination, low-temperature thermal desorption, etc. Other applicable treatment technologies identified in the future because of technological advances will most likely fall within one of these three treatment categories.

Establishing an approach that allows maximum flexibility and sets technology-based treatment standards would offer an appropriate regulatory framework, especially for RMW-contaminated soil and debris. Such an approach would reduce worker exposure to radiation because the LDR verification (i.e., testing) that is required for concentration-based standards would not be necessary. Flexibility to select from among generic treatment categories is warranted, given that waste managers must account for the distinct soil and debris matrices, constituents, and constituent concentrations that occur at different DOE sites. For example, soil washing may be the treatment of choice for the sandy loam soils that are common at the Hanford Site, but it may not be the treatment of choice for the clay soils that are common at the Savannah River Site.

Alternative Approaches for Contaminated Soil

As an alternative to the approach involving generic treatment categories discussed above, a regulatory framework for contaminated soil that uses more specific structural/functional groups and percent reductions could also provide the needed degree of flexibility. Such an approach is discussed in EPA's Superfund LDR Guide #6A (Obtaining a Soil and Debris Treatability Variance for Remedial Actions, OSWER Publication 9347.3-06FS, July, 1989) and #6B (Obtaining a Soil and Debris Treatability Variance for Removal Actions, OSWER Publication 9347.3-06BFS, September, 1990). If a sufficient number of structural/functional groups (e.g. polychlorinated biphenyls, dioxins, herbicides) are used to subcategorize contaminated soil and concentration ranges or percent reductions are established, then requiring treatment of contaminated soil to meet the specified concentration ranges would be appropriate. However, the regulated community should be afforded the flexibility to demonstrate the absence of some of the groups rather than being required to analyze for each group. If this approach is pursued, it would be beneficial to the regulated community for EPA to publish a table or appendix specifying the structural/functional groups that appropriately correspond to each listed waste code.

As a modification to this alternative approach, DOE recommends that EPA consider establishing the percent reduction criteria based on threshold levels. As EPA points out in Superfund LDR Guides #6A and #6B, when contaminant concentrations are very high, a percent reduction can leave an undesirable level of contaminants in soil. Similarly, when contaminant levels are low, valuable resources are expended in reducing contaminants to very minute levels. It is recommended that, within the percent reduction framework, EPA set both upper and lower threshold limits. If the percent reduction required by the regulation does not result in levels of contaminants below the upper threshold level, then treatment would need to continue until the upper threshold level is met. Similarly, treatment could stop if the level of

contaminants is below the lower threshold level. This lower threshold could then potentially serve as the "contained-in" level.

Sampling and Analysis of RMW

Required procedures for sampling and analyzing RCRA hazardous wastes are described in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" (SW-846). However, meeting SW-846 requirements for RMW poses significant difficulties and similar problems will be encountered with RMW-contaminated soil and debris. For example, SW-846 requires the use of specific sample collection equipment and containers that may not be appropriate for RMW-contaminated soil and debris. At some DOE sites, RMW above 200 millirem per hour requires remote-handling procedures. RMW-contaminated soil or debris above this concentration would require remotely- operated sample collection devices, special containers to address the radiological hazards, and analysis in hot cell laboratories. The use of manipulators in limited hot cell laboratory space is very time-consuming, and holding times specified in SW-846 are often exceeded. Limiting the radiation to which workers are exposed (in accordance with the as low as reasonably achievable (ALARA) requirements, as mandated by the AEA) is a major concern for the DOE. Consideration must be given to potential adverse health effects associated with the radioactive component of RMW-contaminated soil and debris, and the difficulties associated with SW-846 protocols for analyzing soil or debris contaminated with such components.

Potential Waste Classification Approach for Contaminated Soil and Debris

DOE supports EPA's proposed approach of placing applicable contaminated soil and debris treatment standards in an appendix or a table within a new regulatory section of 40 CFR Part 268. This would assist the regulated community in easily identifying the most appropriate treatment standards. Furthermore, DOE supports the use of a four-digit alphanumeric code to identify applicable treatment standards for contaminated soil and debris. Such a code, however, should not place contaminated soil or debris in a listed hazardous waste category such that all treatment residues (in particular, the decontaminated soil or debris itself) would continue to be listed. Such an interpretation could follow from the "derived-from" rule.

An alphanumeric code (e.g., C001 - C###, where C indicates Contaminated media) could allow for an initial categorization of the contaminated soil or debris for the purpose of determining an appropriate treatment technology(ies). In addition, all applicable 40 CFR 261 (hazardous waste) codes should be attached to the soil or debris for purposes of treatment residue designation. Using this approach, a debris item or soil contaminated with a listed solvent might carry its unique debris or soil code C### as well as applicable listed (e.g., F001-F005) and characteristic hazardous waste codes. 40 CFR 261 could describe the assignment of "C" codes as being exclusively for purposes of LDR compliance. However, EPA should require the identification of all applicable waste codes for the purposes of hazard management, such as transportation and labelling requirements. The 40 CFR 261 description could also explain that treatment residues will carry their respective D, F, K, U, and P codes, where applicable.

Treatment Facilities for Contaminated Soil

It typically requires five to ten years for DOE to plan, budget, obtain approval for, and construct a new facility. In some cases, Congressional allocation may be required. After construction is completed, up to another year may be needed to complete operational readiness reviews, complete operating procedures, and train operating staff. Thus, a number of years may be required for DOE to provide sufficient treatment or disposal capacities for RCRA-regulated contaminated soils.

Because of the low hazard potential for many contaminated soil and debris wastes, consideration should be given to implementing certain reduced requirements for facilities storing these wastes. This might enable DOE and other Federal facilities to use space in existing buildings that would not meet current RCRA Subtitle C facility requirements, yet could provide adequate containment for such wastes. For example, the Oak Ridge National Laboratory (ORNL) has several storage facilities which meet RCRA interim status requirements but which are slated for closure under RCRA in calendar year 1992. If interim status could be retained for facilities handling contaminated soil and debris, ORNL could continue to use existing facilities and be in a better position to handle such wastes. Given the expected volumes of contaminated soil to be generated at Federal facilities, EPA should seriously consider the added cost and time that would be involved in providing additional (new) storage capacity for these wastes. Of course, it is recognized that onsite facilities managing waste from cleanup actions at CERCLA sites do not require permits under RCRA. However, compliance with RCRA's design and operating standards (40 CFR Part 264) for such facilities may be required if such standards are determined to be applicable or relevant and appropriate requirements (ARARs).

Definition of Debris

Currently, DOE's contaminated debris inventory includes, but is by no means limited to: lead bricks, underground tanks, flooring and roofing materials, sheet metal, discarded equipment, tools, process vessels, job control wastes (booties, wipes, rags, mops, coveralls, etc.), resin and carbon beds, cadmium wastes (control rods, HEPA filters), construction and demolition materials, scintillation vials, pipes, railroad ties cranes, vegetation, and animal remains. In many instances, however, debris generated during DOE's past operations was not inventoried before burial or other storage. Consequently, it is very likely that ongoing and future site characterization studies will reveal additional forms of contaminated debris. Undoubtedly, the private sector and other government agencies also have contaminated debris unique to their enterprises or missions. To avoid future uncertainties, the definition of debris that is codified in regulation should be broad enough to accommodate this diversity and should eliminate any ambiguity as to whether a contaminated object is or is not to be considered debris.

NEWLY IDENTIFIED TOXICITY CHARACTERISTIC ORGANICS

Treatment Standards and Characteristic Levels

The EPA has requested comment on whether treatment standards for TC organics should be established at or below the characteristic level, and whether the standards should be

based on a total constituent analysis or the TCLP. For RMW, DOE supports establishment of treatment standards at the characteristic level based on a total constituent analysis. DOE recommends that EPA set treatment standards at the TC organic characteristic level, and provide endorsement and clarification on the use of a total constituent analysis to arrive at a TC organic concentration through the use of the theoretical maximum leaching level.

Current RCRA regulations require waste generators to determine if a waste is a TC organic hazardous waste by using the TCLP to determine if the concentration in the waste extract exceeds the established characteristic levels. DOE is already experiencing certain difficulties in using the TCLP on RMW. These problems increase as the organic concentration levels that need to be detected are lowered, and radiological exposure is thus increased due to larger required sample volumes. For example, EPA-required sample volumes cannot be obtained for high-dose RMW because these sample volumes would result in excessive radiation exposure to personnel conducting the sampling and analyses. Obtaining required sample volumes can also be difficult due to sampling technology limitations. Technologies are not available to take an adequate sample through the small ports on some RMW containment structures. Likewise, maintenance of a zero headspace is not possible in many instances because of the problems in obtaining a full container of a radioactive sample, while at the same time assuring that no spillage occurs that would contaminate personnel. In some instances it is impossible to obtain a representative sample for organics from a RMW because the RMW is also thermally hot which causes the organics to volatilize. In summary, the imposition of LDR treatment standards based on the TCLP at levels below the characteristic level would result in greater compliance uncertainty for DOE because many more RMW streams would be unquantifiable at such levels.

In addition to these analytical considerations, DOE supports establishing TC organic treatment standards at the characteristic levels because if properly set, the TC levels should represent levels that provide adequate public health and environmental protection. Also, the logic asserted by EPA in its final rulemaking for Third characteristic treatment standards should also apply to TC organics; because of the diversity of waste forms that characteristic wastes encompass, no one BDAT will be appropriate. Therefore, treatment standards should be set at the characteristic level. This will provide sufficient flexibility to select the most appropriate technologies for treating the diversity of TC organic waste forms.

SUMMARY: GENERIC DIFFICULTIES IN MEETING LDR TREATMENT STANDARDS FOR RMW AND RMW-CONTAMINATED SOIL AND DEBRIS

Although it is clearly more desirable to address RMW treatment issues on a generic basis rather than through the variance process, there are insufficient data at present to identify all potential problems that may arise in treating RMW to meet existing LDR treatment standards. Data on RMW characterization and treatment methods are both limited.

RMW characterization efforts are not yet complete, particularly for DOE's large radioactive and RMW inventory from past generation, and for contaminated soil and debris that will be generated in future environmental restoration activities. The use of process knowledge is not always sufficient for such waste streams, since historical information on how these wastes were generated is often lacking. The testing of both old and new RMW can also be difficult because of worker exposure concerns and other problems associated with RMW sampling and analysis, including the lack of validated analytical methods for RMW. In addition, there is very limited laboratory capacity to conduct RMW analyses.

Data on treatment of RMW are also lacking because of the limited number of RMW treatment units currently operating. Treatment systems for RMW must be designed not only to treat the hazardous component of the RMW, but also to limit the release of radionuclides to the environment by airborne and waterborne pathways, and to control contamination. Release limits for radionuclides are stated in terms of a total radiation dose from all nuclides, and the difficulty of complying with the dose limits depends on the particular mixture of radionuclides, their radiotoxicities, and their quantities. The release of some radionuclides can be controlled by chemical or mechanical means, e.g., filters, but some can only be controlled by limiting the amount processed. For example, if soil containing tritium is thermally processed, the only practical way to control the release of tritium to the atmosphere is to control the rate at which tritium is fed to the process equipment, which, in turn, limits the rate at which the soil can be processed. In such cases, immobilization technologies may be preferable in order to maintain radiation exposure that is ALARA. Worker safety concerns include both inhalation hazards and direct radiation hazards. Direct radiation hazards are controlled by limiting both exposure time and quantities processed, and by increasing distance and shielding. Treatment of high radiation waste can require remote operations to control exposure, making it more difficult to run and maintain equipment. Thus, equipment reliability and ease of maintenance are also major concerns that must be factored into the design of treatment systems.

In light of the above issues, it is not at present possible to identify all the potential problems that may arise in meeting existing LDR treatment standards for RMW. However, DOE is moving forward with efforts to characterize its RMW and to develop appropriate treatment capacity. With regard to characterization, DOE has a number of efforts underway to address RMW sampling and analytical problems. These ongoing efforts include: 1. development of remotely handled analytical laboratories, 2. development and approval of alternatives to the methods described in SW-846 for RMW, and 3. development of sampling containers that will improve zero-headspace problems. With regard to treatment capacity, DOE's plans to bring additional RMW treatment units on-line in the near future and research and development efforts related to the treatment of RMW are continuing. As RMW characterization and technology development efforts proceed and come to fruition, DOE will continue to provide EPA with information to ensure that RMW-related issues and concerns are factored into LDR regulations.