

THE MIXED WASTE DILEMMA*

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ABSTRACT

This paper identifies the factors relevant to the Department of Energy's (DOE) compliance with the recently promulgated Land Disposal Restrictions for radioactive waste mixed with hazardous waste and describes the role that Congress, U.S. Environmental Protection Agency, DOE, and the States play in their successful implementation at the Nuclear Weapons Complex. Special attention is given to the conflicting implications brought about by: (1) the relatively little knowledge about the extent of the mixed waste universe at the weapons sites prior to the promulgation of regulatory standards on May 8, 1991; (2) the limited treatment capacity available nationwide for mixed waste; (3) the restricted time allowed DOE to develop adequate technologies to meet the standards; and, (4) the storage limitations under 1984 Hazardous and Solid Waste Amendments of the Resource Conservation and Recovery Act of 1976.

INTRODUCTION

The radioactive mixed waste subject to hazardous waste regulation (RMW) found at most Nuclear Weapons Complex facilities consists of material contaminated during the production of nuclear weapons and the reprocessing of radionuclides. It includes tools, equipment and protective clothing. Other components of RMW are organic and inorganic sludge generated by waste treatment operations and, wastes generated by research and decommissioning activities.

Before 1970, burial in shallow pits and trenches was the traditional disposal method for most RMWs across the United States. The Atomic Energy Commission, now DOE, concerned about the inherent risks associated with these wastes, particularly those transuranic (TRU) in nature, ruled in 1970 that they were no longer to be disposed of, but rather, stored in a manner which would allow their retrieval. As a result, retrievable storage sites are today found at Hanford Reservation, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Nevada Test Site, Oak Ridge National Laboratory, and the Savannah River site. Even though, these facilities provide safe storage for TRU wastes generated on site, and for those at other nuclear facilities including, Lawrence Livermore National Laboratory, Mound Plant and Rocky Flats Plant, regulators and the public continue to be concerned about the widespread contamination caused by decades-long disposal of RMW being uncovered throughout the DOE Complex.

ATTEMPTS TO REGULATE THE RMW UNIVERSE AT DOE

As a serious attempt to control the widespread mismanagement of hazardous wastes and reduce the threat of contamination to human health and the environment, Congress enacted the Resource Conservation and Recovery Act (RCRA) in 1976. To implement the Congressional mandate, EPA promulgated on May 19, 1980, regulations applicable to any individual or facility responsible for the generation, transport, and management of wastes deemed as hazardous. Guid-

ance as to how these regulations would affect mixed waste management was not provided. DOE, claimed that the RCRA regulations were statutorily not applicable to it, and argued that compliance with RCRA conflicted with national security considerations or with its authority granted under the Atomic Energy Act (AEA) for managing hazardous waste. Another claim by DOE was that the AEA, specifically section 271, barred States from enforcing the RCRA law at its facilities.

On July 3, 1986, and after the State of Colorado threatened to close the Rocky Flats Plant for gross environmental mismanagement, EPA issued a determination stating that "wastes containing both hazardous waste and radioactive waste are subject to the RCRA regulation." EPA also requested States to apply for additional RCRA authority prior to including radioactive mixed waste as part of their hazardous waste program (2). No reference, however, was made as to how EPA expected States to implement the two-page rule or what types of regulatory standards were applicable under it. Furthermore, EPA did not provide any specific criteria on how the regulated community was to comply with the rule.

On September 23, 1988, after recognizing that substantial confusion existed on the applicability of interim status requirements to RMW management, EPA stated in the Federal Register that all facility operators managing mixed wastes were subject to RCRA regulation (3). However, as in earlier attempts to regulate mixed wastes, EPA gave little or no guidance on how the States were to implement this ruling or on the types of waste streams that would be affected. This mandate was also flawed because any DOE facility located in a State authorized to carry the basic RCRA program, but without mixed waste authorization, could manage its mixed wastes without demonstrating full compliance. Today, all DOE-operated facilities storing mixed wastes are located in States with mixed waste authorization and, are either in compliance with RCRA interim status requirements pending issuance of a final permit or, are being upgraded to meet these requirements in accordance with negotiated schedules of compliance (4).

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Whether EPA attempted to subject mixed waste to the LDR provisions prior to the proposed third "third" rule of November 22, 1989, is uncertain. For instance, the mixed restricted hazardous waste rule promulgated in June 1989 as part of the second "third" might have appeared to be an effort to address RMW, especially since EPA stated that "...prohibited wastes are not exempted from the Land Disposal Restrictions when they are mixed with other wastes (or any other materials, for that matter)" (5). Although this rule was clearly issued to eliminate mixing restricted wastes with "other wastes" during treatment and avoid compliance with the impermissible dilution provision, its possible application to mixtures in which the "other wastes" are radionuclides was unfortunately never established, and apparently, not considered.

With the possible exception of the Federal Facility Compliance Agreement for the Rocky Flats Plant, no other meaningful effort was made by EPA before the third "third" rule to explicitly regulate mixed wastes at DOE.

MOST RECENT EPA EFFORT TO REGULATE RMW

The most explicit effort made by EPA to regulate the treatment and disposal of radioactive contaminated hazardous wastes is contained in the third "third" rule proposed on November 22, 1989 and promulgated on May 8, 1990 (6, 7). The mixed waste most directly affected by the treatment standards contained in these regulations are, among others, metal-containing wastes, waste lead solids (e.g., lead shielding), sludge from vacuum sumps, hydraulic oils, stored mixed waste, and radioactive contaminated soil and debris.

Several potential problem areas were immediately identified with the proposed Land Disposal Restrictions contained in the third "third." One of the most relevant to RMW was that promulgated treatment standards for hazardous wastes could not provide the degree of safety required to prevent or minimize the radiation exposure that would result from treating radioactive mixed wastes. Of particular concern was the fact that very little information was provided in the proposed treatment standard on how to reduce the human exposure potential, particularly, when treating high-level radioactive mixed wastes generated in the chemical processing of nuclear reactor fuels and targets. Another problem area was the uncertainty of how and where DOE would dispose of the treated high-level waste, especially when, at present, no permitted disposal capacity exists. The Savannah River Site alone contains approximately 100 million liters of RCRA hazardous waste contaminated with high-level radioactive wastes.

As for high-level radioactive waste, demonstrating compliance with proposed technology treatment standards for certain TRU mixed wastes was similarly concerning to DOE. For instance, the surface deactivation followed by macro-encapsulation standard proposed by EPA to treat radioactive lead solids (6) was perceived as potentially harmful rather than a solution to the RMW problem. This was due to the limited supporting treatment data actually available to develop the deactivation standard, and because of the limited and unclear treatment criteria provided for attaining compliance. Prompt clarification was considerably important to DOE since removal of elemental lead from shielding equipment was generally not feasible due to worker's health safety,

equipment configuration, and DOE's view that lead shielding for radioactive waste packages was not a waste in itself but part of the waste containment system. Recognizing the data limitations on the performance of deactivation technologies, EPA opted to eliminate its proposed surface deactivation procedure and promulgate instead macro encapsulation as the required treatment method (7).

Another similarly concerning problem at the Nuclear Weapons Complex is that of achieving compliance with LDRs relating to radioactive contaminated soil and debris. Of the 428,516 cubic meters of contaminated soils reported in 1985, DOE has estimated that only 19 percent is considered safely stored (8). The technologies needed for addressing this serious problem, are either nonexistent or readily unavailable. As a consequence, EPA has granted a two-year national capacity variance for soils and debris contaminated with third "third" and with radioactive mixed waste (7). EPA also issued a Federal Register notice requesting information regarding current storage capacity (9). Such efforts, however, may not be sufficient to address the radioactive contaminated soil and debris problem; particularly since 1.) it will take more than two years to develop appropriate treatment technologies; and 2.) the inventory of contaminated soil and debris will continue to grow due to the hundreds of cleanup activities being carried throughout DOE.

The purpose of discussing the standards for radioactive lead solids and radioactive contaminated soil and debris, and to some extent high level RMW, is not specifically to show their deficiencies, but more importantly to point out the factors that contributed to such shortcomings. Among the most important are: 1.) the predominant lack of adequate resources available to the EPA office responsible for developing RMW standards; 2.) the reluctance by DOE to comply with the RCRA law or cooperate fully with EPA by supplying relevant information on a timely basis; and 3.) the lack of adequate data on the nature, quantities, and possible treatment of RMW found at DOE. The tight schedule within which EPA was required to issue its LDR provisions is also considered a significant contributor to the regulatory and technological challenges involving mixed waste.

STORAGE PROBLEMS AT THE NUCLEAR WEAPONS COMPLEX

Radioactive mixed waste management at the Nuclear Weapons Complex facilities has traditionally been based on storing the waste at the generating facility, with little emphasis on long-term disposal. The primary reason for this is that the majority of DOE facilities were not designed for treating and disposing of RCRA-restricted wastes but for temporarily isolating these wastes from the environment until permanent disposal facilities were built (4). Because waste generation from plant operations at most facilities has continued, the available storage capacity is diminishing rapidly.

Storage of mixed waste has increased substantially in recent years. In 1988, DOE estimated a projected increase of more than 11 percent in storage of transuranic wastes compared to the 1986 total (10). In addition, DOE has reported that some of the capacity needed to deal with mixed waste is currently being utilized to manage nonhazardous radioactive wastes as well as restricted hazardous wastes (4, 11). Fernald, Mound Plant and Oak Ridge National Laboratory anticipate running out of capacity for storing mixed wastes in the early

1990's. Storage capacity at eight other nuclear complex facilities is not expected to be reached until the mid-1990's, but without prompt construction of additional treatment capacity, DOE's future storage capability is problematic. Unfortunately, there seems to be no quick or easy solution to this problem because the waste must remain in controlled storage until it has been fully characterized, adequate treatment capacity is designed and built, and proper operating permits are obtained under the RCRA permitting process. About 70 percent of the nearly 700 mixed waste streams reported by DOE is affected by one or more of these factors; treatment technologies for the remaining 30 percent are not expected to be developed for at least 10 more years (12).

Furthermore, several storage facilities at the Nuclear Weapons Complex face permanent closure by November 1992 if their current "interim" status is not satisfactorily updated and approved (13). In addition to obtaining storage permits for these facilities, it will be imperative for DOE to seek approval for the additional capacity that will be needed for storing 1.) mixed waste generated after November 1992; 2.) mixed waste being addressed for disposal at WIPP; and 3.) mixed waste being repackaged due to deteriorating packaging conditions.

EFFORTS TO SOLVE THE RMW PROBLEM

Although addressing the RMW problem is now inevitable, no single or simple solution seems to exist now or in the immediate future. Most efforts being carried out to date promise to solve only specific problem areas since they are limited in nature, focus, or jurisdiction. Focusing on the effective coordination of these efforts, rather than on individual attempts by concerned agencies, can the RMW dilemma be effectively resolved. Several of the examples leading to this conclusion are discussed below. They include: 1.) the internal guidance issued by DOE to attain compliance; 2.) the Rocky Flats tri-party agreement; 3.) the regulatory relief provided by EPA under the LDR provisions; 4.) permitting of mixed waste disposal at the Waste Isolation Pilot Plant; and 5.) the exemption of storage prohibitions enacted by Congress.

DOE Efforts

It was not until 1989 that DOE issued official guidance documents addressing compliance with RCRA. Of particular relevance to RMW management is Order 5400.3, "Hazardous and Radioactive Mixed Waste Program," which lays out the authorities and responsibilities for implementing RCRA's hazardous and mixed waste regulations. Order 5400.2A, "Environmental Compliance Issue Coordination," is also important because it contains procedures and responsibilities to ensure coordination, timely response, and resolution of RCRA noncompliance issues. Even though, considerable efforts have been invested in guidance development and field implementation, DOE is often criticized because attaining full compliance with these Orders continues to be largely left to the discretion of individual sites.

DOE is also preparing a Programmatic Environmental Impact Statement which addresses RMW in a more comprehensive manner. With this effort, DOE expects to estimate the geographical distribution of RMW and treatment technologies within the Nuclear Weapons Complex. One advantage of this process is that it will allow DOE to match up mixed waste streams with available --or lacking-- technologies. To

accomplish this, however, DOE needs time to determine where the most critical needs for treatment technologies are, so decisions of where to build treatment capacity are appropriate. In addition, interaction with regulators must prove successful because completion of the Programmatic Environmental Impact Statement process, and construction of needed treatment facilities, will exceed the 4-year exemption maximally allowed by the LDR provision.

The Rocky Flats Inter-Agency Agreement

As a response to the increasing concern that storing RMW "may be construed to violate RCRA regulations, in particular the Land Disposal Restricted Waste storage prohibitions in 40 CFR 268.50," DOE, the State of Colorado and EPA signed a Federal Facility Agreement and Consent Order on September 19, 1989. Used as a tool to bring DOE into compliance with RCRA and State regulations, and without disrupting key operations and waste management activities at the Rocky Flats Plant, the agreement directed DOE to prepare and submit a comprehensive description of the amount and types of radioactive mixed wastes found at Rocky Flats and, to provide information on the treatment capacity and technologies currently available for managing such wastes (4). The unrestricted applicability of the agreement also proved highly beneficial because it directed DOE to release to Federal and State officials data on mixed waste storage and treatment practices at Rocky Flats and 29 other DOE facilities.

The Two-Year National Capacity Variance and Case-by-Case Extensions

As part of the final third "third" rulemaking, EPA granted the regulated community a two-year national capacity variance that extends the LDR effective date from May 8, 1990 to May 8, 1992. (7) Nearly 393 million gallons of mixed waste are affected by the extension. The EPA decision to promulgate this two-year variance is an indication of the limited treatment capacity available nationwide. In fact, only six facilities (Hanford Reservation, Idaho National Engineering Laboratory, Kansas City Plant, Lawrence Livermore National, Pantex Plant, and Savannah River Site) in the Nuclear Weapons Complex may have sufficient capacity to store their restricted hazardous wastes in the near future. Furthermore, the combination of continued weapons production, cleanup activities, the rather lengthy Federal budgetary process, which impacts the time-lines for building necessary treatment capacity, and construction delays is certain to deplete storage capacity long before treatment technologies are fully developed.

Additional time may also be required to carefully consider selecting treatment technologies with ample field applications rather than developing processes which address only selected portions of the DOE mixed waste universe. This could be particularly important since about 80 percent of DOE's 600,000 cubic meters of mixed waste was generated and stored before the LDRs were promulgated, and, unless treated or removed, this waste is therefore not subject to such restrictions. Providing DOE with the time needed for developing technologies that address a wider portion of the mixed waste universe might therefore prove to be useful and cost-effective.

Extensions to the effective date are helpful. However, it should also be recognized that a two-year variance does not

provide sufficient time to build the capacity required to treat the mixed waste generated and stored at the Nuclear Weapons Complex facilities. According to a recent survey performed at nine of these sites, most RMW technologies are just in the planning phase (14, 15). Consequently, two years--four if DOE is granted both a one-year case-by-case variance and a one-year extension-- may be barely sufficient to allow the completion and startup of the few facilities already under construction. Furthermore, a four-year regulatory relief may not account for the time required by the budget process to grant DOE the necessary funds or, the time required for EPA to grant operating permits (16).

Creating a variance provision that addresses only facility-specific treatment needs might be another solution. Such variances could be developed to be sufficiently stringent for those facilities with adequate capacity or, sufficiently flexible for facilities at which no capacity exists or where creating such capacity may exceed the four-year limit. A facility-specific variance might also be designed to address only the mixed waste streams of greater concern. Compliance with the requirements stipulated by such variances may be sought through permit applications, compliance agreements, or corrective action programs. A concern with of the facility-specific variance approach is that it could make the establishment of a national or regional RMW approach difficult.

Disposal of Mixed Waste at the Waste Isolation Pilot Plant (WIPP)

In 1975, after more than a decade of research to find a sound geologic repository, DOE, the U.S. Geological Survey and the Oak Ridge National Laboratory selected New Mexico's Delaware Basin as the best area for building a facility for the permanent disposal of TRU wastes. The planning and construction of WIPP were then authorized when Congress passed the Department of Energy National Security and Military Applications of the Nuclear Authorization Act of 1980 (Pub. L. 96-164). Ten years later, in March 1989, DOE submitted a no-migration variance petition for the disposal of radioactive materials contaminated with RCRA-regulated wastes at WIPP.

From a regulatory standpoint, WIPP is associated with a complex set of environmental and geologic conditions not found at any RCRA-permitted land disposal facility. The type of waste and disposal methods planned at WIPP are also remarkably different. For these reasons, and because of the difficulty in obtaining sufficient evidence that environmental contamination will not occur during the life of the facility, EPA has granted only a "conditional" no-migration variance. In its decision of April 6, 1990, EPA limited the disposal of mixed wastes at WIPP to testing and experimentation purposes for a period not to exceed five years (17).

WIPP, if eventually determined to be a permanent repository, will receive nearly 850,000 drums containing TRU mixed waste from 10 different DOE nuclear facilities. They include, Argonne National Laboratory, Hanford Reservation, Idaho National Engineering Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Mound Plant, Nevada Test Site, Oak Ridge National Laboratory, Rocky Flats Plant, and Savannah River Site (18). After disposing of the waste for approximately 25 years, DOE is expected to seal the mine shafts with cement plugs and compacted salt and, proceed to decommission WIPP.

Although in its recently published Five-Year Plan, DOE indicates that "WIPP will continue to be the focus for TRU waste disposal," WIPP is not expected to accept waste for disposal until 1998 (13). Even this date seems uncertain. Only after successfully demonstrating compliance with EPA requirements, and after obtaining State approval, will DOE be then able to permanently dispose of its mixed wastes at WIPP. Even if WIPP was allowed to operate as planned, DOE will have to solicit additional storage permits from EPA to address the considerable amounts of mixed waste awaiting disposal at WIPP but which have to remain in storage because filling the repository will take 20 to 30 years.

Storage Exemption Under Proposed Federal Facility Compliance Act of 1991

The Federal Facility Compliance Act of 1991 introduced to Congress in March, 1991, seeks to subject federal facilities to comply with environmental regulations to the same extent as private or commercial institutions (19). If approved by Congress, this law will give Federal and State regulators the authority needed to carry out enforcement actions. Because the Act will clearly apply to DOE's mixed waste, negotiations are under way to include elements which would provide DOE with the regulatory relief needed to avoid the large number of fines and penalties expected to arise from violations of RCRA's storage prohibitions.

If negotiations are successful, the Federal Facility Compliance Act would, when enacted, amend the storage requirements of RCRA (Section 3004(j)) by exempting those DOE mixed waste streams for which treatment technology does not exist or, for which adequate treatment capacity is not available. In addition to providing for exemptions, the Act would require DOE to prepare a National Compliance Plan which would coordinate RMW management and research and development efforts within reasonably established schedules, and provide appropriate State and EPA oversight and public participation. The implementation of the Plan is expected to be carried out in a manner that will not interfere with milestones established under existing compliance agreements (20).

The National Compliance Plan may provide DOE with the regulatory relief it needs to focus more comprehensively on technology research and development. However, considerable work lies ahead for this plan to prove successful. For instance, before DOE is capable of defining its RMW universe, it will have to: 1) conduct hundreds of remedial investigations throughout its Nuclear Weapons Complex facilities; 2) determine the types and extent of long-term storage needs; and 3) assess current and future RMW production rates. Evaluating potential obstacles which could hamper the implementation of a national approach to RMW, for example, concerns about the transporting of RMW is of similar importance. The Plan would also have to foster means by which DOE works openly and consistently with Federal and State officials, and with the public, on the formulation and implementation of the Plan. Without serious consideration to these factors, the overall success of the National Compliance Plan in resolving the RMW problem may be rather limited.

CONCLUSION

Several regulatory attempts have been made to control the mixed waste universe and reduce their threat of

contamination. Most of the progress made to date toward these goals has been limited. Acquiring a better understanding of the nature, extent, and volumes of the different waste streams that make up this universe, while simultaneously achieving full compliance, continues to be a serious regulatory and technological dilemma. A factor that has helped strengthening this dilemma is the conflicting view of regulators and DOE on the actual applicability and enforcement of regulations; the selection and development of appropriate treatment and disposal technologies; and the extent of resources and time needed to demonstrate full compliance. Because considerable work remains to be done, it is imperative that areas of conflict be resolved, as well as, that all major efforts being carried out throughout the Nuclear Weapons Complex to address mixed waste be coordinated more effectively. This might eliminate the mixed waste dilemma long before the goals envisioned in the law are no longer reasonably attainable.

REFERENCES

1. United States Congress, Office of Technology Assessment, Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production, OTA-0-484, Washington, D.C.: U.S. Government Printing Office (February 1991).
2. 51 Federal Register 24504 (July 3, 1986).
3. 53 Federal Register 37045 (September 23, 1988).
4. U.S. Department of Energy, "National Report on Prohibited Wastes and Treatment Options as Required by Rocky Flats Plant Federal Facilities Compliance Agreement Dated September 19, 1989," (January 16, 1990).
5. 54 Federal Register 26601 (June 23, 1989).
6. 54 Federal Register 48437 (November 22, 1989).
7. 55 Federal Register 22533 (June 1, 1990).
8. U.S. General Accounting Office, "Nuclear Waste: Department of Energy's Transuranic Waste Disposal Plan Needs Revision," GAO/RCED-86-90 (March 1986).
9. 56 Federal Register 55160 (October 24, 1991).
10. U.S. Department of Energy, "Integrated Data Base for 1988: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW-0006, Rev. 4 (September 1988).
11. LEO P. DUFFY, Director, DOE's Office of Environmental Restoration and Waste Management, testimony before the House Armed Services Committee (March 15, 1990).
12. Congressional Record, S14883-19404, daily edition (October 17, 1991).
13. U.S. Department of Energy, Environmental Restoration and Waste Management Five-Year Plan - Fiscal Years 1993-1997, Washington, DC: U.S. Department of Energy, pp. 193, 391, 633 (August 1991).
14. Rockwell International, Aerospace Operations, Rocky Flats Plant, Federal Facilities compliance Agreement/Compliance Order Treatment Plan No. 1, Golden, CO: Rockwell International, pp. 4.2-4.106 (March 1990).
15. Rockwell International, Aerospace Operations, Rocky Flats Plant, Federal Facilities compliance Agreement/Compliance Order Treatment Report No. 1. Final Report, Golden, CO: Rockwell International (December 1989).
16. U.S. Department of Energy, "Comments on Land Disposal Restrictions for the Third Scheduled Wastes Proposed Rule (54 Federal Register 48372)," submitted to EPA RCRA Docket (OS-305) on January 8, 1990.
17. 55 Federal Register 47700 (July 6, 1990).
18. 55 Federal Register 13085 (April 6, 1990).
19. Federal Facility Compliance Act of 1991: Hearing on S.596 Before the Subcommittee on Environmental Protection of the Senate Committee on Environmental and Public Works, 102d Congress, 1st Sess. (1991).
20. Senate Report No. 102-67, 102d Congress, 1st Sess. (1991).