DOE ACCEPTANCE OF COMMERCIAL MIXED LOW-LEVEL RADIOACTIVE WASTE: RESULTS OF FEASIBILITY STUDIES

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ABSTRACT

Several studies have been initiated to determine the feasibility of the U.S. Department of Energy accepting some role in the management of commercially generated mixed low-level radioactive waste. These studies were an outcome of host States and compact regions requesting that DOE investigate this feasibility. Commercially generated mixed waste comprises approximately one-tenth of that generated by DOE facilities. Because of the small volumes, high costs associated with commercial disposal of mixed waste, and DOE's willingness to investigate the feasibility of accepting a role in the management of commercial mixed waste, no commercial mixed waste disposal facilities are being developed. Feasibility studies have focused upon the legal, regulatory, and liability issues associated with DOE acceptance of commercial mixed waste as well as the technical. The following paper addresses the treatment options available to mixed waste generators and the technical issues associated with DOE accepting commercial mixed waste for disposal.

INTRODUCTION

The topic of DOE accepting commercial mixed waste at DOE facilities has been proposed by host States and compact regions developing low-level radioactive waste disposal facilities. States support the idea of DOE accepting commercial mixed waste because: (a) there is very little commercial mixed waste generated in relation to that generated at DOE facilities (DOE generates 26,300 m^3 annually while commercial industries generate only 3900 m^3), (b) costs for commercial disposal are estimated to be very expensive because of the economy of scale, (c) once treatment capability becomes available, at least 70% of commercial mixed waste will be eliminated (not have to be disposed of in a dually regulated facility), (d) some State laws prohibit the development of mixed waste disposal facilities in their States, (e) DOE is developing a nationwide strategy that will include treatment and disposal capacity for its own mixed waste and the incremental burden on the DOE facilities would be minuscule, and (f) no States are developing mixed waste disposal facilities.

The Nuclear Regulatory Commission sent a letter to Admiral Watkins stating, "NRC is ready to support any effort to resolve the mixed waste issue that is consistent with our responsibility to protect the public health and safety and the environment. NRC would like to believe that through the joint efforts of NRC, DOE, EPA, the States, and the regulated community, the increasingly urgent problems surrounding mixed waste management and disposal can be successfully resolved."

Some DOE Headquarter's management have expressed willingness to consider investigating the feasibility of DOE assuming a role in commercial mixed waste management. Some officials believe this to be a cost-effective way to solve commercial mixed waste management problems.

There are several similarities between the DOE and the commercial mixed waste problem. There are no treatment technologies able to treat all types of mixed waste streams, no disposal capacity exists, local opposition exists for developing new treatment and disposal capacity, and it is estimated that treatment and disposal costs may be significant. DOE and the States are faced with the fact that mixed waste will have to be treated and disposed of in only a few States. It is recognized that if a national strategy for mixed waste is to be successful, the treatment and disposal facilities must be distributed in an equitable manner across the country. Because of storage limitations and other compliance issues, essential research may be affected by the lack of disposal facilities. Figure 1 shows the cradle to grave liability for mixed waste generators.

RESULTS OF FEASIBILITY STUDIES

Information is currently being developed to facilitate a decision on whether it is feasible for DOE to accept a role in commercial mixed waste management. A strategy was developed and presented to upper DOE management.

Studies have been completed to determine the feasibility of DOE accepting commercial mixed waste. The studies and their results are grouped into five areas:

1. Analysis of the legality of DOE accepting commercial mixed waste. Does DOE have authority to assume responsibility for commercial mixed waste?

   The original driving forces behind the development of programs for the safe disposal of mixed waste were the Low-Level Radioactive Waste Policy Act and the Low-level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA). These Acts authorized the establishment of regional compacts by two or more States for the safe and efficient management of low-level radioactive wastes, including mixed wastes. However, implementation of the statutes has not resulted in the development of mixed waste disposal facilities, nor are any facilities planned.

   The LLRWPAA requires that States, not DOE, provide disposal capacity for low-level radioactive wastes generated within their borders, and thus serves as a strong argument against DOE management of commercial mixed waste. However, no language in the statute specifically prohibits DOE from acting as an agent of a State by providing disposal capacity. Because of the sensitivity of this issue, General Counsel at DOE will have to determine whether DOE has the legal authority to accept commercial mixed waste.

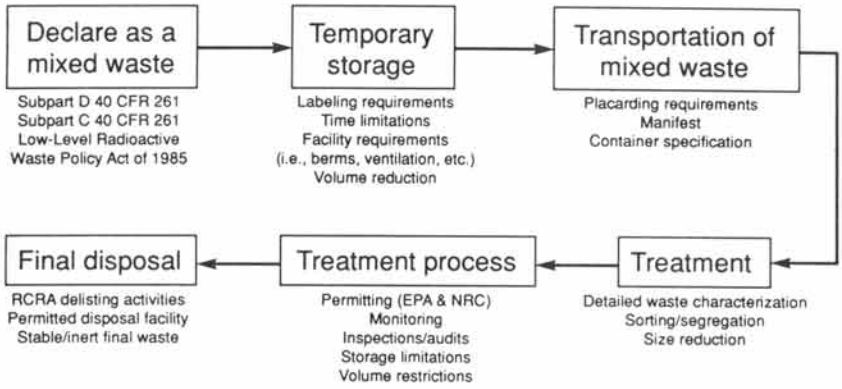

Fig. 1. Cradle to grave liability for mixed waste generators.

2. Study of the regulatory and liability issues associated with DOE accepting commercial mixed waste.

   With regard to DOE's legal liability, analysis of relevant language in the Federal Facility Compliance Agreements, Comprehensive Environmental Response Compensation and Liability Act, Resource Conservation and Recovery Act, and the LLRWPAA indicates that no additional liability is imposed beyond that which would be imposed by existing DOE operations. The extent of DOE's exposure is, however, increased proportionally to the volumes of waste accepted.

   An evaluation of the regulatory requirements and standards concerning acceptance and management of commercial mixed waste also indicated that the responsibilities and authorities of the generator, States, and DOE under the present management framework are generally consistent with those that would be required under a scenario of DOE commercial mixed waste management. Although RCRA regulations would not impose restrictions on transfer of mixed waste between the public and private sectors, management of commercial mixed waste by DOE may require modifications to RCRA permits and compliance schedules for DOE disposal facilities. Because of the RCRA prohibition on storage of untreated hazardous waste, DOE is also precluded from accepting commercial mixed waste for long-term storage.

3. Assess the capabilities and compatibility of any existing or planned commercial treatment or storage facilities.

   This information was provided to EG&G Idaho in response to a Commerce Business Daily solicitation issued July 17, 1992. Because this is vendor-provided information, any information included is subject to change based on the disposition of the facility and permits. Waste acceptance criteria and current facility capabilities should be directly solicited from the vendors.

   Five companies have both the NRC licenses and the Environmental Protection Agency's permits necessary to handle mixed waste. These include Diversified Services, Inc. (DSSI), ENVIROCARE of Utah, Inc., NSSI/Source and Services, Inc., RAMP Industries incorporated and Quadrex Recycle Center. Scientific Ecology Group, Inc. has filed an application with the EPA to treat mixed waste.

   DSSI is licensed and permitted to store and incinerate flammable liquid mixed wastes. Its permits allow acceptance of D002, F001-F005, plus many D-, U-, and P-listed materials. DSSI is licensed to receive about 2000 isotopes, including some special nuclear and source material. Under typical operating conditions, waste is burned onsite in a co-generation mixed waste fueled boiler at a rate of approximately 1.1 million gallons per year. Wastes are usually processed within one month, avoiding long-term storage liabilities. DSSI's overall storage capacity is about 1750 fifty-five gallon drums (95,000 gallons) at any one time in the bermed, covered, and fire-protected storage area. Bulk fluid storage up to 30,000 gallons is available at any one time. DSSI is currently not operational and is not currently accepting waste.

   ENVIROCARE of Utah, Inc. is licensed and permitted for the disposal of radioactive mixed wastes. Their waste acceptance criteria includes characteristic waste codes D001-D043, listed wastes F001-F012, F019, F024, F028, F039, K011, K013, K050-K052, K061, K069, and many P-listed and U-listed wastes. ENVIROCARE may accept solid-phase hazardous wastes which are radioactive. Such wastes include contaminated soils and debris from government clean-up projects, process solids, sludges and other wastes. Waste acceptance criteria for the radioactive portion of waste is low activity.

   NSSI/Sources & Services, Inc. is licensed and permitted for treatment and storage of a wide range of radioactive, hazardous, and mixed low-level waste. Treatment capabilities of NSSI include fuel blending, consolidation of waste containers into lab packs, reconsolidation of lab packs for disposal or processing, chemical treatment, neutralization, oxidation, reduction, recycling of solvents, cleaning of particulate solids, empty drums, and equipment, centrifugation, filtration and ion exchange, solidification, shredding, separation (chemical or mechanical), absorption, solids drying, and recovery of waste chemicals for reuse or resale.

   RAMP Industries, Inc. is licensed and permitted to treat absorbed liquids, compacted trash, contaminated

plant hardware, contaminated bulk, dewatered filter media, demineralizes, dry activated waste, gaseous sources, incinerator ash, institutional lab and biological waste, liquids (solidified), liquids (aqueous and organic), liquid scintillation fluids and vials, radioactive devices of gauges, sealed sources, solidified uranium waste and sludges and others. Their treatment capabilities include volume reduction by compaction and shredding, separation, reclamation of liquid scintillation fluids, decontamination and solidification.

Quadrex Recycle Center is licensed and permitted to treat liquid scintillation fluids and vials for fuel reclamation. They also decontaminate and recycle lead shielding and bricks (not categorized as waste). The NRC license is limited to 5 μC/g.

4. Analyze costs of commercial mixed waste disposal Costs of low-level radioactive waste disposal facilities are estimated to average approximately $61 million in California to about $136 million in the Southeast compact. Taking an average of these projections, a new "standard" low-level radioactive waste disposal facility could cost on the average of $110 million.

   Because of existing laws or positions taken in California, Illinois, and other States, separate facilities dedicated to the disposal of mixed waste will be required, i.e., the mixed waste disposal facility for these States cannot be co-located at the "standard" LLW disposal facility. A new mixed waste disposal facility could result in disposal costs as low as $6,864 per cubic foot. If, however, development costs for the new facility are on the average of $110 million, the cost per cubic foot could be as low as $11,600 for a new facility receiving all of the nation's mixed waste, or as high as $106,000 per cubic foot if mixed waste were limited to a single compact (assuming a single compact generated 11% of the nation's waste). Note, that under this scenario, the $1 to $7 million extra for permitting and EIS costs becomes insignificant compared with the other costs associated with development.

   If a new mixed waste disposal facility were added to an existing or developing "standard" LLW disposal site, incremental additional costs on the order of $740 per cubic foot could be expected if the site received all of the nation's mixed waste. If the compact facility received only that waste generated in the compact (e.g., approximately 11% of the nation's total), additional disposal costs would be proportionately larger, growing to $6,700 per cubic foot. These estimates would be in addition to the cost of "standard" LLW disposal, estimated to be $200 to $400 for the newer disposal facilities.

5. Analyze commercial mixed waste streams for compatibility with the DOE mixed waste streams.

   Based upon preliminary results of feasibility studies and discussions with DOE Senior management, it was concluded that the potential role of DOE would be limited to disposal of commercially treated residues.

   DOE's role in treatment would be limited to transferring technology and experience dealing with these wastes to the private sector. Many of the commercial waste streams are similar to DOE's and the technologies would be easily adaptable. However, there are a significant number of commercial mixed waste streams for which these technologies might not be appropriate. It is important that the commercial sector identify and focus efforts on these waste streams to identify the appropriate treatment processes and management strategies.

   The Department of Energy is currently generating mixed waste at a rate of 26,300 m^3 per year, whereas the commercial industries are only generating 3,900 m^3 per year. Even though the commercial mixed waste streams are very small in comparison with those of the DOE, some commercially generated mixed wastes are significantly different than the DOE mixed waste streams. For example, many unique waste streams generated in the medical and research industry are not found in the DOE system. Therefore, treatment technologies for these waste streams may not be developed by DOE. The commercial sector will have to develop treatment methods for these unique waste streams.

Figures 2 and 3 show commercially generated and stored wastes. Figures 4 and 5 show percentages of wastes unique to the commercial sector.

As indicated in Fig. 6, some waste streams are identified as problematic. This means that treatment technologies have not been identified for these waste streams because of components contained within the waste stream or because of their physical waste form. One problematic waste stream is the cemented wastes. This waste stream will require treatment if it currently does not pass TCLP tests, thus making this waste stream RCRA hazardous. Since the cement mixed with this mixed waste stream will not burn, very high temperatures will need to be obtained in a thermal treatment process. A joule-heated melter is dependent on the chemistry of the melt. The addition of cement in a joule-heated treatment process would make achieving a successful vitrified product difficult without the addition of glass making materials (resulting in a volume increase). In addition, the cemented waste would require

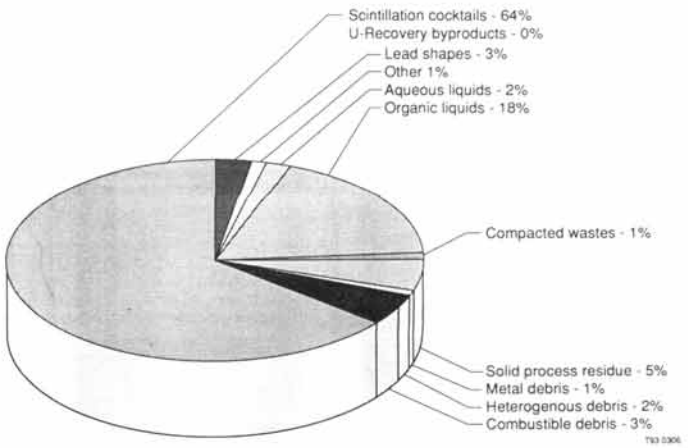

Fig. 2. Distribution of commercially generated mixed waste.

pulverization to reduce residence time to incorporate the cement into glass. Some means for blending the cement and glass making components would also be needed to maintain reliable process control.

Another option to treating the cemented waste is the plasma thermal treatment unit. This unit can easily obtain the elevated temperature requirement. Since the plasma thermal treatment unit is not dependent on the chemistry of the melt, there is a good probability that this system can effectively handle these cemented wastes. In fact, it has been demonstrated that the plasma system can accept whole drums (30 gallon drums have been tested, 55 gallon drums are scheduled for testing this year) of cemented waste precluding the need to pulverize the cemented waste prior to being fed into the system.

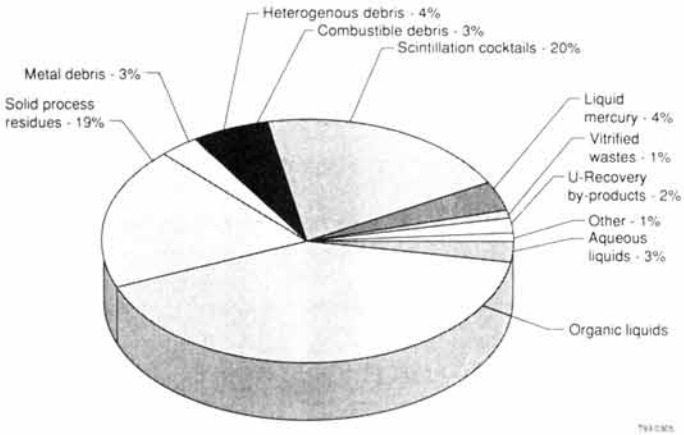

Fig. 3. Commercially stored waste distribution as of 1990.

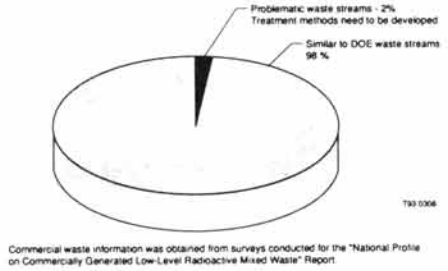

Fig. 4. Commercially generated mixed waste streams.

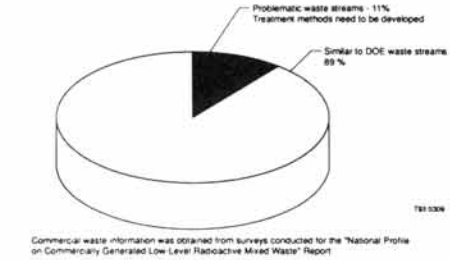

Fig. 5. Stored volumes of commercially generated mixed waste.

Currently, it is common practice by the commercial sector to use compaction to reduce the volume of the waste streams they generate. Unfortunately, this practice makes treating these wastes very difficult. Obtaining an accurate characterization of these compacted wastes streams is nearly impossible, unless accurate characterization was done before compaction. Most available treatment methods for these compacted waste streams involve removing the waste from the drum. The front-end waste handling requirements for these waste streams are costly and will increases worker exposure. Aggressive incinerators can treat these compacted waste streams in the drums; however, there are currently none available. (DOE TSCA incinerator at the K-25 plant in Oak Ridge potentially can handle these waste streams, but currently they have a five-to-six year backlog.) If transportation rules and regulations require organic liquids to be solidified, it is advisable to use an organic-based matrix absorbent (i.e., pulverized corn cobs). This will ensure incineration as a treatment option.

Beryllium fines were also identified as a problematic waste stream. Since beryllium is a listed carcinogen, the Clean Air Act has set very restrictive feed and emission limits on any thermal treatment of beryllium containing wastes. Infact, these limits are so low that the thermal treatment of high concentrations of beryllium waste is prohibited.

The Uranium Recovery By-Products are listed as problematic waste for many reasons. First uranyl nitrate compounds present a NOx emission problem when treated thermally. Since uranium is an alpha emitter, treatment is strictly controlled. The U-235 isotope of uranium is capable of fission. Uranium metal fines are also pyrophoric. Currently, no commercial treatment exists for this waste stream.

Treated commercial waste streams will need to meet the final waste form requirements for ultimate disposal at DOE facilities. Currently, DOE is evaluating final waste form options to determine the most applicable to the DOE mixed waste streams. It appears at this time that vitrified waste may be selected because it is the most stable/inert final waste form for the majority of DOE waste streams.

Waste stream descriptions	Volume generated annually (cubic meters)	Volume stored as of 1990 (cubic meters)
Compacted wastes	27	4
Uranium recovery by-products	18	29
Magnesium-thorium alloy	1	-
Ion exchange media	3	4
Halogenated organic sludge	2	22
Explosives	1	1
Vitrified waste (glass)	4	20

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Assessment of the radionuclide contaminant has not yet been completed.
It is anticipated that more problematic streams will be identified.

Commercial waste information was obtained from surveys conducted for the "National Profile on Commercially Generated Low-Level Radioactive Mixed Waste" Report.

Fig. 6. Waste streams unique to the commercial sector.

CONCLUSIONS

Low waste volumes, high regulatory burdens, and public opposition to new disposal sites have made DOE acceptance of commercial mixed waste for disposal a favorable management alternative. Analysis of the relevant statutes indicates that existing law does not specifically authorize or prohibit the activity. The analysis also indicates that the Low-level Radioactive Waste Policy Amendments Act requires the states to provide disposal capacity for low-level radioactive wastes. DOE acceptance could be interpreted as a possibility under the general duties provisions of these statutes, and could be conducted at the specific request of the states. Waste acceptance criteria at future DOE disposal sites will determine the waste forms and streams that will be accepted. Through analysis, it has been determined that several commercial mixed waste streams do not fit into the DOE treatability groups.

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