OPERATIONAL REQUIREMENTS OF THE ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT FIVE-YEAR PLAN AT DEPARTMENT OF ENERGY SITES

E.A. Jordan, S.P. Cowan, J.E. Dieckhoner
U.S. Department of Energy
Office of Environmental Restoration and Waste Management

ABSTRACT

The U.S. Department of Energy (DOE) has committed to achieving compliance with environmental laws and regulations, cleaning up and restoring its nuclear sites, and accomplishing this in an open and participatory manner. The Environmental Restoration and Waste Management Five-Year Plan documents the process through which these goals will be achieved and is the reference against which progress towards achieving these goals will be measured.

The waste management operations program has the responsibility to safely manage the radioactive, hazardous, mixed and sanitary waste from the Department's nuclear activities. The Department has large quantities of waste which have been stored for future treatment and disposal. The Department's defense and nuclear research and development activities continue to generate waste which must be safely and effectively managed. The Five-Year Plan describes activities and facilities which must be put in place to have an effective treatment, storage and disposal method for each waste type. This must be accomplished within resource constraints and within a complex regulatory framework in order to be successful. The waste management operations program must be successful in order to gain the public acceptance and confidence necessary for the Department to continue its defense and nuclear research and development mission.

INTRODUCTION

DOE is committed to achieving compliance with laws, regulations, and agreements, and to protect human health and the environment. To achieve this commitment, the Department has prepared the Environmental Restoration and Waste Management Five-Year Plan to establish an agenda for compliance and cleanup against which progress can be measured.

The goal of the waste management operations program is to assure safe and effective treatment, storage and disposal for radioactive, hazardous, mixed and sanitary waste. The Five-Year Plan describes the activities and facilities needed in order to put in place effective treatment, storage and disposal methods for each waste type.

THE DOE MISSION AND WASTE GENERATION

For over 40 years, the DOE and its predecessor agencies have provided, in large part, the nuclear materials for nuclear weapons that support the national defense. Other nuclear-related research and development was performed at many national laboratories.

A significant volume of radioactive waste has been generated as a result of implementing the above energy research and development, and defense program activities. Table I presents the volumes and activities of the three categories of DOE defense radioactive wastes accumulated through 1988. The table shows that 80 percent of the waste volume is low-level radioactive waste, while 98 percent of the activity is in the high-level waste. Additional volumes of low-level radioactive waste from current and planned nuclear related activities are projected to range between 130,000 to 200,000 cubic meters per year from 1990 to 2020. Projections of annual volume additions for high-level and transuranic waste are less than 5000 cubic meters.

WASTE MANAGEMENT ASPECTS

In order for DOE facilities to carry out their waste management functions, certain generic activities apply to all sites. The method of implementation of these activities varies depending upon the nature of the mission of the facility, site location, site-specific conditions, and other considerations. Essentially all waste management operations activities at DOE sites can be characterized by the following generic functions:

- Continuity of Operations
- Treatment
- Storage
- Disposal
- Waste Minimization

Each of these functions may apply to each of the waste types handled at DOE facilities.

Continuity of Operations

This function encompasses broad activities that are similar in scope at each site, and are necessary to maintain active and fully compliant waste management operations. Such activities include surveillance and maintenance of facilities and equipment, training programs, general environmental compliance programs, waste examination and certification, and waste information systems. These activities ensure safe operating facilities that comply with the

TABLE I
DEPARTMENT OF ENERGY WASTE INVENTORY AS OF 12/30/88

	Volume	Radioactivity
High-Level Waste	382.8 (10^3 m^3)	1,174 (10^6 *Ci*)
Transuranic Waste	59.7 (10^3 m^3)	3,879 (10^3 Ci)
Low-Level Waste	2,472 (10^3 m^3)	13,416 (10^3 Ci)
Mixed Low-Level Waste	52.1 (10^3 m^3)	Not Available

various applicable federal, state, and departmental regulations and orders.

Treatment

The objective of all waste management operations activities is to substantially reduce the amount of waste in interim storage and to achieve permanent disposal. The purpose of treating waste is to reduce the volume and/or the hazard and to meet regulatory requirements, thereby reducing the risk to the public and the environment. Transforming the waste to a more stable form facilitates safer storage and disposal. Selection of a treatment method is dependent upon the suitability of the treatment method to handle a particular waste constituent and to achieve a desired final concentration of that constituent.

Storage

Storage of waste, while a major and integral part of site waste operations, is viewed as only a temporary activity before treatment or disposal.

The fact that DOE facilities are subject to regulation under RCRA for the hazardous components of wastes has resulted in major changes to site storage programs. The DOE commitment to full compliance with State and Federal regulations has resulted in extensive and continuing planning of the storage systems throughout DOE, a growing commitment of personnel and funds to upgrade existing storage systems, and to provide new storage capacity and capability to meet these laws.

Disposal

Disposal is waste emplacement that ensures isolation from the biosphere for the foreseeable future with no intention of retrieval, and requires deliberate action to regain access to the waste. Safe disposal is the culmination of waste management.

Minimization

Waste minimization is the means by which DOE will make major cutbacks in the amount of waste headed for storage and disposal. For years, treatment has been relied on to reduce waste volume, but actions such as incineration, evaporation, and compaction treat the result of waste production, not the source. The DOE waste minimization program will now focus on all liquid and solid wastes that are planned to be disposed of by avoiding generation and by recycling as much material as possible. Avoidance of waste generation is a major priority in this program. Avoidance can be accomplished by process modifications or by substituting less hazardous or nonhazardous items for hazardous ones.

STRATEGY

The goals of waste management operations are twofold: 1) cost-effective waste management operations, and 2) compliance with applicable regulations in the processing of existing waste inventories and newly generated waste. Both existing waste inventories and newly generated waste must be processed and disposed of in an environmentally acceptable manner which meets regulatory requirements. A Research, Development, Demonstration, Testing, and Evaluation program is being pursued to identify more economical and efficient means of managing waste.

Low-Level Waste

Low-level waste is typically produced at most DOE sites that deal with nuclear materials. The primary objectives for dealing with low-level waste is to treat the waste to reduce its volume and dispersability and to dispose of it in facilities that provide environmental protection. Depending on the waste form (solid or liquid) and the radionuclide characteristics (half life), treatment methods for low-level waste vary.

Evaporation and ion exchange are the most common treatment methods for liquid low-level waste across the complex. Grouting is another method of treating liquid low-level waste. This process entails combining the liquid waste with cement and other additives and then pouring the grout into vaults for solidification and disposal.

The Effluent Treatment Facility at the Savannah River Site uses ultrafiltration, reverse osmosis, and evaporation to remove contaminants from liquid low-level waste so that the effluent may be released to a permitted stream. The Waste Experimental Reduction Facility in Idaho began operation in 1986, and processes combustible low-level waste with an

incinerator, metallic waste by melting, and noncombustible waste with a 200-ton compactor. The Waste Receiving and Processing facility at Hanford and the Consolidated Incineration Facility at the Savannah River Site are also planned.

Solidification is another method being used to treat liquid low-level waste. Both Hanford and Savannah River have major programs under way. At Hanford, the Grout Treatment Facility, which began operating in 1988, treats the liquid low-level waste currently in interim storage and the low-level waste fractions generated by pretreatment. The waste will be mixed with cement and fly ash and pumped to disposal vaults. At the Savannah River Site, facilities are being constructed to solidify the liquid saltstone waste for disposal in aboveground concrete vaults.

DOE disposes of the majority of its solid low-level waste by shallow land burial. This disposal method has proven to be the safest and most cost-effective means for isolating this waste from man and the environment with minimal exposure to working personnel. The tumulus concept for engineered disposal at Oak Ridge is being demonstrated and is expected to be full scale and on-line in 1996 and will provide an acceptable means of solid waste disposal.

Transuranic Waste

Transuranic waste is produced during reactor fuel assembly, weapons fabrication, and reprocessing operations. The primary goals for managing transuranic wastes include treating the waste for safe storage, storing the waste, and demonstrating the effectiveness of the Waste Isolation Pilot Plant (WIPP) for ultimate disposal.

DOE will treat transuranic waste to comply with stringent acceptance criteria for disposal in the planned geologic repository at WIPP. A number of facilities are planned to retrieve stored waste and to process both retrieved waste and newly generated transuranic waste for shipment to the WIPP.

Two facilities being constructed at Idaho for retrievably stored transuranic waste are the Retrieval Containment Building that allows removal of stored drums in a weathertight containment to permit work year round, and the Transuranic Waste Treatment and Storage Facility (TWTSF) that will treat the waste by examination, shredding, compaction, and repackaging. They are expected to begin operations in 1992 and 1995, respectively.

The Transuranic Waste Facility at Savannah River and the Waste Receiving and Processing Facility at Richland are also planned to treat transuranic waste. The last facility planned is the Waste Handling and Packaging Plant at Oak Ridge. The plans for this facility call for it to process approximately 90% of the Department's remote handled transuranic waste.

The WIPP has been constructed to demonstrate disposal of transuranic waste. Following completion of the test/demonstration phase, DOE will decide whether WIPP meets disposal standards and criteria set by the U. S. Environmental Protection Agency. If successful, a routine disposal system will be available.

High-Level Radioactive Waste

High-level radioactive waste primarily results from the reprocessing of spent fuel and will be disposed of in a geologic repository along with commercial high-level radioactive waste.

Vitrification and calcining are two demonstrated methods for treating high-level waste for storage and/or disposal. Three DOE facilities are planning to incorporate this vitrification process: the Defense Waste Processing Facility (DWPF) at Savannah River, the West Valley Demonstration Project (WVDP) at West Valley, New York, and the Hanford Waste Vitrification Plant (HWVP) at Richland. Currently, high-level waste at these sites is stored in underground storage tanks as a mixture of liquid, salts from evaporation, and sludge from precipitates. The vitrification process will produce a more stable product for storage until it can be ultimately disposed in the geologic repository for high-level waste and spent reactor fuel. The DWPF should begin operating first, in 1992, followed by the WVDP and the HWVP.

Calcining solidifies liquid waste by spraying droplets onto hot particles which results in a granular product. This product is then transferred to stainless steel bins in underground concrete vaults. The Waste Calcining Facility at Idaho uses calcining for treating high-level waste. Calcined waste is suitable for extended storage; however, DOE has not determined its acceptability for final disposal. The calcined high-level waste is readily retrievable and, if necessary, will be immobilized for disposal.

Mixed Waste

Much of the waste generated at DOE defense sites can legitimately be considered as mixed waste (radioactive and hazardous). Mixed waste is regulated by both the Atomic Energy Act (AEA) and RCRA.

Several facilities treat low-level mixed waste. The Waste Experimental Reduction Facility in Idaho is currently incinerating mixed waste. Plans are for the TSCA Incinerator at Oak Ridge to be fully permitted to incinerate mixed waste. Incineration of low-level mixed waste is also planned at Savannah River.

Currently, only mixed waste streams that can be treated to render them nonhazardous are being disposed of. Solid

mixed wastes are being stored at DOE sites until disposal facilities meeting both RCRA requirements for hazardous waste and DOE requirements for radioactive waste are in place. Some sites are planning for mixed waste disposal capacity. They are: the Savannah River Site, Nevada Test Site, Los Alamos National Laboratory, Idaho National Engineering Laboratory, and the Hanford Reservation.

Hazardous Waste

Hazardous waste is managed according to requirements established by the Environmental Protection Agency and the states. In general, the same policy is adopted for hazardous wastes as for the nonradioactive components of mixed waste.

Treatment facilities for hazardous waste are generally intended to be the same as those used for mixed waste. These include the TSCA Incinerator at Oak Ridge and the Consolidated Incinerator Facility at Savannah River. Where possible, hazardous materials are being replaced with nonhazardous materials.

The majority of hazardous waste is collected in 55-gallon drums that are placed on permitted storage pads and prepared for shipment in compliance with RCRA requirements. The drums are then shipped offsite to a permitted commercial facility for treatment and disposal.

All DOE sites have RCRA-approved facilities for less than 90-day storage of hazardous wastes and many continue to ship these materials offsite to permitted commercial facilities for recycle, treatment, and/or disposal.

CHALLENGES FOR THE FUTURE

Regulatory Compliance

Waste management operations must be accomplished in compliance with all applicable Federal, State and local requirements. These include the National Environmental Policy Act (NEPA), the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and others along with the State laws and regulations which derive from these Federal statutes. DOE also has internal regulations (DOE Orders) governing waste management activities which derive from the Atomic Energy Act (AEA).

The applicability of some of these laws, particularly RCRA and CERCLA to Departmental activities under AEA had been a subject of controversy for a number of years. That controversy has been resolved with the policy determination by the Department that RCRA and CERCLA govern the hazardous portion of the waste while the AEA governs the radioactive portion. Since it will take some period of time for the Department's waste management activities to come into compliance with RCRA, CERCLA and other regulations, the Department is entering into compliance agreements with states and the EPA. The compliance agreements specify regulatory authorities and specific actions and timetables to achieve compliance with laws and regulations. These agreements are a major factor in the scope and direction of the program. The Department must energetically cope with a changing regulatory framework to bring waste management operations into full compliance with what the laws and the public justly demand.

Changing Directions and Priorities

For many years the Department's defense and nuclear research and development activities received greater emphasis and priority than waste management activities. The Environmental Restoration and Waste Management Five-Year Plan and the Department's new policies make it clear that environmental protection, safety and health activities will now have higher priority than other missions. This should not be viewed as an either/or trade-off. It has become quite clear that the Department must meet environment, safety and health requirements in order to carry out its defense and nuclear R&D missions. Meeting environment, safety and health requirements is essential to gaining the public acceptance and confidence which the Department must have in order to achieve all of its missions.

SUMMARY

The 30-year goal for DOE's Environmental Restoration Program is to ensure that risks to the environment and to human health and safety posed by inactive and surplus facilities and sites are either eliminated or reduced to prescribed, safe levels. In contrast to this objective, waste management operations will continue to manage wastes generated from DOE's nuclear activities, requiring the use of proven, acceptable methods of treating and disposing of wastes.

The goal of waste management operations is to have an established process for transitioning from a mode of treatment and interim storage of wastes to a mode of treatment and delivery of the waste product directly to a disposal site for each waste type. Projects such as the DWPF for treating high-level waste, the WHPP for handling transuranic waste, and the TSCA Incinerator for burning hazardous wastes are examples of treatment facilities that will enable DOE to achieve that capability. Operating procedures currently being developed will also facilitate this transition.

Today, DOE puts greater emphasis on achieving environmental compliance, waste cleanup and management, and public and worker health and safety. This new culture has implications as well for public scrutiny. Society expects not only adequate protection of their health and safety and the environment, but also information and involvement in

planning and monitoring progress toward achieving safety and environmental compliance.

REFERENCES

1. U.S. Department of Energy, (DOE/S-0070), Environmental Restoration and Waste Management Five Year Plan (1989).
2. U.S. Department of Energy Nuclear Weapons Complex Modernization Report, Report to the Congress by the President, December 1988.
3. Oak Ridge National Laboratory, (DOE/RW-0006, Rev. 5), Integrated Data Base for 1989: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics (1989).