

STATUS OF U.S. DEPARTMENT OF ENERGY
RADIOACTIVE WASTE MANAGEMENT PROCEDURES

Anthony F. Kluk
U.S. Department of Energy

INTRODUCTION

The Department of Energy (DOE) is preparing an Order which defines policies and guidelines for managing radioactive waste, waste byproducts, and surplus facilities. The broad policy framework of the Order is intended to cover all types of radioactive waste management by DOE and will help to provide assurance that the entire nuclear energy fuel cycle of the Department has been closed. The policy is also designed to aid in defining the transition to the disposal mode from the current practice of storing high-level waste (HLW) and TRU waste.

Historically, a uniform policy for waste management was first defined by the Atomic Energy Commission in 1973 with the issuance of a manual chapter on radioactive waste management.¹ The 1973 policy formally specified that waste contaminated with transuranium nuclides in excess of 10 nCi/g was to be separated from other radioactive waste and stored pending a decision on disposal (a practice which was first implemented in 1970) and provided operating criteria for managing HLW and radioactive solid waste other than HLW. Prior to that each government site developed its own radioactive waste management practices. In 1982, the DOE established 100 nCi/g as the level above which disposal in a geologic repository is necessary for TRU waste.²

The objective of the Order is to assure that all operations involving management of radioactive waste, waste byproducts, and surplus facilities are conducted to protect the public health and safety and according to the same nationally and internationally recognized radiation protection standards^{3,4} that apply to all DOE nuclear operations. The Order is intended to provide protection comparable to that provided by Nuclear Regulatory Commission (NRC) regulations for licensed activities and conforms to applicable Environmental Protection Agency (EPA) standards.

Table I is a list of basic definitions used in the Order. In determining what constitutes radioactive waste, the "threshold quantity" concept is used and individual sites are permitted to establish these values based on guidance provided separately from the Order.⁵ Figure 1 is a flow diagram for DOE's radioactive waste streams.

REQUIREMENTS

The requirements of the Order apply to all DOE nuclear operations that manage radioactive waste and surplus facilities including defense-related, nuclear energy development, and basic energy research programs and address waste storage, treatment and disposal techniques and decommissioning. Through the requirements, a framework is established within which individual sites can develop and implement radioactive waste management procedures. The procedures can take into consideration the waste generating operations as well as local climatological, hydrogeological, and demographic characteristics.

High-level Waste

High-level waste results from irradiated fuel reprocessing and contains at least 100 nCi/g of transuranium radionuclides as well as high concentrations of fission products. Three distinguishing characteristics of HLW are high toxicity, longevity, and high heat generating capacity. Storage and transfer

TABLE I. DEFINITIONS

Byproduct Material. Waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface waste resulting from uranium solution extraction processes.

Geological Repository. A deep underground mined cavity used for the disposal of radioactive waste.

Greater Confinement. A technique for waste disposal that employs natural and/or engineered barriers to provide a degree of isolation greater than shallow land burial but less than a geologic repository.

High-level Waste (HLW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations as to require permanent isolation.

Low-level Waste (LLW). Any radioactive waste not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct material as defined by this Order.

Naturally Occurring Radionuclides. Radionuclides and their decay products which occur as part of the natural environment.

Radioactive Waste. Solid, liquid, or gaseous material of insignificant value which contains radionuclides in excess of threshold quantities.

Shallow Land Burial (SLB). Disposal of waste in near-surface excavations which are covered with a protective overburden.

Surplus Facility. Any facility or site (including equipment) that has no potential programmatic use and is radioactively contaminated to levels that require controlled access.

Threshold Quantity. A quantity or concentration of radioactivity above which waste must be managed as radioactive waste and below which the waste may be disposed of as nonradioactive waste at a DOE sanitary landfill.

TRU Waste. Without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting trans-uranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g.

Waste Byproducts. Material, other than special nuclear material, that can be separated and recovered from radioactive waste streams and made available for safe, environmentally acceptable, and cost-effective applications.

systems for liquid HLW must be doubly contained and have adequate monitoring and leak detection systems, and spare tank capacity for emergency situations.

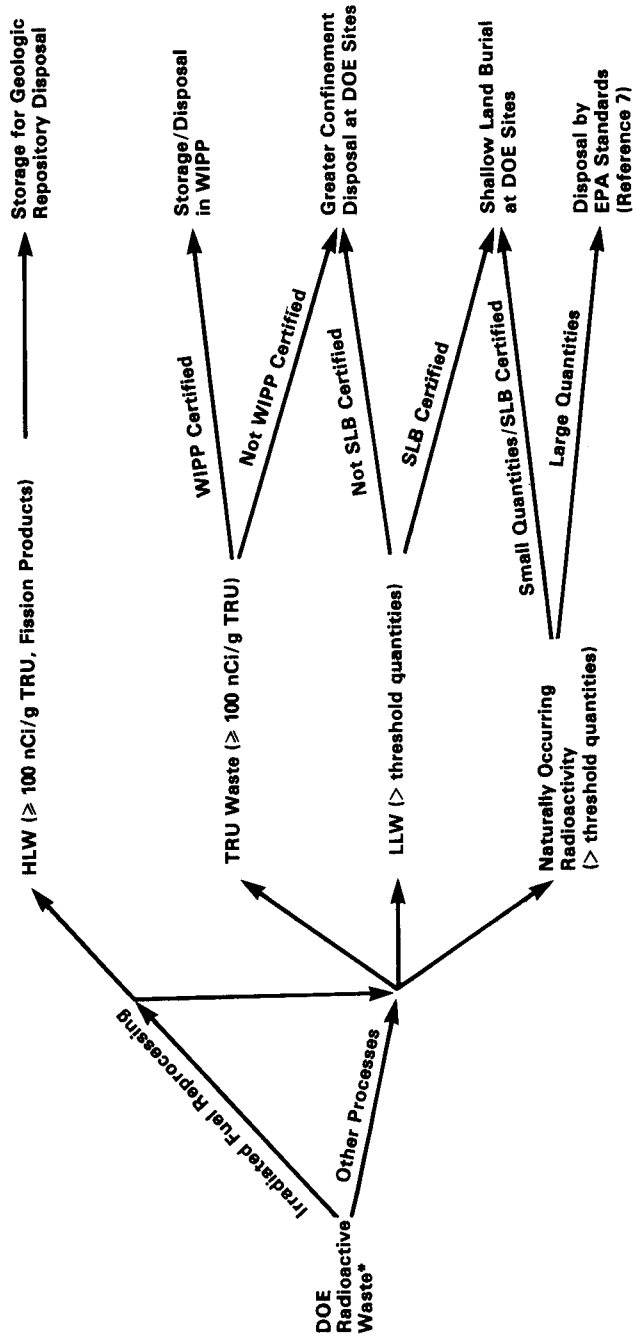
Recovery of waste byproducts and waste volume reduction are encouraged.

Disposal shall be in a geologic repository established under the provisions of the Nuclear Waste Policy Act.⁶ In exceptional cases, other disposal techniques that are technically and economically feasible and present lower public health risks may be considered after requisite environmental documentation.

TRU Waste

TRU waste is characterized by its high toxicity and longevity and contains at least 100 nCi/g of transuranium radionuclides at the end of institutional control periods (about 100 years). This concentration limit has gone into effect in the past 2 years at DOE facilities. The requirements specify that TRU waste is to be certified to meet disposal site acceptance criteria and that it shall be stored in preparation for disposal at the Waste Isolation Pilot Plant (WIPP), a facility located in New Mexico for conducting research and development to demonstrate safe disposal of radioactive waste from defense activities and programs of the United States exempted from regulation by the NRC.⁷ Small

FIGURE 1. DOE RADIOACTIVE WASTE STORAGE AND DISPOSAL



* Waste that is below threshold quantities may be disposed of as nonradioactive waste.

quantities of TRU waste that do not meet waste acceptance criteria for WIPP may be disposed of by greater confinement. TRU waste that in the past was disposed of by shallow land burial is to be monitored and periodically assessed to determine the need for corrective action. Waste with less than 100 nCi/g of transuranium nuclides will be managed as LLW.

Low-level Waste

As defined, LLW means any radioactive waste not included in the other categories and therefore encompasses a wide range of materials, radioactivity concentrations and radionuclides. Disposal is by shallow land burial or in some cases by greater confinement. Each disposal site is to issue waste acceptance criteria which address topics such as allowable quantities and concentrations of radioactivity, mechanical stability of waste packages, restrictions for harmful gases, vapors, free liquids, hazardous chemicals, respirable substances, chelating and complexing agents, and other safety related characteristics. Each site shall also issue operating criteria which address topics such as protecting the public health and safety and the environment, site security, housekeeping and volume reduction practices, as well as operator training, first aid, emergency response plans, recordkeeping, access control, quality assurance, and other items. Sites shall also issue closure/post-closure criteria which specify final site stabilization techniques, residual soil contamination levels, identification markers, and long-term security, surveillance and maintenance. Guidance is also given for preparing selection and design criteria for new disposal sites.

Discharge of liquid LLW directly to the environment or on natural soil columns is to be replaced by other techniques such as solidification or in situ immobilization. Wastes containing only naturally occurring radionuclides including uranium or thorium and their decay products and byproduct material shall also be disposed of as LLW by shallow land burial or according to the intent of EPA standards.⁸

Decontamination and Decommissioning of Surplus Facilities

Surplus facilities are to be managed in a safe, cost-effective manner and structures, equipment, and valuable materials recovered for reuse as practical. The requirements specify procedures for conducting surveillance and maintenance, developing plans and priorities, implementing projects and releasing facilities for other use. They also include design features for new nuclear facilities that facilitate decommissioning.

REFERENCES

1. U.S. Atomic Energy Commission Manual Chapter 0511, "Radioactive Waste Management," September 19, 1973.
2. U.S. Department of Energy Order 5820.1, "Management of Transuranium Contaminated Material," September 30, 1982.
3. National Council on Radiation Protection and Measurements, "Basic Radiation Protection Criteria," NCRP Report No. 39, January 15, 1971.
4. "Recommendations of the International Commission on Radiological Protection," ICRP Publication 26, Vol. 1, No. 3, Pergamon Press, New York, NY (1977).
5. To be published, U.S. Department of Energy, Idaho Operations Office.
6. U.S. Public Law 97-429, Nuclear Waste Policy Act of 1982, January 7, 1983.
7. U.S. Public Law 96-164, Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980, December 29, 1979.
8. "Standards for Remedial Actions at Inactive Uranium Processing Sites," U.S. Environmental Protection Agency, January 5, 1983, Federal Register, p. 590.