DESIGN AND OPERATION OF A LOW-LEVEL SOLID WASTE DISPOSAL SITE AT LOS ALAMOS

K.A. Balo, N.E. Wilson, and J. L. Warren
Waste Management Group
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

ABSTRACT

Since the mid-1940's, approximately 185000 m^3 of low-level and transuranic radioactive solid waste, generated in operations at the Los Alamos National Laboratory, have been disposed of by on-site shallow land burial. Procedures and facilities have been designed and evaluated in the areas of waste acceptance, treatment and storage, disposal, traffic control, and support systems. The methodologies assuring the proper management and disposal of radioactive solid waste are summarized.

INTRODUCTION

Since the mid-1940's, approximately 185000 m^3 of low-level and transuranic radioactive solid waste, generated in operations at the Los Alamos National Laboratory, have been disposed of by on-site shallow land burial and retrievable storage in dry volcanic tuff. All investigations of the solid waste disposal sites have indicated that, with the exception of relatively small quantities of tritium, no migration of buried and stored radionuclides have been detectable. This paper summarizes the design of procedures and facilities developed at Los Alamos to assure the proper management and disposal of radioactive solid waste. In reviewing the design and operation of the solid waste disposal system at Los Alamos, five primary areas of consideration are identified: waste receiving and acceptance, treatment and storage, disposal, traffic control, and support systems.

ENVIRONMENTAL SETTING AND WASTE CHARACTERISTICS

The current Los Alamos disposal site, Area G, is located in north central New Mexico on a mesa top with steep-sided canyons on either side (Fig.1). This site has been in continuous use since 1957, with the present fenced portion of the site incorporating about 250000 m^2 of the estimated 360000 m^2 available on the mesa. The waste material is buried in moderate-to-densely welded volcanic tuff. Disposal pits and shafts are located between 200-300 m above the regional water table. Moisture content in the tuff has been determined to be generally 5% or less, by volume, at depths greater than 4 m.[1,2]

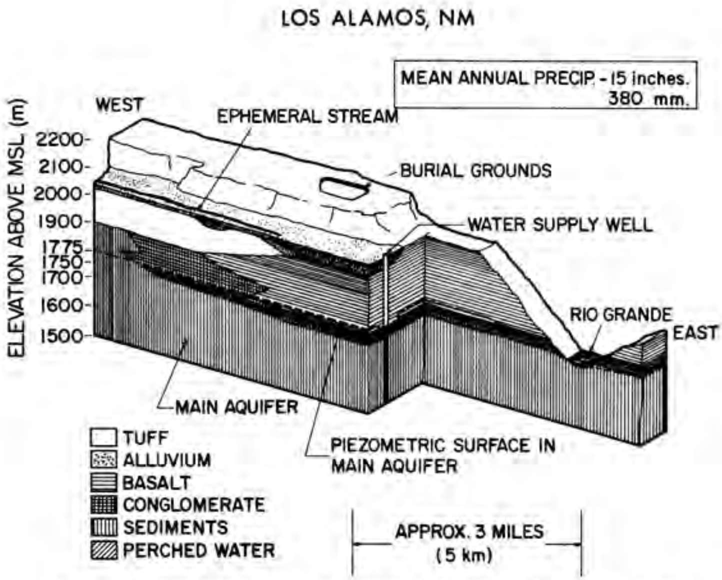

Fig. 1. Geologic cross-section, Los Alamos, N.M.

Each year, an average of 5000 to 8000 m^3 radioactive solid waste is buried and stored at Los Alamos. Tables I and II provide an overview of the types and volumes of wastes and the types and amounts of radioactive contaminants.

Table I. Los Alamos National Laboratory Radioactive Solid Wastes (1979-1981)

Waste Category	Volume m^3	Volume %
Laboratory Trash	2962	16.6
Failed Equipment	5683	29.9
Building Rubble	3469	18.2
Cement Paste/Cement Sludge	3092	16.2
Soil	858	4.5
Others	2970	15.6
Total	19034 m^3	100.0%

Table II. Los Alamos National Laboratory Waste Radioactive Contaminants (1979-1981)

Radionuclide	Volume m^3	Volume %	Radioactivity Ci	Radioactivity %
Transuranics (238Pu, 239Pu, 241Am & 233U)	9827	71.0	1612	1.4
Uranium (depleted, normal and enriched)	3366	24.0	38	< 0.1
Fission Product/ Induced Activity	356	3.0	2654	2.4
Tritium	347	2.0	107096	96.1
Total	13896 m^3	100.0 %	111400 Ci	100.0%

SITE DESIGN AND OPERATION

Receipt and Acceptance of Waste

Goals strived for through the operation of a waste receiving and acceptance area include the control of radiation and contamination, the meeting of appropriate transportation requirements, and the receipt of documentation. A related and extremely important aspect of waste receiving and acceptance is the monitoring of procedures developed by Laboratory waste generators for the preparation of waste for disposal, and assuring that these procedures have been met when waste is accepted at the disposal site.

As in most industry, standard operating procedures (SOP) are developed to cover specific operations as assurance that all necessary health and safety precautions have been considered. At the Laboratory, an SOP must be approved for waste management from any operation that creates radioactive solid waste. The waste management SOP must clearly cover the operation, packaging, and transportation of the waste. These SOP's are reviewed annually by waste management personnel, a process which includes an on-site inspection of a generator's facilities to determine whether procedures are being properly implemented. The SOP and documented on-site inspection serve as quality assurance and control measures on the form the waste is in when it arrives at the disposal site.

At the disposal site, vehicles containing waste are initially stopped at the barrier gate for documentation approval. A Radioactive Solid Waste Disposal form must accompany each shipment (Fig.2). It is reviewed for proper information and signatures. The waste generator signature certifies compliance with all applicable disposal requirements and the health physics signature certifies that packaging and transportation requirements have been met (Fig.3). The vehicle is then moved just beyond the barrier for physical inspection. Radiation levels are checked and contamination swipes are taken. Verification that all aspects of the waste packaging and transportation were conducted in accordance with proper prodedures is performed. If only waste transportation discrepancies are noted, they are documented prior to proceeding with disposal operations. Situations involving improper waste form, packaging, or documentation requires the shipment to be moved to a holding area until corrective action can be determined. In all cases, personnel at the waste generator site are contacted to assist in determining corrective action and to initiate action to prevent recurrence. When all disposal criteria have been satisfied, the shipment is directed to a storage, treatment, or disposal location.

Waste Treatment

Waste treatment at Los Alamos involves the operation of a compactor-baler to reduce volume and stabilize the waste form. Temporary storage facilities are provided where immediate disposal/storage is not practical. In both of the above cases, the facilities represent a cost effective approach.

Low-level waste at Los Alamos is required to be segregated into compactible and noncompactible categories by generators. Compactible waste is defined as:

> Solid waste consisting of trash-type materials such as paper, plastic, rubber, and small items of glassware up to 1-gallon in size. Small items such as short lengths of pipe or conduit, small pieces of wood or sheet metal, may be included in compactibles; larger wood or metal items are to be excluded. Also excluded are any waste chemicals, free or absorbed liquids, biological waste, pressurized containers, or other hazardous materials.[3]

The majority of this type of waste is received in 0.06 m^3 boxes inside dumpsters. Boxes are limited to a maximum weight of 13.6 kg. Dumpsters are directed after inspection to the compactor area where they are unloaded into a large bin (Fig.4). The boxes are removed by the operator from the bin and fed into the compactor. This process is continued between compacting cycles until a bale 0.4 m^3 in size and weighing 200 kg is formed. This bale is banded, wrapped and sealed in plastic, and placed

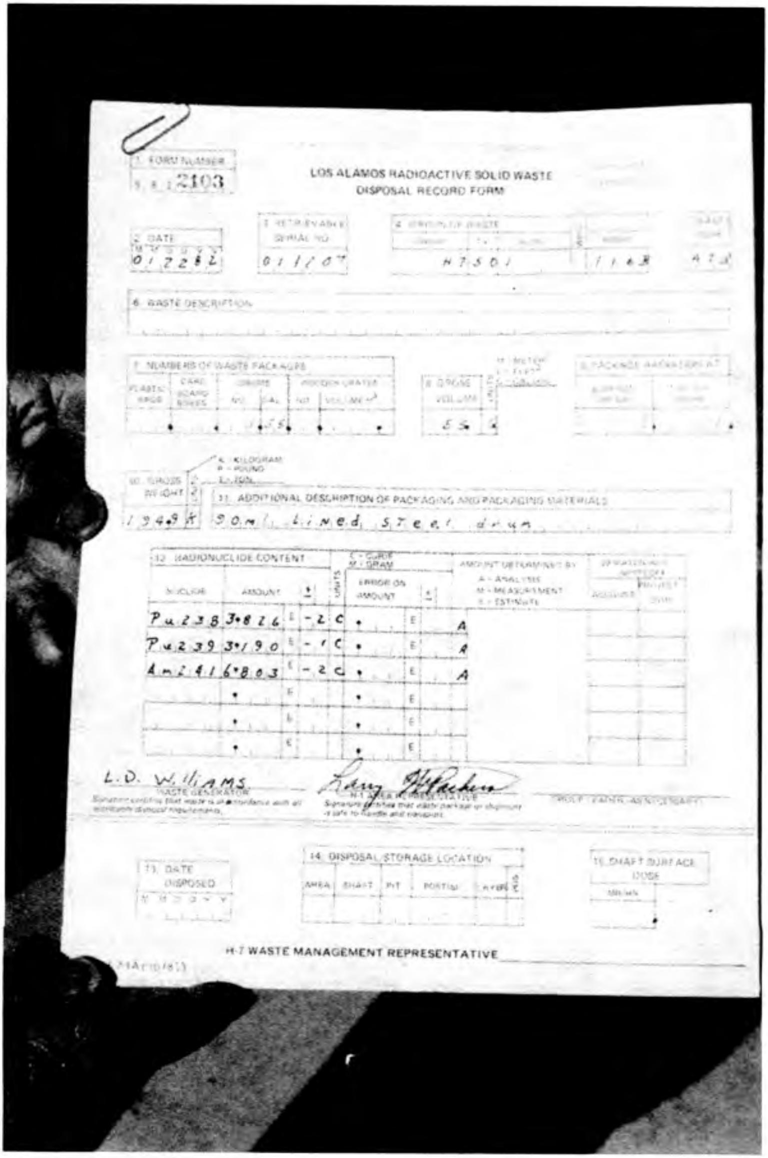

Fig. 2. Los Alamos Radioactive Solid Waste Disposal Form

Fig. 3. Inspection of an in-coming waste vehicle.

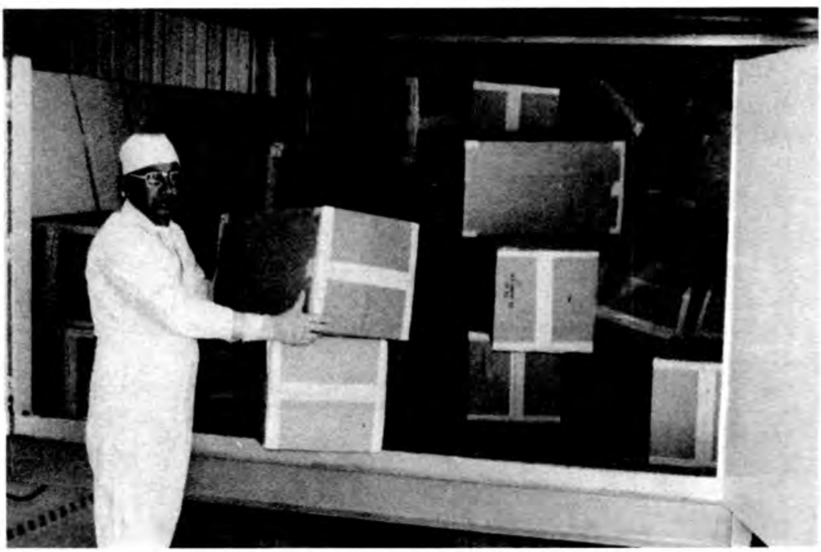

Fig. 4. Boxed compactible waste.

in the disposal pit (Fig. 5). An average 5:1 volume reduction ratio is achieved in this type waste. Specific attributes, besides reduced volume, include minimizing the combustibility of the waste and the potential for future pit subsidence. The Los Alamos compactor-baler acquired in 1977 at a cost of approximately $30,000 through 1981 has compacted 3778 m^3 of waste to a burial volume of 752 m^3, for an overall volume reduction of 5.02:1.

One of the buildings at the disposal site was designed for the temporary storage of 210L drums of transuranic[4] waste (Fig. 6). The drums are accumulated in this building as they arrive until the capacity of the building has been reached (250 drums). At that time,the drums are sprayed with a corrosion inhibitor and emplaced in an interim storage facility. This is designed in accordance with Federal requirements mandating a minimum 20 year retrievable storage of transuranic waste. In manpower and equipment this proves to be more cost effective than emplacement of a few drums on a daily basis. No waste other than transuranic is stored on a routine basis.

Fig. 5. Waste compactor-baler at Los Alamos

Fig. 6. Temporary storage facility for transuranic waste.

Disposal

Disposal site operations must involve adequate procedures and/or facilities for proper waste segregation, disposal, and contamination and pollution control. The type of disposal facility used, the waste form and packaging, the application of cover material, and site restoration are all items that must be considered in achieving these goals. The method and location of disposal of waste is dependent upon the physical, chemical, and radiological properties of the waste.

The bulk of the waste generated at the Los Alamos Laboratory is buried in large pits ranging in size from 120 to 180 m long, 8 to 30 m wide, and 8 to 14 m deep. Pits are oriented with the long dimension as parallel as possible to the area surface contours to minimize surface erosion. The ends of pits are dug with slopes to allow access by vehicles and equipment. As a final step, tuff is ground and compacted in the pit bottom to a depth of 0.15 to 0.30 m to provide a seal for any fractures in the pit bottom, and an absorption medium for precipitation that enters the pit prior to waste burial.

To provide for better isolation following burial and/or to increase worker safety, certain Los Alamos wastes are buried in augered shafts measuring 0.3 to 1.8 m in diameter by up to 20 m deep. One oversize shaft, 1.8 x 3.6 x 13.7 m, has been drilled for disposal of large highly-activated wastes. While most shafts are unlined, a few are lined with concrete or metal primarily for additional contamination control.

To prevent possible association between buried waste and perched water which exists in alluvial material in the floors of adjacent canyons, no burial facilities may be deeper than the adjacent canyon floor (23m). Both pits and shafts are dug no closer than 15 m to a canyon wall and all topsoil is removed and stockpiled for future site revegetation. All burial facilities are surveyed, recorded, and approved for use by the Laboratory Environmental Surveillance Group prior to use. Pits and shafts are filled to a level 1 m below the "spill point", defined as the lowest point on the facility rim, thus ensuring complete containment of waste by undisturbed tuff. Pits are then covered with tuff, a layer of topsoil, and revegetated. Shafts are capped with concrete the entire final meter.

As stated earlier, the bulk of Los Alamos National Laboratory waste is placed in pits. This includes large equipment, most decommissioning wastes, all compactible waste bales, and most routine non-compactible waste (Fig. 7). Items such as radioactive chemical waste, biological waste, and highly activated materials are routinely placed in shafts.

Waste packaging is provided in most instances primarily for contamination and radiation control during transportation as the disposal site environment is the primary containment following burial. In some instances, however, disposal facility liners or special packages are utilized to supplement containment. The waste that this occurs with most frequently is that contaminated with tritium. Tritium waste $>20mCi/m^3$ must be placed in asphalt lined or encapsulated drums and then placed in lined shafts. This type of containment is being evaluated to determine its effectiveness against tritium migration.[5]

The immediate cover on all waste disposed of at Los Alamos is excavated tuff. In the shafts, this material is used to cover packages for better isolation of individual packages and to fill voids. In pits, all waste is covered daily (Fig. 8). This is accomplished using a layered-landfill approach with additional compaction achieved during the covering by the weight of the heavy equipment. Operation in this manner has proven effective in preventing pit subsidence.

Efficient site utilization is achieved through a combination of disposal facility design, operations, and closure. Because of the size restrictions of the disposal


Fig. 7. Pit disposal of radioactive waste.


Fig. 8. Daily coverage of waste in pits.

site at Los Alamos, maximum land use is accomplished by leaving minimal space between pits and shafts and by having transuranic waste storage areas located on top of old pits. Operationally, waste volume reduction by compaction is encouraged wherever possible to minimize land usage. Disposal facility closure incorporates revegetation with native grasses, appropriate surface drainage control by restoration of natural gradients, and monument installation for permanent identification.

Traffic Control

Traffic control encompasses the design and location of gates, parking areas, and roads for the optimization of traffic flow. Gates are designed in a manner to allow control of access to specific areas. At the present time two gates exist at the disposal site. The first is a security gate which is open only during normal operating hours. The second is a traffic barrier at the waste receiving and inspection area. Besides preventing uninspected waste shipments from entering the active disposal area, gate two also limits the number of non-waste vehicles inside the area at any one time.

A parking lot exists outside of the active disposal area for disposal site employees and for the use of other personnel working in the area. Laboratory vehicles are permitted in the active disposal area only when a need can be justified. This minimizes the potential for traffic tie-ups, destruction of revegetated areas, and the spread of contamination.

Since traffic is kept to a minimum, few roads exist on the site. As activities are relocated, so are the roads. Again, in this manner, minimal traffic occurs over filled pits and through revegetated areas.

Support Functions/Facilities

Essential support functions/facilities that must be designed into the operating system include health physics support, decontamination facilities, utilities, data collection, environmental monitoring, and security.

At the Los Alamos Laboratory, health physics personnel operate under separate management to allow for unbiased decisions when required. Health physics personnel monitor incoming and outgoing vehicles and people, maintain records of area swipes and surveys, and assist in the event of emergency or decontamination. Decontamination facilities consist of change rooms with showers which drain to a collection tank for appropriate later treatment and a limited wash area for equipment and vehicles. The majority of the vehicle decontamination is conducted at the primary Laboratory decontamination facility at another Laboratory location.

A data collection system is an integral segment of waste management recordkeeping. At Los Alamos, a Hewlett-Packard 3000 system retains all data concerning disposal. The information (what the material is, radioactive contaminants, quantity, and where buried/stored) is entered directly into the computer from a remote terminal at the disposal site. Information later is verified and reports generated in the main offices.

Environmental monitoring is conducted on a continual basis as part of the Laboratory's overall environmental surveillance program. Air, soil, animal, and surface run-off water sampling that is burial site specific is conducted to verify that no radioactive release has occurred. Collection of water samples from unsaturated tuff is difficult or impossible; consequently, samples of tuff with its contained water are analyzed. Meteorological data collected at Area G provides additional information on the rates of water movement into and out of the tuff.

Utilities and security are required on an ongoing basis. A water line for personnel use, decontamination, dust control, and fire protection is presently being installed. Currently, water is trucked into the area daily. The area is secured from intruders by an eight foot security-type fence having double outriggers with concertina rolls on top.

SUMMARY

Over 35 years of experience show that shallow land burial of low-level solid radioactive waste can be safely accomplished in an environmentally acceptable manner. At the Los Alamos National Laboratory, this has been accomplished through careful planning in the areas of receiving and acceptance of waste, treatment and storage, disposal, traffic control, and support systems. These areas are scrutinized on a constant basis for improvement to the disposal site operations.

REFERENCES

1. Transuranic Solid Waste Management Programs: July-December 1974, Los Alamos Scientific Laboratory report LA-6100-PR, October 1975.