DECOMMISSIONING OF LOW-LEVEL RADIOACTIVE
WASTE DISPOSAL SITES
IMPLICATIONS FOR FUTURE SITES

Charles W. Mallory
Hittman Nuclear & Development Corporation

Practically all of the low-level waste generated by nuclear power plants has been disposed of at shallow land burial sites. The first commercial site was opened in 1962 at Beatty, Nevada. The opening dates and current status for all the sites are shown in Table I.

TABLE I

COMMERCIAL SHALLOW LAND BURIAL SITES

Site	Opened	Status
Beatty, Nevada	1962	Operating
Morehead, Kentucky (Maxey Flats)	1963	Closed, 1977
West Valley, New York	1963	Closed, 1975
Richland, Washington	1965	Operating
Sheffield, Illinois	1967	Closed, 1978
Barnwell, South Carolina	1971	Operating

As indicated, three of the six commercial disposal sites now have been closed. This paper discusses the conditions which lead to the closure of two of these sites, and the remedial actions that are being taken at one site to permit the site to be decommissioned. The objective of this paper is to provide information which can be used in the decommissioning of existing sites and in the planning of future sites.

BACKGROUND

The West Valley and the Maxey Flats disposal sites were both constructed over impervious strata. In both cases, the conditions which lead to closure of the site were generally as follows:

- o Trenching caused the surface to become permeable
- o Stormwater infiltrated into trenches
- o Water accumulated in trenches
- o Trench water contaminated by buried waste
- o Vertical migration of radioactive water
- o Potential for lateral migration.

REMEDIAL ACTIONS

In the case of the Maxey Flats site, a number of actions have been taken to reduce the potential for off-site migration.

- o Water is being pumped from the trenches 24 hours per day, five days per week
- o Water is being processed by evaporation to reduce the volume
- o Ponds previously located on the site are being eliminated
- o The site has been graded to increase runoff
- o Trench covers have been improved to increase runoff
- o Trench subsidence is corrected as it occurs.

There are a number of potential problem areas which remain and must be addressed in the remedial action program.

- There is still an estimated 5,000,000 gallons of water in the trenches
- Surface water continues to infiltrate the trench at rates of 300,000 to 500,000 gallons per year
- The rate at which the water can be removed and processed is limited by tritium release limit. With three shift operations, five days per week, about 1,300,000 gallons of water can be removed per year
- With net removal rates in the range of 800,000 to 1,000,000 gallons per year, at least five years will be required to drain the trenches
- Processing of the waste reduces the volume by factors of 40 to 60 and about 20,000 gallons of concentrate and sludge are produced each year
- The concentrate and sludge is currently being stored in tanks and must eventually be solidified for on-site burial
- The area continues to subside and additional subsidence is expected as the water is removed from the trenches
- The potential for lateral migration will exist until all of the water is removed from the trenches.

The greatest problem is that these remedial actions and problems were not anticipated and the perpetual care funds collected during the operation of the site have been expended.

DECOMMISSIONING PLAN

The plan for the permanent long term decommissioning of the Maxey Flats site involves continuation of the remedial action program and a number of additional projects.

- A long term site drainage plan is being developed and will be implemented

- Lined channels will be installed to convey stormwater off site
- Plastic membranes are to be installed over the entire area to control infiltration
- All pumpable water will be removed from the trenches
- The concentrate and sludge will be solidified and buried
- The dewatered trenches will be allowed to stabilize
- Subsidence will be corrected to maintain drainage
- Permanent intrusion barriers will be installed after the area stabilizes.

The present decommissioning plan is based on control by surface water management following the draining of the trenches. If lateral migration of ground water is found to exist, it may be necessary to install barrier walls.

LESSONS LEARNED

There are a number of lessons to be learned from the Maxey Flats experience.

- Water infiltration is a problem at shallow land burial sites overlying impervious strata
- Provision must be made to control water infiltration during the active operation of the site and during the decommissioning phase
- If lateral migration can occur, it will be necessary to provide barrier walls
- Continuing maintenance will be required to correct subsidence and maintain drainage until the waste and trenches stabilize

- The site must be stabilized before permanent intrusion barriers can be installed unless structural barriers are used

- Decommissioning of shallow land burial sites will require many years

- Custodial maintenance and decommissioning cost are much higher than originally anticipated

- Adequate perpetual care and decommissioning funds should be accumulated during active operations.

It shoald be noted that the above items are directly related to shallow land burial sites above impervious strata. They would not apply to shallow land burial sites in permeable soil. For burial sites with permeable soils and trenches located a sufficient distance above the water table, most of the problems cited would not exist. Water infiltrating the trenches would flow down and around the waste packages. The water would have limited contact with the waste and less chance to be contaminated. The majority contamination of the water would be removed by ion exchange capacity of the soils. However, management of surface water is important even with permeable soils. By reducing the amount of water that can come in contact with the waste, the potential for leaching is reduced and the ion exchange capacity of the soil is preserved. The following would be applicable to shallow land burial sites in permeable soils:

- Surface water drainage should be provided for both the active and decommissioning phases

- Maintenance will be required until the trench and wastes stabilize

- In most cases, permanent intrustion barriers cannot be installed until the site is stabilized

- The time required for stabilization could be longer, if water is not present (i.e., corrosion of containers, etc.)

- o Custodial maintenance and decomissioning costs should be comparable.

The operating experience and requirements for decommissioning of the existing land disposal sites should be investigated to identify potential problem areas. The items to be investigated should include operating experience, water management, radionuclide migration, decommissioning plans, and acceptable intrusion barriers.

ALTERNATIVES

Most states are now considering entering into compacts which will lead to the opening of future low-level radioactive waste disposal sites. The experience with existing sites should be factored into the planning of these new sites.

The basic issue that must be addressed is whether the requirements for long term decommissioning can be met with controlled release of radioactivity. If physical confinement of the waste is required, shallow land burial as it is practiced today is no longer an acceptable alternative. If this is the case, engineered storage and disposal, combined engineered storage and improved shallow land burial or geological storage become the most viable alternatives. The features of the various alternative methods are summarized as follows:

- o Shallow Land Burial - Permeable Soils
  - Experience satisfactory
  - Evaluate decommissioning
- o Shallow Land Burial - Impervious Soils
  - Experience unsatisfactory
  - Problem areas defined
  - Usable with special features
- o Engineered Storage and Disposal Facilities
  - Provides confinement
  - Stabilization not required

- Readily decommissioned
- Expensive

o Combined Engineered Disposal and Burial

  - Can provide confinement
  - Stabilization reduced
  - Decommissioning planned
  - Moderately expensive

o Geological Storage

  - Provides isolation
  - Decommissioning planned
  - Expensive

FINANCIAL ASPECTS

The planning of future low-level waste disposal facilities must consider the financial aspects in greater depth. As indicated, the costs of remedial action and custodial maintenance were not fully anticipated in the planning of existing facilities. In addition, it appears the cost of decommissioning the existing and future facilities to meet proposed regulations will also be higher than previously anticipated.

Since 1975, the cost of low-level waste burial has risen by 450 to 925 percent depending upon the type of waste. At the present time, the volume charges are in excess of $12 per cubic foot. With radiation and handling charges, burial costs can range up to $60 per cubic foot for power plant wastes. With burial prices in this range, consideration can be given to engineered disposal facilities and other alternative disposal methods heretofore considered prohibitively expensive.

The overall cost of planning, operating, maintaining and decommissioning must be considered to evaluate disposal alternatives. In addition, interest on loans and return on investments must be included. For example, it may be found that the cost of decommissioning a shallow land burial site will be greater than the cost of constructing and decommissioning an engineered disposal facility. Further, constructing a facility which can be readily decommissioned will provide financial protection with respect to the escalation and inflation of future construction costs.

The allocation of burial fees should be examined. In many cases the funds set aside for perpetual care have not been adequate and the states now fund the custodial care and decommissioning costs. Considering the risks involved, the fees should also provide a reasonable return to the operator and the investors.

IMPLICATIONS FOR FUTURE SITES

Shallow land burial at sites with permeable soils will probably continue to be the most attractive method for the future disposal of low-level radioactive waste. Experience has shown this to be an acceptable method of disposal and data from existing sites can be used to show that dispersion of radioactivity will be controlled by the ion exchange capability of the soil. The factors that could affect this method of disposal are the cost of custodial maintenance during the stabilization of the trench and wastes and the design and cost of long term exclusion barriers.

Shallow land burial over impervious strata should be avoided. Even though the existing sites of this type will be satisfactorily decommissioned, the problems and costs will dictate against future applications.

Engineered disposal facilities will probably not be used extensively unless the concept of controlled release of radioactivity from pervious shallow land burial sites is found not to be valid.

Engineered disposal facilities combined with improved shallow land burial facilities represent a potentially attractive alternative. Facilities can be designed to provide physical confinement of the waste. These facilities can also be designed to allow decommissioning to occur prior to the stabilization of the waste and thereby reduce decommissioning costs.

Geological disposal of low-level waste is not considered to be likely except where natural cavern exist which can be utilized with minimal investment.

The experience with the six commercial low-level waste disposal sites has provided a base of knowledge and experience which can be built upon in the future.