RED-76-54
1-12-76

REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Improvements Needed In The Land Disposal Of Radioactive Wastes-- A Problem Of Centuries

Nuclear Regulatory Commission

Energy Research and Development Administration

Large volumes of other than high-level radioactive wastes, including some that are long lived and highly toxic, are disposed of at six licensed commercial and five principal Federal facilities in the United States.

Some of these sites have been operating for more than 30 years, yet, it is not known what mix of hydrogeological characteristics and engineering features offers the greatest assurance that radioactivity, once disposed of, will not create a possible public health hazard.

The report shows the need for a comprehensive study of existing disposal sites, the development of site selection criteria, and other efforts to improve program management and regulation of disposal sites.

RED-76-54

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164105

To the President of the Senate and the
Speaker of the House of Representatives

This report concerns the land disposal of radioactive wastes. The report discusses the need for a comprehensive study of radioactive wastes disposal sites, improvements in program management and regulatory efforts, and evaluations of long-term-care requirements.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Chairman, Nuclear Regulatory Commission; and the Administrator, Energy Research and Development Administration.

Comptroller General
of the United States

CONTENTS

ABBREVIATIONS

ERDA	Energy Research and Development Administration
EPA	Environmental Protection Agency
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
USGS	United States Geological Survey

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

IMPROVEMENTS NEEDED IN THE LAND DISPOSAL OF RADIOACTIVE WASTES--A PROBLEM OF CENTURIES
Nuclear Regulatory Commission
Energy Research and Development Administration

D I G E S T

Protecting public health and safety requires that radioactive wastes be isolated for the period they may pose a health (i.e., radiation) hazard. This report is concerned with other than high-level radioactive wastes disposed of by land burial. (See p. 3 for a description of these other wastes.)

Radioactive disposal sites have been in use from 4 to more than 30 years, yet it is not known what mix of hydrogeological characteristics and engineering features offer the greatest assurance that radioactivity, once buried, will not migrate to create a possible public health hazard and require extraordinary and costly efforts to correct. (See p. 1/.)

There are six licensed commercial and five principal Federal land disposal sites. Through 1973 about 9.1 million cubic feet of solid radioactive wastes have been buried at the commercial sites.

These wastes contained about

--2.3 million curies of byproduct material,

--1.2 million pounds of source material, and

--1,200 kilograms of special nuclear material, including 80 kilograms of plutonium. (See pp. 3 to 5.)

At Federal facilities, an estimated 42 million cubic feet of radioactive wastes have been buried through June 1974. These facilities are controlled by the Energy Research and Development Administration.

At the five principal Federal facilities, an estimated 36.3 million cubic feet of solid wastes have been buried containing 18 million

curies of byproduct material and 740 kilograms of plutonium. At three of these over 140 billion gallons of liquid radioactive wastes also have been discharged into the ground. (See pp. 5 and 6.)

Before sites are selected to receive radioactive material, the earth science characteristics should be evaluated and measured against criteria which describe suitable sites. However, GAO found that

--site selection criteria have not been established (see p. 9),

--important earth science characteristics are not well defined (see p. 12), and

--some disposal sites now are releasing radioactivity to the environment (see p. 14).

The studies supporting the establishment of Federal disposal sites were brief, and for some sites established in the 1940s, there were no geological evaluations. Some of these disposal sites have been studied extensively in recent years.

The commercial disposal sites were studied in varying degrees by license applicants and by licensing agencies. (See p. 12.) Further evaluations currently are underway or planned for some of the commercial and Federal disposal sites. (See pp. 15 to 16.)

GAO recommends that the Nuclear Regulatory Commission and the Energy Research and Development Administration jointly

--see that comprehensive studies are made of existing disposal sites to evaluate their ability to retain radioactive wastes and

--use the results of such studies to develop site selection criteria for determining the long-term suitability of existing disposal sites and for selecting future sites.

GAO is also making a number of recommendations for

--establishing detection standards for determining when radioactivity migration at

disposal sites reaches unacceptable levels (see p. 19),

--improving radiation monitoring programs (see p. 22), and

--improving other regulatory and management activities (see p. 26).

Because monitoring and maintenance at disposal sites will be required for many centuries, it is important that long-term-care requirements are identified and funded adequately before terminating and decommissioning disposal sites.

Neither the Nuclear Regulatory Commission nor several of the agreement States that license commercial disposal sites have established long-term-care requirements and determined the adequacy of long-term funding arrangements to meet such requirements.

Although the Nuclear Regulatory Commission and the Energy Research and Development Administration are responsible for regulating and developing the nuclear industry, respectively, neither has a program under which the States can be aided in taking corrective actions at disposal sites. (See p. 34.)

The Nuclear Regulatory Commission should:

--Establish, in cooperation with agreement States, long-term-care requirements for commercial disposal sites and require that adequate funding be provided and

--Develop, with the Energy Research and Development Administration a policy on Federal involvement in correcting migration problems at commercial disposal sites.

Officials of the Nuclear Regulatory Commission and the Energy Research and Development Administration generally agreed with GAO's findings and the intent of its recommendations. However, officials of both organizations questioned the appropriateness of joint sponsorship of a study of existing Energy

Research and Development Administration and commercial disposal sites because of their separate missions. The Nuclear Regulatory Commission recommended the establishment of a committee of experts in relevant technical areas to advise and guide a joint Nuclear Regulatory Commission and State study of commercial waste disposal sites and a separate Energy Research and Development Administration study of its sites. This proposal is an acceptable alternative approach to GAO's recommendation if the objectives of that recommendation can be met. For further details on comments received, please turn to appendixes IV and V.

CHAPTER 1

INTRODUCTION

Under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, and title II of the Energy Reorganization Act of 1974* (42 U.S.C. 5841), the Nuclear Regulatory Commission (NRC) has authority and responsibility to protect public health and safety through regulating the possession, use, and disposal of radioactive materials.** NRC discharges its responsibility through a licensing and inspection program. The Office of Nuclear Material Safety and Safeguards licenses radioactive materials users, while the Office of Inspection and Enforcement conducts inspection and enforcement activities.

Under section 274 of the 1954 act, NRC may relinquish regulatory authority over certain types and quantities of radioactive materials to States by entering into formal agreements with them (agreement States). Before approving an agreement State, NRC must determine that the State's radiation control program is compatible with NRC's regulatory program and is adequate to protect public health and safety. As of January 1975, there were 25 agreement States.

The Energy Research and Development Administration (ERDA), under authority of the 1954 act and title I of the 1974 act (42 U.S.C. 5811), administers several Government-owned, contractor-operated laboratories and production facilities. ERDA operations offices supervise contractors' activities. ERDA has established requirements at its nuclear facilities to protect workers and the public from radiation hazards.

In addition to NRC's and ERDA's responsibilities, the Environmental Protection Agency (EPA) is responsible for establishing generally applicable environmental standards to protect the general environment from radioactive material.

NATURE AND HAZARDS OF RADIOACTIVITY

Humans are exposed daily to naturally occurring radiation in the environment—in soil, water, and air. Such radiation

---

*This act transferred the functions of the U.S. Atomic Energy Commission to NRC and the Energy Research and Development Administration.

**The term "radioactive materials" refers to source material (uranium and thorium), byproduct material (radioisotopes produced in nuclear reactors), and special nuclear material (plutonium, uranium-233, and uranium enriched in the isotope 233 or 235).

is referred to as natural background radiation, and it accounts for essentially all of the radiation exposure received by the general population exclusive of the exposure from the medical use of radioactive materials and x-rays.

Currently in the nuclear industry, there are more than 1,300 distinct types of radioactive elements called radioisotopes. Each nuclear activity may involve a variety of these radioisotopes in a solid, liquid, or gaseous form; either soluble or insoluble; and giving off different types of radiation (alpha, beta, gamma) at various energy levels. Most radioisotopes lose their radioactivity (decay) rapidly, while a few require hundreds to many thousands of years to decay. For example, plutonium-239 requires about 24,000 years to lose half of its radioactivity; rhodium-107, 30 seconds.

The dangers posed by radioactivity vary depending on such characteristics as radioactive life and energy level, type of radiation, and ability to concentrate in the body. Radiation can affect both individuals exposed to it and their descendants by damaging reproductive cells. Radiation effects are often cumulative and may not be evident for some time.

All authorities agree that, due to the potential hazard posed by the destructiveness of radiation to living cells, radiation protection standards are needed, although there is some controversy over how restrictive the standards should be. There are standards for radioisotope concentrations in air and water. Maximum exposure limits for the human body and its critical organs have also been established.

REGULATION AND MANAGEMENT OF RADIOACTIVE WASTES

All operations that produce or use nuclear materials generate radioactive wastes. The wastes produced vary widely in volume, composition, and intensity of radioactivity, depending on the materials and nature of the operations from which they originate. Typical sources of radioactive wastes include university and industrial research centers, medical diagnostic and treatment units, and nuclear reactor operations and related nuclear fuel cycle activities. Most of the radioactive wastes generated today are from ERDA site operations and nuclear reactors and nuclear fuel cycle activities, mainly at fuel fabrication and reprocessing facilities (no commercial reprocessing facilities are currently operating).

The radioactive wastes that are produced are generally classified as either "high level" or "other" wastes. High-level wastes are created during the initial step in chemically reprocessing used nuclear fuel. High-level wastes have

concentrations of radioactivity measured in hundreds to thousands of curies* per gallon or cubic foot. We have issued three reports** on the program for managing high-level radioactive wastes.

Other wastes may be radioactive or only suspected of radioactive contamination. These wastes are disposed of according to their type and/or concentration of radioactivity. Liquid and gaseous wastes are usually treated, diluted, or held for radioactive decay and then released to the environment. Solid wastes, sludges, and solidified liquids are disposed of at shallow land burial sites (see figure 1), and some liquids are discharged into cribs (see figure 2) or seepage ponds.

A great deal of solid wastes that are buried consist of dry waste materials with low levels of radioactivity or suspected of being radioactive. Examples of these wastes are paper trash, packing material, protective clothing, broken glassware, plastic sheeting and tubing, defective or obsolete equipment, and building rubble. Other types of solid wastes having higher concentrations of radioactivity include spent ion exchange resins, filters, filter sludge, and evaporator bottoms. Buried wastes also include shielding, piping, instrumentation, control rods, and other nuclear reactor equipment which had become radioactive. Some buried wastes are contaminated with transuranic*** radionuclides including plutonium.

Commercial disposal sites

Three private companies currently operate six licensed commercial burial grounds. The disposal site location and the year when licensed are:

---

*Curie is a measure of the intensity of radiation. It is equivalent to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium.

**B-164052, May 29, 1968; January 29, 1971; and December 18, 1974.

***Transuranic elements have atomic numbers greater than 92. All transuranic elements are artifically produced and are radioactive.

Disposal site location	Year licensed
Beatty, Nevada	1962
Morehead, Kentucky (Maxey Flats)	1963
West Valley, New York	1963
Richland, Washington	1965
Sheffield, Illinois	1967
Barnwell, South Carolina	1971

All commercial disposal sites are licensed to handle byproduct, source, and special nuclear material. All sites are on Federal- or State-owned land. At five sites, the States owned the land and lease it to the burial ground operators. At the Richland site, the Federal Government leased the land to Washington which then leased it to the burial ground operator. NRC licenses the Sheffield facility because Illinois is not an agreement State. Agreement States partially or completely regulate the other sites. At Beatty and Richland, NRC regulates the handling of special nuclear material since large quantities are authorized to be handled by these facilities. The States regulate the handling of byproduct and source material at these sites.

A proposed amendment to NRC's regulations will ban commercial burial of wastes contaminated with transuranic radionuclides. Since the initial licensing of the Barnwell disposal site in 1971, South Carolina has prohibited the burial of transuranic-contaminated wastes (except americium-241). Since October 1973 the New York site has not been allowed to receive for burial more than trace quantities of plutonium. In 1974 Kentucky announced that it was limiting the concentration of transuranics to be buried to 10 nanocuries* per gram, and the licensee placed the 10 nanocurie limit on wastes at the Sheffield site. On September 1, 1975, Nevada placed the same limitation on transuranic wastes.

Since the beginning of commercial land burial operations in 1962 through 1973, approximately 9.1 million cubic feet of radioactive wastes have been buried, containing 2.3 million curies of byproduct material; 1.2 million pounds of source material; and 1,200 kilograms of special nuclear material, including about 80 kilograms of plutonium. Of the total buried at commercial sites, Kentucky and New York have received the greatest amount--about 38 percent and 22 percent, respectively. Before 1962 commercially generated solid waste was usually disposed of at sea or at the Atomic Energy Commission's burial sites.

Each year the volume of waste buried at commercial sites increases. Substantial increases are expected in the 1980s

*A nanocurie is a billionth of a curie.

and 1990s commensurate with the expected growth of the nuclear power industry. In a recent study EPA projected an average annual volume of other than high-level waste at 14.5 million cubic feet for 1981 to 1990 and 79.0 million cubic feet for 1990 to 2000. By 2000 EPA estimated that approximately 1 billion cubic feet of other than high-level solid wastes would accumulate. EPA also projected that, under existing waste treatment technology, the six existing commercial sites would be full by 1998 with two sites reaching capacity by 1985.[1]

ERDA disposal sites

ERDA contractors operate large land burial operations at five principal ERDA facilities: Holifield National Laboratory, Oak Ridge, Tennessee; Los Alamos Scientific Laboratory, Los Alamos, New Mexico; Idaho National Engineering Laboratory, Idaho; Hanford, Richland, Washington; and Savannah River Plant, South Carolina. Smaller land burial sites are at other ERDA facilities, including Sandia, New Mexico; Pantex (Amarillo), Texas; Nevada Test Site, Nevada; Fernald, Ohio; and the gaseous diffusion plants at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio.

ERDA estimates that 42 million cubic feet of radioactive wastes have been buried at its facilities through June 1974, exclusive of classified wastes. In April 1970 ERDA established a policy that transuranic wastes in concentrations exceeding 10 nanocuries per gram be stored above ground and be retrievable. At the five principal facilities, an estimated 36 million cubic feet of wastes have been buried containing 18 million curies. The waste includes approximately 952 kilograms of plutonium, mainly at Idaho and Hanford, about 740 kilograms buried and 212 kilograms stored retrievably.

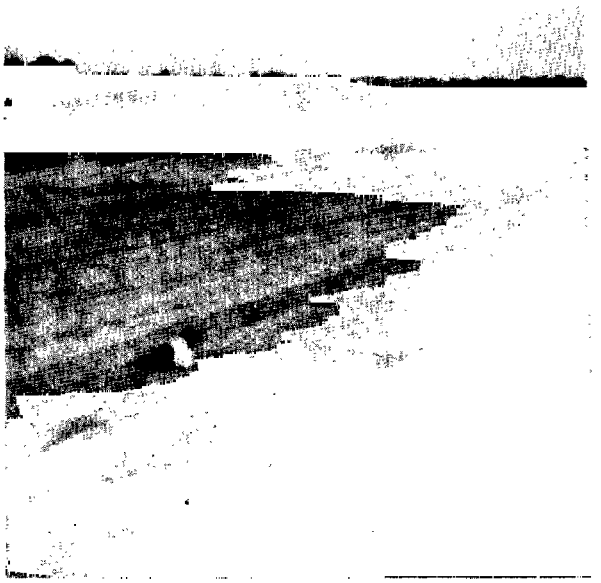
The current annual volume of ERDA-generated waste is about 1.3 million cubic feet. The volume is expected to gradually decrease in the future.

ERDA facilities at Oak Ridge, Los Alamos, Savannah River, Idaho, and Hanford have also used cribs or seepage ponds for disposing of some liquid wastes which contain levels of radioactivity that are unacceptable for release to uncontrolled areas (see figure 2). Through 1974 over 140 billion gallons of liquid waste containing about 5 million curies have been discharged into the ground at Savannah River, Idaho, and Hanford with the intention that the radioactivity would be trapped as it moved through the soil beyond the point of

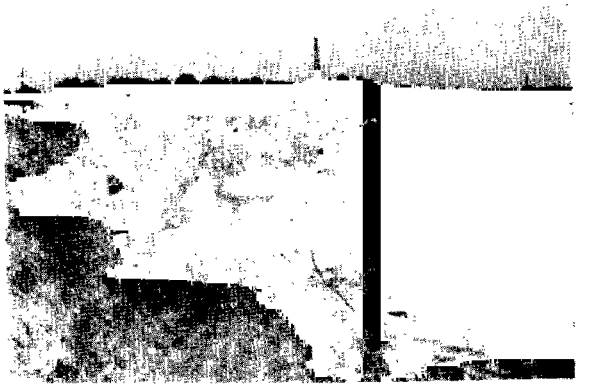
---

1/References are identified in appendix I.

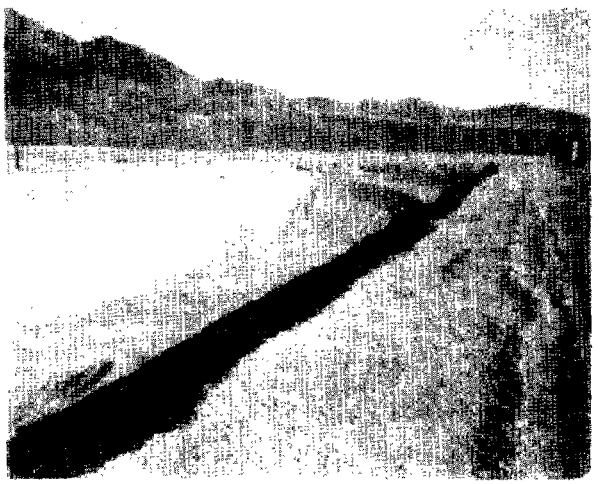
release and that the extent of migration would be limited by removing the driving force of further liquid releases. As soon as technically and economically practical, ERDA plans to discontinue such practices.



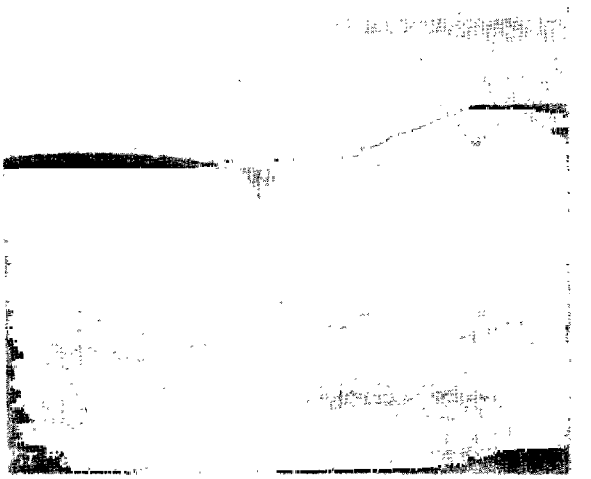
Beatty, Nev.



Maxey Flats, Morehead, Ky.



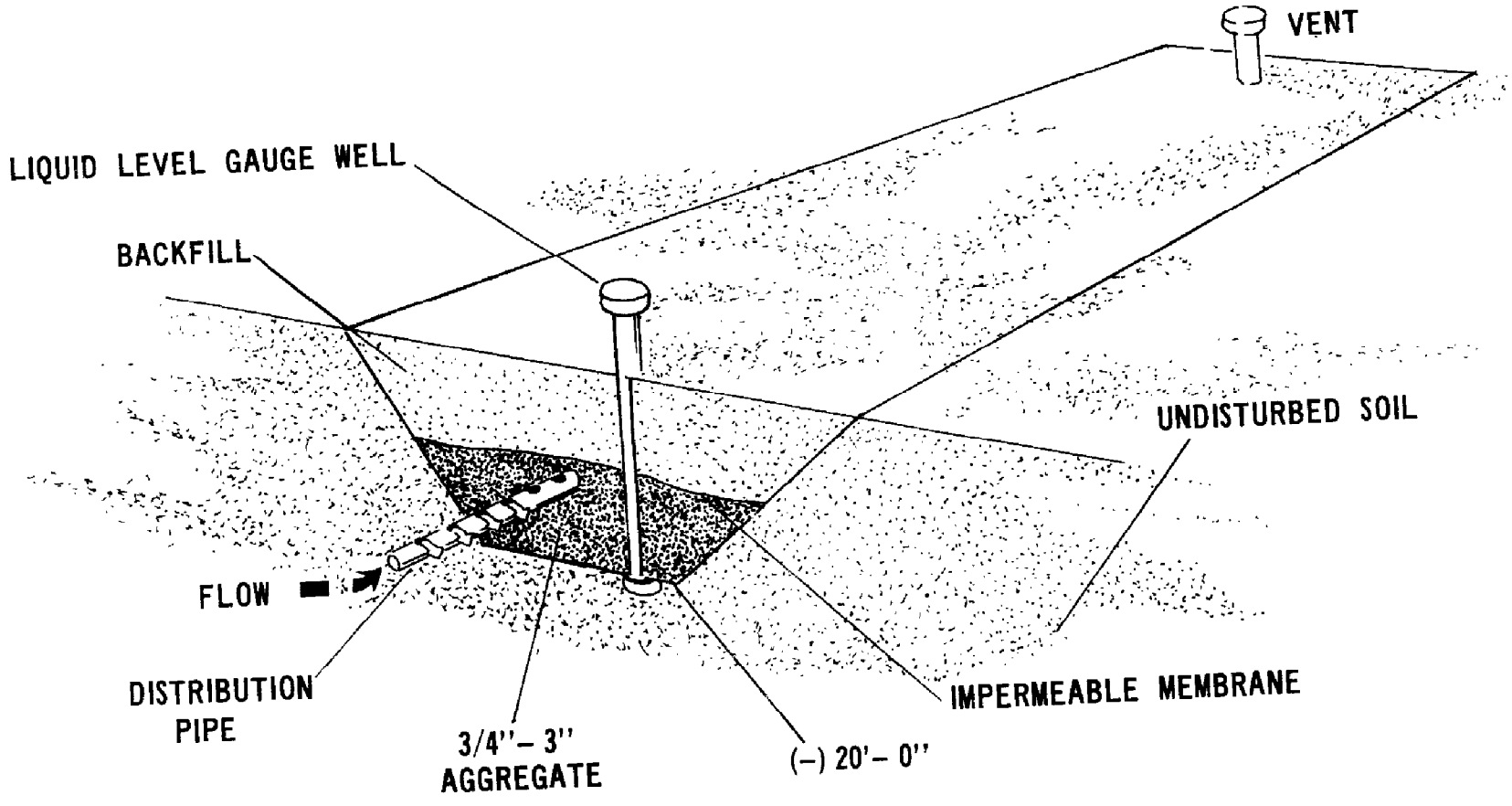
Barnwell, S.C.



Los Alamos, N. Mex.

Typical trenches are about 300 feet long, 30 feet wide, and 20 feet deep.

FIGURE 1. WASTE BURIAL TRENCHES



A crib is a ditch (perhaps over 1,000 feet long) backfilled with rock and covered with soil.

FIGURE 2. ARTIST'S CONCEPTION OF CRIB FOR LIQUID WASTE

CHAPTER 2

DISPOSAL SITE SUITABILITY

Site suitability for radioactive materials disposal depends on its ability to retain such materials and prevent the radioactivity from becoming a public hazard. Properly assessing this ability requires that qualified geologists, geochemists, and hydrologists study and define the site's earth science characteristics (geology, geochemistry, hydrology, soil, water chemistry, and climatology). Such studies may require 2 to 5 years of data before interpretations can be made.

Before disposal sites are selected to receive radioactive material, the earth science characteristics should measure favorably against criteria which describe suitable sites, and the evaluations of the information collected should demonstrate that sites will retain the radioactivity and prevent it from becoming a public hazard. However, our review showed that

--systematic site selection criteria have not been established,

--important earth science characteristics have not been well defined at some existing disposal sites, and

--some disposal sites are releasing radioactivity to the environment.

A comprehensive study of existing disposal sites is needed to provide the basis for developing systematic site selection criteria to determine long-term site suitability of existing sites and to select future disposal sites.

LACK OF SYSTEMATIC SITE SELECTION CRITERIA

The "Environmental Survey of the Uranium Fuel Cycle," published by the regulatory staff of the former Atomic Energy Commission (now NRC), stated that authorization to operate a commercial land disposal facility was based on analyses of data submitted by the applicant "which demonstrate that buried radioactive waste will not migrate from the site."[2] NRC officials said that they could not be absolutely certain that radioactivity would not migrate from a disposal site but that they tried to provide reasonable assurances that radioactivity would not be released.

Such assurances are based on evaluations of data on the topographical, geological, meteorological, and hydrological

characteristics of sites which license applicants are required to provide to NRC.

The characteristics vary greatly at existing disposal sites. For example, the range of certain characteristics at the six commercial disposal sites are presented below.

Characteristics	Range[3]
Climate	Humid to desert
Annual precipitation	2.5 to 46 inches
Burial media	Desert colluvium to fractured claystones and siltstones
Thickness of burial media	50 to 575 feet
Depth to water table	15 to 340 feet

Despite the wide variations in characteristics among the sites, there is no systematic site selection criteria which weighs the mix of characteristics to establish the best disposal locations.

The need for site selection criteria is recognized by ERDA, NRC, EPA, and the U.S. Geological Survey (USGS). In July 1973 Battelle Pacific Northwest Laboratories issued a report to EPA which pointed out that disposal site standards had not been established and recommended standards be developed and used for selecting and licensing disposal sites.[4]

A 1974 USGS report, prepared at the request of EPA, notes that:

> "Potential mechanisms through which critical radioelements in low-level solid wastes may be released from a burial site and introduced into the [environment] * * * are: a) transport of dissolved nuclides by ground waters to wells, gaining streams, or springs; b) transport upward to the soil zone by capillary flow followed by concentration of the nuclides in plants and c) exposure and overland transport by normal erosion processes (water and wind), erosion due to floods, or erosion following disruption of landscapes by earthquakes.
>
> "The suitability of a site for shallow burial of low-level wastes, therefore, depends on the extent that its environs are capable of preventing the occurrence of these release mechanisms."[5]

The USGS report lists several characteristics for evaluating disposal site suitability to prevent these release mechanisms. The characteristics are based on favorable site features proposed in an October 1973 report[6] for disposal sites which contain long-lived radionuclides and which depend mainly on hydrogeologic (rather than engineered) conditions for protection. The characteristics specify that

--the site should be generally devoid of surface water;

--erosion and weathering should not be at a rate which could greatly alter the land surface over the next few hundred years;

--the hydrology must be such that flow from the disposal site does not lead to areas which provide potential pathways to man, such as fractured bedrock, public waterways, and aquifers used for water supply;

--the hydrogeologic conditions must be simple enough for reliable residence time predictions to be made;

--the predicted residence time of radionuclides must be several hundred years;

--the natural water table should be below the disposal site by at least several meters; and

--large water table fluctuations should be unlikely.

According to the study, the characteristics emphasize that accurate predictions of the pattern and rate of radioactivity movement are needed to adequately evaluate disposal site suitability.[7]

Generally, disposal sites have not been selected on the basis of detailed studies and evaluations of the hydrogeological characteristics of a number of prospective sites.

ERDA disposal sites were selected mainly because the land was already federally owned, the disposal sites were convenient to the waste-producing activity, and the disposal sites provided a use for lands of otherwise marginal utility. The studies supporting the establishment of the existing disposal sites at ERDA facilities were brief. For some of the disposal sites established in the 1940s, there were no geological evaluations. Although some ERDA disposal sites have been extensively studied in recent years, additional studies are still needed to determine their suitability.

In establishing commercial disposal sites, consideration was given to (1) the availability of the property, (2) the possibility of the disposal site attracting other segments of the nuclear industry, or (3) the desire to locate the site near potential customers. Sites were studied in varying degrees by license applicants and by licensing agencies. Geologists studied commercial disposal sites before they were licensed, and the geologists' reports were submitted to the licensing agency (NRC or an agreement State) as part of the application. In judging the suitability of proposed sites, the licensing agencies relied on the applicants' information, although some States independently studied proposed sites. NRC and one agreement State requested USGS to review and evaluate applicant-supplied data for proposed sites. The reviews also considered published and unpublished data from USGS files. The USGS geologists were not requested to perform investigations, and resources were not made available to conduct thorough, independent analyses of the proposed sites. USGS officials told us that no information was provided on the specific wastes or radionuclides to be buried, other than that the wastes were solids containing low-level radioactivity. NRC officials told us that no commercial waste burial sites were licensed by the Atomic Energy Commission without a review and favorable response by USGS.

Important characteristics not well defined at existing sites

USGS and EPA scientists believe that earth science information gathered at existing disposal sites has not been sufficient to reasonably demonstrate that highly toxic and long-lived radionuclides will remain isolated from the environment for the long periods of time required.

EPA does not believe that commercial burial grounds were studied sufficiently before being licensed. EPA has stated:

> "We have reviewed the engineering and hydrogeological reports used for the licensing of the existing commercial burial grounds. In our view these were preliminary reports suitable for identifying potentially acceptable burial sites. However, the investigations * * * did not include sufficient detail to, '* * * demonstrate that radioactive wastes will not migrate from the sites.' Additional detailed engineering and hydrogeological studies * * * are necessary to establish that the assumptions made initially were indeed valid and that the wastes will not migrate from the burial sites."[8]

The 1974 USGS report (see ref. 5) on waste disposal in the ground lists 17 areas in which information is needed to predict the direction and rate of radioactivity movement. A list of these areas in order of increasing difficulty and/or cost to obtain is included in appendix II. The report indicates that to obtain the needed information would entail exploration costs of several tens to several hundreds of thousands of dollars, contingent on the complexity of a site's hydrology. Although the report noted that information in all areas would not necessarily be needed on each site, USGS scientists told us that the hydrogeology of some sites may be so complex that it may not be possible to accurately predict the direction and rate of radioactivity migration.

Earth scientists have identified some characteristics at both ERDA and commercial disposal sites about which not enough is known to reasonably predict the migration direction and rate or to determine whether reasonable predictions can be made.

Disposal site	Major information needed
Beatty	Rate of infiltration and direction and rate of ground water movement.
Maxey Flats	Extent and orientation of fractures and direction and rate of ground water movement.
West Valley	Direction and rate of ground water movement with special attention to fracture movement.
Idaho	Extent and orientation of fractures in basalt and rate and direction of infiltration.
Hanford	Rate of infiltration, direction and rate of ground water movement, and connection between shallow and deep aquifers.

USGS officials told us that other information, such as ion exchange capacity of soil and water chemistry, is needed for all sites. A more comprehensive listing of information needed at some disposal sites is included in appendix III.

Migration of radioactivity

Disposal activity at Maxey Flats began in 1963. In 1972 environmental monitoring data showed an increase in radioactivity levels in the offsite environment. In November 1973 the Kentucky Department for Human Resources initiated a special study to identify the source of the increased radiation levels. The study identified radioactivity in the offsite environment, including the following radioisotopes: tritium, cobalt-60, strontium-89 and -90, cesium-134 and -137, and plutonium-238 and -239. A report issued in December 1974 concluded that the disposal site was contributing radioactivity to the environment although not at levels which pose an immediate public health hazard. Because of the activity detected offsite, the report stated that a further study would be conducted and would include a detailed geological and hydrological evaluation of the site.[9]

The State's monitoring of the West Valley disposal site over past years detected small amounts of radioactivity in onsite streams. According to State officials, the activity appeared to be associated with surface contamination due to spills during burial operation and to deposits from stack discharges at the nuclear fuel reprocessing plant next to the disposal site. State officials said the monitoring results showed no clear evidence of underground migration from the burial trenches to adjacent streams. The results of a study initiated in November 1973 indicated that no extensive underground migration had occurred. Early in 1975 water seepage was identified from the surface of three trenches which had accumulated water. In March 1975 the licensee stopped operating the site pending a decision by State regulatory authorities on the operation of the waste burial area. The State and the licensee have agreed on a plan to reduce the water level in the trenches while a plan is developed to prevent water infiltration. The State, with assistance from EPA and USGS, has planned an extensive review of the site. The radioactivity detected at the site was not at levels which pose an immediate public health hazard.

Several burial trenches at the Hollifield facility have intercepted the water table, and the wastes are in contact with water for several months each year. Radioactive materials from these trenches leach into a creek which flows across the facility and into the Clinch River. The radioactivity from the trenches accounted for about half the radioactivity released into the creek. The level of radioactivity measured at the creeks last onsite monitoring station had exceeded maximum permissible concentrations for water. This radioactivity level was diluted to less than 1 percent of such

concentrations at the junction of the creek and the Clinch River. Remedial action to correct the leaching problem was undertaken.

A USGS study at the Idaho facility has detected radioactivity more than 100 feet below the disposal site. ERDA officials questioned the drilling techniques used in the USGS study. Further studies are planned to resolve this issue.

Need for a comprehensive study of existing sites

Disposal sites should be chosen only after proposed sites' characteristics are well defined and measured favorably against criteria for suitable sites. The amount of information necessary may vary from one site to another depending on the complexity of site geology and hydrology, and experts may disagree concerning the scope of study necessary at any particular site. However, USGS and EPA earth scientists said that extensive studies of proposed sites were necessary. These scientists also said that detailed studies of existing disposal sites would provide information needed to properly determine their suitability and to develop standards for evaluating the suitability of future disposal sites.

The Task Force on Radioactive Waste Management of the National Conference of Radiation Control Program Directors has also taken a similar position. The task force, which is supported by EPA and NRC and, for several years, has studied the problems of States in licensing and regulating commercial disposal sites, has made a number of recommendations to the National Conference over the last couple of years. In a 1973 report,[10] the task force recommended that field studies be made at existing disposal sites to determine the extent of or potential for radioactivity migration.

Kentucky and New York have recognized the need for additional detailed hydrogeological studies at Maxey Flats and West Valley, respectively. This recognition stemmed mainly from recent indications that radioactivity was migrating. USGS has negotiated with these States to use existing disposal areas as field laboratories for studying radioactive waste disposal.

The initial study of Maxey Flats and the December 1974 State report recommended a more detailed evaluation of the site, including its hydrogeological characteristics. In May 1975 Kentucky requested financial and technical assistance from USGS, EPA, NRC, and ERDA to carry out the recommended study. The estimated total cost for the study was $1.1 million over a 5-year period. In July 1975 NRC and ERDA notified the State that they could provide technical but not financial assistance. USGS advised the State that it would provide both

technical and financial assistance at a cost of about $350,000 over a 5-year period to study the hydrogeology and geochemistry of the site. EPA, which has funded approximately $165,000 in investigations at the site, is presently negotiating with the State for financial assistance to support the proposed studies at the site.

USGS and New York have negotiated an agreement for a study of the West Valley site similar to the study of the Maxey Flats site. The proposed USGS-funded study will involve field testing by geologists and hydrologists from USGS and New York State Geological Survey. The State has also negotiated a concurrent study with EPA on ground water transport of radioactive pollutants from the buried radioactive wastes. In addition to the studies at Maxey Flats and West Valley, USGS officials told us that they were planning to do studies at Barnwell and at other commercial disposal sites. USGS earth scientists estimated that they would need a year or two to define the hydrogeological system and another 2 or 3 years of monitoring to evaluate the site's behavior since receiving wastes.

NRC asked for $750,000 for fiscal year 1976 to support studies of commercial waste management practices, including burial grounds. In May 1975 NRC officials met with USGS and EPA officials to discuss how they might cooperate on investigating land burial sites.

ERDA contractors will continue to determine the need for special studies of existing or suspected problems for each ERDA disposal site. ERDA has been supporting site studies and evaluations at its five principal disposal sites and plans to support more studies in the future. According to ERDA officials, ERDA funding levels for studies and evaluations of its land disposal sites over a 4-year period (fiscal years 1973 through 1976) have totaled about $2.6 million. Over $1 million of these funds were used to support USGS studies at Los Alamos Scientific Laboratory, Holifield National Laboratory, and Idaho National Engineering Laboratory. In addition, ERDA is supporting a study by the Panel on Land Burial of the Committee on Radioactive Waste Management of the National Academy of Sciences of land burial practices for solid radioactive wastes. ERDA officials told us that the Panel would identify deficiencies and recommend corrective actions. ERDA expects the Panel's report to be ready by the summer of 1976.

Unfavorable hydrogeological characteristics can be overcome and favorable hydrogeological characteristics can be further enhanced by using certain engineering techniques in such operating activities as trench excavation, waste dumping and compaction, and completed-trench management. The techniques are directed at improving the ability of

disposal sites to retain their radioactivity by keeping water from infiltrating the trenches, contacting the buried wastes, and leaching the radioactivity from the trenches. For example, tight compaction reduces the permeability of wastes. Effective compaction can be achieved through only about 3 feet of fill material. However, at some disposal sites, compaction is attempted only after trenches are filled to depths of 30 feet and more. Attempts to compact such fill would have virtually no effect, analagous to placing an inverted saucer over a sponge; that is, a thin hard cover over loose, absorptive material.

CONCLUSIONS

Each of the existing disposal sites has different hydrogeological and other characteristics. Some appear more suitable than others for retaining radioactivity. It is not presently known what mix of hydrogeological characteristics and engineering features offers the greatest assurance that radioactivity, once buried, will not migrate to create a public health hazard and require extraordinary and costly efforts to correct.

Because (1) disposal sites must retain radioactivity for an extremely long time, (2) migration has already been detected at some sites, and (3) USGS and EPA earth scientists have questioned the adequacy of the studies made at some existing sites, a comprehensive study should be undertaken at both ERDA-owned and commercial sites. If the public is willing to accept the risk of land disposal of radioactive materials, it has a right to assurance that radioactivity will be disposed of only at sites which are expected to retain it and prevent it from becoming a public hazard. The public also has a right to expect at least a concensus among earth scientists that disposal sites are suitable.

ERDA and NRC, in conjunction with other Federal and State agencies which have regulatory or program responsibilities for protecting the public from unnecessary exposure to radiation and have expertise in the earth sciences, should develop a coordinated study of disposal sites. The study should be designed, made, and reported by experts in geology and hydrology. The study team should have the independence necessary to make a thorough and objective evaluation. Such a study should:

--Determine how effective sites have been in retaining wastes.

--Identify existing or emerging problem areas so that effective corrective actions can be planned.

--Provide the knowledge of site's hydrogeological systems needed to identify their waste retention capabilities and possible migratory pathways.

The results of such a study could serve as the bases for developing site selection criteria for determining the long-term suitability of existing sites and for selecting future sites.

RECOMMENDATIONS TO THE CHAIRMAN, NRC, AND TO THE ADMINISTRATOR, ERDA

NRC and ERDA jointly should:

--Enlist the cooperation of other Federal and State agencies with regulatory or program responsibilities and expertise and sponsor a comprehensive study of existing commercial and ERDA disposal sites to better evaluate their ability to retain radioactive waste.

--Use the results of the comprehensive study to develop site selection criteria for determining the long-term suitability of existing disposal sites and for selecting future sites.

AGENCY COMMENTS AND OUR EVALUATION

NRC and ERDA agreed with our conclusions and with the intent of our recommendations. However, both ERDA and NRC officials questioned the appropriateness of joint sponsorship of a study of existing ERDA and commercial disposal sites because of their separate missions. NRC recommended the establishment of a committee of experts in relevant technical areas to advise and guide a joint NRC and State study of commercial waste disposal sites and a separate ERDA study of its sites. NRC's proposal is an acceptable alternative approach to a joint comprehensive study if the study objectives stated in the conclusions above can be met.

On the second recommendation, NRC officials stated that site selection criteria could be established now should an urgent need exist but that research appears to be needed to provide better quantitative indices for several criteria, such as permeability of soils and geological formations and ion exchange capacity of soils.

CHAPTER 3

IMPROVEMENTS NEEDED IN PROGRAM MANAGEMENT AND REGULATORY EFFORTS

Since NRC, the States, and ERDA are responsible for insuring that individual nuclear facilities under their control do not release unnecessary radiation to the environment, effective program management and regulatory efforts are essential. Agencies with regulatory and program management responsibilities have opportunites to provide greater assurance that disposal site operators will be better able to control site activities by:

--Establishing radiation detection standards for determining when migration at disposal sites reaches unacceptable levels and corrective actions are needed.

--Improving monitoring programs.

--Improving other regulatory practices.

NEED FOR DISPOSAL SITE RADIATION STANDARDS

Standards have not been developed for determining when radioactivity migration at disposal sites reaches unacceptable levels and corrective actions are needed. EPA is responsible for issuing generally applicable standards for the protection of the environment from all sources of radiation, including standards for the total amount of radioactivity that can be released from all facilities in the nuclear fuel cycle. However, NRC and ERDA are primarily responsible for developing, implementing, and enforcing radiation standards for individual nuclear facilities.

Radiation standards for air and water do exist but they are meant to apply to nuclear activities where release levels to the environment can be controlled by modifying the level of nuclear activity. These standards permit the averaging of samples taken over a period of time in computing the release concentrations. Averaging fails to recognize that radioactive material can migrate periodically, and at disposal sites a single sample can indicate that followup action is needed to determine whether an unsatisfactory condition exists.

Agreement State officials and disposal site operators told us that they applied the maximum permissible concentration of radioactivity in air and water as set out in the

Code of Federal Regulations (appendix B of 10 C.F.R. 20). The concentrations are similar to the recommended concentration guides established by ERDA for its facilities.

In November 1974 discussions with Atomic Energy Commission regulatory officials, we questioned whether it was appropriate to apply standards meant for controlled facilities to disposal sites. We also questioned the practices of averaging of samples to evaluate the release concentrations from disposal sites.

These officials said that applying these standards at the disposal sites was not appropriate, but they pointed out that comparing readings against the maximum permissible concentrations does provide some valuable health and safety information on radioactivity in the disposal site vicinity.

In a January 1975 letter to NRC, a Kentucky official asked for NRC's advice on applying the maximum permissible concentrations to disposal sites. He stated:

> "* * * [r]egulatory agencies have applied the * * * Maximum Permissible Concentrations (MPC's) * * * for determining the potential hazard to the public health of persons in the environment surrounding the radioactive waste disposal facilities.
>
> "* * * in light of the as 'low as practicable' concept*, we currently question the applications of MPC's in determining acceptable releases of radioactivity to the environment from such disposal sites * * *.
>
> "This Agency is evaluating the applicability of standards to meet the 'as low as practicable' concept for the release of radioactive material from the waste disposal facility located in Kentucky. Since the application of any standard may have impact nationally, we request that your Agency review the 'as low as practicable' concept as applied to the release of radioactive material from shallow land burial sites, and advise us of your recommendations."[11]

---

*Concept guiding nuclear activities that, given the unknown health impact of long-term exposures to low-level radiation, all radiation releases to the environment should be as low as practicable considering the technology and economics involved.

In February 1975 an NRC official responded that:

> "* * * the MPC values should not be used as detection levels or action levels in determining whether migrating radioactivity is acceptable or unacceptable, or whether or not corrective action should be instituted. The MPC values are only useful in assessing the radiation safety and public health aspects of the released radioactivity, and thus the urgency in taking corrective action. Also we do not believe the [as low as practicable] concept is applicable here either. What appears to be needed is the establishment of action levels, which if exceeded would result in specified measures being taken, e.g. more intensified monitoring, corrective action, etc. However, once it has been determined that radioactive material is migrating from a burial site, we believe a benefit-risk concept should be applied in evaluating the various alternative corrective actions that might be taken to minimize such migration."[12]

NRC officials told us that any unexpected concentrations of radioactivity should be studied to determine the source and whether a health hazard exists. An NRC official said that radioactivity levels in samples should be compared with the natural background radiation* levels and, if much higher, the radionuclides involved should be identified and the possibility of a public health hazard should be assessed. He also said that such determinations should be made on individual measurements rather than on the average of radioactivity measurements over a year's time.

Conclusions

Standards should be developed for disposal sites which provide clear criteria as to when radioactivity migration reaches an unacceptable level and corrective actions are needed. Once developed, the standards should be made universally applicable to disposal sites.

Recommendations to the Chairman, NRC, and the Administrator, ERDA

We recommend that the Administrator, ERDA, and the Chairman, NRC, jointly develop radiation detection standards

---

*Radiation which is naturally occurring; that is, contained in soils and so on in the area.

for disposal sites and issue such standards for universal application.

Agency comments

NRC and ERDA agreed with this recommendation. ERDA officials said that the ability to monitor around land burial sites with assurance that migration of significance from a health and safety standpoint will be properly detected and measured is not adequate at this time. ERDA officials believe that the approach suggested by the NRC official quoted above is a good one.

EFFECTIVENESS OF MONITORING PROGRAMS SHOULD BE EVALUATED

Radiation monitoring programs are designed to (1) evaluate the effectiveness of a nuclear facility's effluent release program,* (2) identify the ultimate disposition of radioactivity released to the environment, including its pathways to man, and (3) compute radiation exposures to people. Such a disposal site program must also be designed to detect the migration of radioactivity, not as a way of verifying a controlled release program but as an early warning device for identifying the movement of radioactivity away from the trenches in which it was placed.

Specific features of monitoring programs, such as sample locations, types, methods and frequency, and analyses, are designed and implemented by each licensee and contractor subject to review and approval by the regulatory or program agency involved. Some of the areas monitored by licensees at their disposal sites are summarized in the following table.

The sample analyses vary but generally include gross radioactivity (alpha, beta, gamma) and some specific radionuclides, such as tritium.

The effectiveness of a monitoring system largely depends on the knowledge of a site's geology and hydrology. Insufficient information on important earth science characteristics could result in an ineffective monitoring system because radioactivity may bypass it, avoiding detection while migrating from the disposal site and affecting the environment.

---

*Gaseous and low-level liquid radioactive wastes deliberately discharged on a controlled basis by nuclear facilities.

Disposal site	Water	Air	Vegetation	Soil	Other
Barnwell	10 onsite wells, semiannually; offsite water supplies, annually.	Offsite, continuous.	Offsite, annually.	Offsite, weekly.	Offsite, animals, annually.
Beatty	1 onsite well, monthly; offsite wells, monthly.	Continuous.	Offsite, quarterly.	Offsite, quarterly.	None
Maxey Flats	8 onsite wells, monthly; offsite water samples, quarterly.	Continuous.	4 samples onsite, 4 offsite, quarterly.	4 samples onsite, 4 offsite, quarterly.	None
Richland	3 onsite wells, quarterly; offsite surface water, semiannually.	Continuous.	Onsite, quarterly.	Onsite, quarterly.	None
Sheffield	8 onsite wells, quarterly; offsite surface water, quarterly.	Continuous.	Offsite, quarterly.	Offsite, quarterly.	None
West Valley	2 onsite streams, quarterly; offsite surface water, weekly.	Offsite, continuous.	Offsite, annually.	Offsite, quarterly.	Offsite, animals and fish, semiannually; milk, weekly.

Disposal site sampling results, in most instances, have not indicated increased radioactivity in the environment. In those instances in which migration has been suspected, the monitoring systems were not comprehensive enough to indicate the extent of migration without special studies. Because of insufficient information about their sites' hydrology and geology, licensees and contractors have little assurance that sampling points are properly placed in relation to possible paths of migration. For example:

--Los Alamos Scientific Laboratory officials said an effort was underway to develop geological information to help identify paths of most likely migration for radioactivity and a monitoring network would be developed to concentrate on these pathways.

--USGS officials believe that present monitoring wells at ERDA's Idaho National Engineering Laboratory disposal site may be missing migratory routes because of the unknown extent of subsurface fractures and joints.

At the Sheffield disposal site, NRC inspectors recently noted:

"The licensee utilizes geological test bores as monitoring wells; these locations are not necessarily optimally placed for monitoring migration of buried material. Nor did the licensee have available information defining the types and depths of casings used in these wells. Although surface water run off appears * * * to move northeast, southeast, west (and possibly northwest) from the burial site, the licensee samples only the northeast and southeast locations."[13]

NRC's Director of Inspection and Enforcement has recognized that the validity of sampling results depends on monitoring programs which have been designed on the basis of extensive knowledge of sites' geology and hydrology.

On November 20, 1974, the Director of Regulation directed that a special inspection of five commercial disposal sites be made on a priority basis because Kentucky was about to make public a report on radioactivity migration at the Maxey Flats disposal site.

The inspections were made in an extremely short time and completed by the end of November 1974. The inspectors visited the licensed sites and made a routine inspection, interviewing licensee employees, reviewing records, and touring the facility. The inspectors collected samples from some of the onsite sampling points at each site--seven at

Sheffield, five each at Barnwell and West Valley, three at Beatty, and two at Hanford. Samples from onsite monitoring wells were taken by licensee personnel under the inspectors' supervision and were analyzed by the Atomic Energy Commission Health Services Laboratory in Idaho.

In January 1975 the Director of Regulatory Operations (now Director of Inspection and Enforcement) reported to the Director of Regulation that "there was no evidence of any significant transport of radioactive materials through migration." This conclusion was based on the sample analyses plus the licensees' monitoring data. In all cases the inspections depended on the licensees' monitoring network which may not have been properly placed. In this regard, the Director of Inspection and Enforcement noted that:

> "The location of the test wells for measuring migration are critical and there is no satisfactory means of determining that a suitable placement has been accomplished. Test wells placed close to the trenches can be bypassed by trench leakage, whereas wells too far away may not detect migration until it is significant. In addition, the depth of the test well is crucial since the possible migration elevation is not normally known. However, even if activity is detected in the test wells, this may, in many cases, be due to surface runoff into the well rather than lateral migration. Therefore, in order to make a more conclusive determination of migration of radioactive materials from the burial trenches, detailed studies on soil conditions, geological structure, underground water movement and meteorology, etc., would be required. Such studies are well beyond the scope of routine monitoring programs."[14] (Underscoring added.)

Conclusions

Comprehensively determining disposal site suitability involves an extensive study of the geology and hydrology of existing disposal sites. More complete information of sites' geohydrological systems could provide the bases for designing more effective monitoring systems to detect migration.

Recommendation to the Chairman, NRC, and the Administrator, ERDA

We recommend that the Administrator, ERDA, and the Chairman, NRC, direct their staffs, as part of the comprehensive study previously recommended, to evaluate the effectiveness of monitoring programs at existing disposal sites and to redesign them as necessary. Redesign work should be done

in conjunction with agreement States for disposal sites regulated by such States.

Agency comments

NRC and ERDA agreed with this recommendation. NRC agreed that the environmental monitoring programs at certain burial sites needed improvement. NRC officials said that monitoring programs not only should be directed at early detection of radioactivity migration but also should monitor the pathways of exposure to man.

ERDA officials noted that a substantial effort has been underway for several years to evaluate the effectiveness of monitoring programs at ERDA land burial sites.

OPPORTUNITIES TO IMPROVE REGULATION OF DISPOSAL SITES

There are other regulatory problems regarding disposal sites, specifically

--slow progress in getting an agreement State licensee to implement effective corrective action,

--a lack of timely and effective licensing actions,

--a need to coordinate independent monitoring programs, and

--a need to study ways to improve recordkeeping practices at disposal sites.

Slow progress in implementing effective corrective actions

Kentucky has been slow in getting the licensee to take effective corrective action on the problem of water in the burial trenches at the Maxey Flats disposal site.

Before the Maxey Flats site was licensed in 1963, the geologist who made the geohydrological evaluation warned that water may accumulate in the trenches. He recommended measures to help prevent this and suggested that actions would be necessary to remove the water.

A 1972 order to the licensee summarized some of the violations resulting from past State inspections, a number of them related to the management of the water problem:

--Water accumulated in completed trenches.

--Proper sump pump pipes for sampling and removing water from completed trenches not provided.

--Improper use of holding pits for contaminated water pumped from completed trenches.

--Contaminated water disposed of improperly.

The licensee told the State he would correct the cited violations, including those related to the water problem. Inspections in March and October 1973 showed that the licensee had made progress but noted additional violations which the licensee promised to correct. In September 1974 a State inspection showed that violations continued, including some which related to the management of the water problem:

--Large amounts of contaminated water found in the tank farm and in a trench.

--Backfilling of a working trench not done.

--No relief valves for tanks used to store contaminated water from trenches.

Early in 1975 the State, as a result of its radioactivity migration study, amended the disposal site license to require improved operating procedures, burial containment, and environmental monitoring by the licensee. On April 30, 1975, the State requested NRC to independently assess the disposal site, and, in its July 1975 report to the State, NRC made several recommendations for improving the management of the water problem at the site.

The licensee told us in early December 1975 that all but 1 of 42 trenches at the site have been pumped, 14 are still yielding small amounts of water, and 27 are now dry in accordance with license requirements.

Lack of timely and effective licensing actions

Disposal site licenses are issued for 5 years and are renewable. By regulation if a licensee applied for a license renewal at least 30 days before the present license expired, it was automatically extended while the renewal application was processed.

In 1968 the licenses for Sheffield, Beatty, and Richland expired. The licensees had submitted their license renewals according to regulations. In March 1975 NRC still had not reviewed nor approved license renewals for any of the sites.

An official of the Nevada agreement State agency told us that it was difficult to properly inspect the operation at Beatty because of the outdated license and numerous old amendments. When Nevada became an agreement State in 1972, it took over and applied the existing source and byproduct materials license which was then 4 years overdue for renewal. When Nevada assumed regulatory responsibility, it did not require the licensee to update the license. A Nevada official told us that the licensee had submitted a complete license renewal application and it was anticipated that Nevada would issue the source and byproduct material license before the end of 1975. The official was uncertain whether NRC had acted to approve the licensee's latest revision of its "Radiation Safety Manual" which the licensee had submitted for NRC's review and approval in 1972. An NRC inspector told us that the outdated license presented problems during site inspections because he did not have current criteria to use when inspecting the site.

By delaying license renewals, NRC has missed an opportunity to establish a more effective regulatory program for evaluating and strengthening licensing conditions. For example, the special inspection of Sheffield caused the inspector to note that:

> "* * * The monitoring program can be faulted for a lack of rigor (i.e., location of monitoring points, development of a basis for judging anomalous results, types of analyses performed, program proceduralization, etc.). The program requirements appear to be quite loosely defined. The licensee did not possess comprehensive procedures defining conduct of the environmental monitoring program. The fragmentary procedures that were available were neither current nor were they rigorously followed.
>
> "The [NRC] license requires: (1) water, soil, and vegetation monitoring, but does not specify locations or numbers of samples required; and (2) evaluation of increases detected during the monitoring program, but does not specify how to determine if a particular result has increased over preoperational results (this evaluation is particularly difficult since only one preoperational sample was collected from each individual sample point)."[15]

Since the renewal applications were submitted, NRC has established a new requirement for an environmental assessment. The requirement, effective in August 1974, calls for a review and evaluation of the environmental impact of licensed nuclear activities, including commercial disposal sites. If the review and evaluation show that an environmental impact

statement should be prepared, a notice of intent will be published and both draft and final environmental statements will be prepared. A decision not to prepare an environmental impact statement must be justified and be made available to the public.[16]

We discussed the delays with an NRC licensing official who told us that license renewal was being delayed pending a decision on whether transuranic waste disposal would continue to be permitted at commercial disposal sites.

In September 1974 the Atomic Energy Commission published a proposed regulation which would ban transuranic waste disposal at commercial disposal sites. The regulation, if made effective, would automatically revise existing licenses to revoke any authority licensees have for disposing of transuranic wastes.[17] As of December 1975, the regulation had not been made effective.

Independent monitoring programs should be coordinated

In carrying out their inspections, NRC inspectors do not routinely do independent sampling but rather review licensees' sampling results. Of the six States with commercial disposal sites, South Carolina, Kentucky, New York, and Illinois conduct independent monitoring programs. For example, Illinois makes quarterly visits to the Sheffield site to observe operations and to take water samples from various sample points both onsite and offsite. The State laboratory analyzes these samples.

Nevada and Washington do not have monitoring programs for the commercial disposal areas in their States. However, Washington did independent radiation sampling during its May 1974 inspection of the Richland site and plans to initiate a routine monitoring program in 1975. In Nevada EPA's National Environmental Research Center in Las Vegas samples the Beatty onsite well semiannually as part of an extensive environmental sampling program around the Nevada test site.

The State and EPA results from monitoring commercial disposal sites are not routinely requested by NRC. For example, a few samples in the Illinois monitoring program for the Sheffield disposal site over a period of years had radiation concentrations above the maximum permissible concentrations for water. A State official told us that the radiation readings exceeding the maximum permissible concentrations were analyzed and that State public health officials concluded that no offsite samples had ever indicated radioactivity migration from the site. He also noted that

sample results obtained since July 1974 are more definitive and reliable than previous results due to improved equipment and techniques. NRC was not aware of this situation, because it did not request that the results from the State's monitoring program be routinely reported.

An NRC official told us that he received some monitoring results from a few States but only because of his personal efforts or the initiative of the States and not because of deliberate NRC policy.

Need for improved records at disposal sites

Radioisotopes have different half-lives and different levels of toxicity. The isotopic identity of radioactive wastes must be known to predict their hazardous life and expected impact on a site's hydrogeologic environment. In addition, the waste form and chemical composition should be known because of their possible effects on a site's retention capability by changing such characteristics as soil pH,* temperature, or ion exchange properties.

Disposal site operators rely on package labels or shipping documents to maintain records of wastes buried. Wastes are packaged and labeled at the place where they are produced. Disposal site operators usually do not open waste packages to avoid exposing workers to radiation. Many wastes' package labels or shipping documents and disposal records contain only general information on the form, composition, or isotopic content of the waste. NRC officials told us that disposal records at commercial sites identify large portions of the wastes as mixed-fission products or activation products, source material, and special nuclear material (amounts of plutonium and uranium-235).

Kentucky attempted to determine the current inventory of specific radionuclides at the Maxey Flats site and found that a large amount of byproduct material was identified as mixed-fission products. Inventories of two trenches were compiled from shipping records, and 43.2 and 48 percent of the byproduct material activity was accounted for as mixed-fission products. Because the specific radionuclides were not identified, it was not possible to properly assess the long-term hazard potential of much of the wastes buried at the site. Recommendations from the study, among other things, included that:

---

*A relative measure of acidity and alkalinity.

--Burial records should be on a form that can be handled by computers.

--Commercial burial sites should adopt a uniform format for waste disposal.

--Waste disposal data should identify the specific radionuclides, the chemical form, and the most toxic material in waste.[18]

Some ERDA facilities now use an automatic data processing form for recording burials and maintaining disposal records. However, ERDA officials have told us that records before 1971 were not reliable. Some burials at ERDA facilities have not been recorded, and the exact locations of some burial grounds at Hanford are not known. Also, the records for burial ground number 4 at the Holifield National Laboratory were destroyed in a fire.

EPA officials told us that they were developing, in cooperation with the Kentucky Department for Human Resources, a computerized inventory system of materials buried at the Maxey Flats site. When the implementation of the system is completed at the Kentucky site, EPA intends to make the system available to other States.

Conclusions

There are selected opportunities to improve the regulation of certain disposal sites through more timely and effective licensing, inspection, and program management efforts.

Kentucky has been slow to correct the trench water problem at a commercial disposal site, despite having worked on it for a number of years. Under the agreement State program, NRC should monitor the actions currently being taken by the State to correct the problem and should insure that the trench water problem is corrected.

Considering the delays experienced to date and the impact of those delays on the inspection program, NRC needs to initiate administrative action to process applications for commercial disposal site license renewals. Considering the problems and uncertainties of disposal sites, NRC will need to evaluate the environmental impacts before renewing disposal site licenses.

Independent sampling at about the same time that licensees sample could help NRC verify licensees' monitoring program results. Independent sampling in the intervals between

licensees' sampling would provide for more monitoring continuity and greater opportunity for detecting migration. NRC should arrange for the systematic exchange of monitoring results among the Federal and State agencies regulating or independently monitoring commercial disposal sites. Where NRC considers independent monitoring for disposal sites it regulates to be inadequate, NRC should establish an adequate independent environmental monitoring program.

ERDA and NRC should consider ways to improve recordkeeping practices at commercial and Government-owned burial sites. The two agencies should consider adopting a uniform classification system which could also be adopted by the agreement States. A standardized format for data collection should include, to the extent practicable, identifying specific radionuclides and their chemical form. This data could be used to maintain inventories of activity at burial sites and be a basis for predicting the hazardous life of the material at a site. The data could also be used in planning for the type of long-term monitoring and the length of time monitoring would be needed at the site.

Recommendations to the Chairman, NRC, and to the Administrator, ERDA

We recommend that the Chairman, NRC, direct the NRC staff to:

--Monitor the actions being taken by Kentucky and insure that the trench water problem at the Maxey Flats disposal site is corrected.

--Take the necessary administrative actions to determine whether disposal site licenses should be renewed.

--Arrange for the systematic exchange of monitoring results among the Federal and State agencies regulating or independently monitoring commercial disposal sites.

--Establish independent monitoring programs for NRC-licensed disposal sites where there are no such programs or where existing monitoring programs are inadequate.

We recommend that the Administrator, ERDA, and the Chairman, NRC, direct their staffs to study ways to improve recordkeeping practices at commercial and Government-owned disposal sites.

Agency comments

ERDA concurred in the recommendation directed to it. NRC concurred with the recommendations for the systematic exchange of monitoring results and for studying ways to improve recordkeeping practices. NRC noted that it had sole regulatory responsibility for only the Sheffield site and that the necessary administrative actions for renewing its license had been taken. NRC also agreed that some form of independent monitoring program or method of assessing the quality of existing monitoring programs should be established.

In our proposed report we suggested that NRC cooperatively develop and implement with Kentucky a program for correcting the trench water problem at Maxey Flats. In its comments NRC noted that it had conducted an independent review and made recommendations for improving operations at the site and that the State was responsible for correcting deficiencies in the operation of the site.

CHAPTER 4

LONG-TERM CARE OF DISPOSAL SITES

Monitoring and maintaining disposal sites will be required for many centuries because of the long-lived, highly toxic radionuclides disposed of at the sites. Therefore, it is important that long-term-care requirements are identified and adequately funded before terminating and decommissioning the sites. NRC and several agreement States have not established long-term-care requirements for commercial disposal sites and determined the adequacy of long-term-care funds to meet such requirements.

NRC and ERDA are responsible for regulating and developing the nuclear industry, respectively. Neither agency has a program under which the States can be aided in taking corrective actions at disposal sites.

NEED TO ESTABLISH LONG-TERM-CARE REQUIREMENTS AND FUNDING ARRANGEMENTS

Regulations require commercial disposal sites to be on land owned by the Federal or a State government. When the operations at a commercial site are completed, the facility decommissioned, and the license terminated, the State government will assume responsiblity for long-term care of the site.

NRC officials told us that they were interested only in seeing that a public agency was identified for long-term-care responsiblity and not in financing arrangements. They said that NRC licensed Beatty, Richland, and Sheffield after the States accepted responsibility for long-term care and maintenance of the sites.

Five agreement States (Kentucky, Nevada, New York, Washington, and South Carolina) require the disposal site operator to contribute to a fund to cover the cost of long-term care. Illinois, which is not an agreement State, requires the Sheffield disposal site operator to contribute to such a fund since the disposal site is on State land. The commercial site at Richland is on a Federal reservation, but Washington is responsible for long-term care of the disposal site.

South Carolina has attempted to define what long-term care will require and to establish burial payments in line with such requirements. The South Carolina Department of Health and Environmental Control recently received a report on a special study it commissioned concerning the funding arrangements for meeting the State's obligation relative to

maintenance, surveillance, and contingency costs associated with the Barnwell site. The two major factors that the study considered were (1) the charge per cubic foot for adequate long-term care and (2) the funding arrangements needed to protect the State if the licensee ceased operations before the planned decommissioning date.[19]

South Carolina currently receives 8 cents for each cubic foot of waste buried. As of January 1975, the State had a balance of $118,283 in an interest-earning account. In addition, the licensee maintains a $20,000 performance bond. The study concluded that (1) the required size of the perpetual care fund as of January 1975 should have been $1,643,550 to generate sufficient income to pay for the annual routine surveillance and maintenance costs, (2) $130,000 should be added to the fund each year for contingencies, and (3) $2,583,400 would be required by 1995 to adequately maintain the site. In 1995--the estimated date the site would reach capacity-the fund will have $1,211,971 at the current charge of 8 cents a cubic foot. This would leave a shortage of $1,371,429. The study recommended an increase of 6 cents a cubic foot, or a total fee of 14 cents for each cubic foot of waste buried. The study also recommended that the licensee execute a $1,621,172 performance bond to protect the taxpayers of South Carolina from being required to bear the cost of long-term care for the site should the licensee cease operation before the planned decommissioning date. The bond would have a declining balance as the long-term-care fund increases and would insure the State adequate funds to maintain the site.[20]

Illinois receives 5 cents for each cubic foot of waste buried at the Sheffield site. In addition, a fee of $50 is levied on the licensee annually. These fees, which total about $85,000, are placed in the Illinois general fund. The funds do not earn interest, and an act of legislation would be necessary to release them. A State official said that, should the need arise for extensive corrective actions, the amount would not be adequate and the State would have to provide supplemental funds.

Kentucky receives 4 percent of the licensee's customer charge for each cubic foot of waste buried. The licensee's current charge is $1.25 for each cubic foot. These fees are placed in an escrow fund administered by the Kentucky Science and Technology Commission. The fund, which earns interest, had a balance of $113,476 through August 1974. Fees, however, have not been collected since 1972 because of possible renegotiation of the burial fee percentage which the State receives. State officials believe the current State fee is to small an amount for long-term care.

Nevada receives 7 cents for each cubic foot of waste buried. As of November 1974, the State had accumulated over $170,000 of these burial fees. The February 1962 lease between the State and the licensee says that the licensee will attempt to obtain a $250,000 performance bond. As of November 1974, the licensee had not obtained a bond; however, a State official told us that instead of the performance bond the licensee had been prepaying the burial fee for each million cubic feet of waste, so the State was receiving some funds ahead of the rate of wastes buried.

At West Valley the operator is required to contribute to a State-maintained long-term-care fund on the basis of the volume of waste buried. A State official told us that the State attempted to define long-term-care requirements and to establish related payments. Initially the State received 8 cents for each cubic foot of waste buried. The rate has been periodically increased over the years, and the current charge is 15 cents a cubic foot. By March 1975 the amount in the long-term-care fund was approximately $190,000, including accumulated interest. State officials told us that these funds were part of a long-term-care fund totaling about $2.6 million which was intended to cover both the disposal site and the high-level wastes stored at the nuclear fuel reprocessing plant next to the disposal site.

Washington receives 5 cents for each cubic foot of waste buried at the Richland site. As of October 1975, the State had about $22,000 in an interest-earning account. The State is currently renegotiating this burial fee.

NEED FOR FEDERAL POLICY ON TAKING CORRECTIVE ACTIONS

What will happen if the previously recommended comprehensive study of existing disposal sites shows that extensive corrective actions are necessary at commercial disposal sites? Existing long-term-care arrangements do not provide for financing such actions. If corrective actions are needed, experience at two ERDA facilities shows that the cost of such actions can be considerable, particularly if exhumation of transuranics is required.

At the Idaho National Engineering Laboratory, ERDA is undertaking an extensive program to retrieve buried transuranic wastes from a 22-acre section of a disposal site. This program is being undertaken to lessen the long-term surveillance and maintenance requirements for the site. ERDA estimates funding through fiscal year 1976 at $935,000 to identify retrieval problems and to plan an operational pilot project for 1981. The 1981 operational pilot project costs are

estimated at $41 to $51 million for 3 years, with a subsequent full-scale estimated project cost of $130 to $180 million for 15 years.

At the Holifield National Laboratory, a current study at one burial ground showed that water was seeping from the trenches and carrying small amounts of radioactivity offsite. Preliminary studies show a potentially similar problem at another burial ground. The estimated cost for evaluating and correcting the relatively minor migration problems at these burial grounds is $600,000.

The responsibility for taking corrective action at commercial disposal sites would rest primarily with the site operator and the owner of the land (usually the State). However, it is reasonable to expect that the Federal Government will be asked to provide technical and financial assistance. The Federal Government made the decision to develop commercial uses for atomic energy. These commercial uses are generating a large part of the nuclear waste that is being disposed of at commercial burial grounds. The Federal Government encouraged the nuclear industry to establish and operate these waste disposal programs and initially licensed many of the disposal sites. Therefore, the Federal Government could expect to be asked to provide financial and technical assistance in identifying and correcting radioactivity migration at commercial disposal sites. Federal agencies have already been asked to help in assessing whether such hazards exist. Kentucky has recently asked for assistance from four Federal agencies to assess the current situation at Maxey Flats. Each agency considered the State's request in terms of its own programs and their priorities. As previously noted, ERDA and NRC have decided they can provide technical but not financial assistance. USGS has decided it will provide both technical and financial assistance, and EPA is currently negotiating with Kentucky on this matter.

There are precedents for Federal assistance to States in evaluating and in correcting radiation problems in the commercial nuclear industry. In one case a remedial action program to identify and correct the radiation hazards from uranium mill tailings in the Grand Junction, Colorado, area was specifically authorized by the Congress (title II of Public Law 92-314, June 16, 1972). In other cases, including the correction of radiation hazards at a commercial facility abandoned by a bankrupt licensee in Tennessee, ERDA has diverted resources from other programs to cover relatively minor assistance costs.

Currently, the Federal Government has no policy nor program for systematically taking corrective action at disposal

sites regardless of which agencies have regulatory or program responsibilities.

CONCLUSIONS

The cost of nuclear power and other nuclear activities should be borne by those that directly benefit from such activities. Therefore, adequate financing arrangements should be established for the long-term care of commercial disposal sites. Currently, the States are following different approaches to meeting long-term-care requirements which, in some cases, do not appear to adequately cover needs. NRC, in cooperation with agreement States, should establish long-term-care requirements for commercial disposal sites to provide a basis for establishing adequate funding to support such requirements and should require that such funding be established.

Because of the Federal Government's involvement with regulating and promoting the nuclear industry, a policy is needed to determine the need to establish a specific program providing Federal financial and technical assistance for taking corrective actions at commercial disposal sites. Such a policy should recognize the limitations on available Federal resources and the need to apply such resources to the most serious problems first without regard to which agencies have regulatory or program responsibilities. The relative seriousness of problems at existing ERDA and commercial disposal sites can be determined from the results of the previously recommended comprehensive study.

RECOMMENDATIONS TO THE CHAIRMAN, NRC, AND THE ADMINISTRATOR, ERDA

We recommend that the Chairman, NRC, direct his staff to establish, in cooperation with agreement States, long-term-care requirements for commercial disposal sites and require that adequate funding be established to support such requirements.

We also recommend that the Chairman, NRC, and the Administrator, ERDA, develop a policy on Federal involvement in correcting migration problems at commercial disposal sites.

AGENCY COMMENTS

NRC agreed that it should work with the agreement States in developing criteria for long-term care and maintenance of the commercial wastes burial sites. NRC officials said that long-term care and maintenance criteria must be site specific since requirements for each site will be different.

Both NRC and ERDA agree that a policy needs to be developed on Federal involvement in correcting migration problems at commercial burial sites. NRC officials said that funding corrective action taken in the agreement States would probably require additional statutory authority since NRC's authority under the Atomic Energy Act to provide such funding is unclear. ERDA officials said that the four Federal agencies considering Kentucky's request for assistance agree that a Federal position should be established, and it is anticipated that the Federal agencies will meet with Kentucky officials within the next few months.

CHAPTER 5

SCOPE OF REVIEW

We made our review at

--ERDA headquarters, Germantown, Maryland;

--ERDA operations offices at Oak Ridge, Tennessee; Albuquerque, New Mexico; and Idaho Falls, Idaho;

--ERDA's Holifield National Laboratory, Los Alamos Scientific Laboratory, Sandia Laboratories, Rocky Flats Plant, and Idaho National Engineering Laboratory;

--NRC headquarters, Bethesda, Maryland;

--NRC regional offices at Atlanta, Georgia; Glen Ellyn, Illinois; and Berkeley, California;

--State agencies in New York, Kentucky, South Carolina, Illinois, and Nevada; and

--commercial disposal sites at Maxey Flats, Kentucky; Barnwell, South Carolina; and Beatty, Nevada.

We also reviewed available documentation for information on the West Valley, New York, commercial disposal site and the ERDA facility at Hanford, Washington.

We interviewed NRC and State regulatory officials, ERDA officials and contractor personnel, and commercial disposal site licensees. We reviewed records on the selection, operation, and regulation of disposal sites. We also held several discussions with USGS and EPA officials and earth scientists.

Our work at several commercial disposal sites was limited by a licensee's question of our legal authority for access to records and personnel. Due to our broader audit objectives, we did not pursue the matter of access in these instances.

REFERENCES

[1]O'Connell, M. F. and W. F. Holcomb. "A Summary of Low-Level Radioactive Wastes Buried at Commercial Sites Between 1962-1973, with Projections to the Year 2000" Radiation Data and Reports, Vol. 15, no. 12, U.S. Environmental Protection Agency, December 1974, pp. 765-767.

[2]Fuels and Materials, Directorate of Licensing. "Environmental Survey of the Uranium Fuel Cycle," (WASH-1248), Washington, D.C.: U.S. Atomic Energy Commission, April 1974, p. G-4.

[3]Meyer, G. Lewis and Michael F. O'Connell. "Potential Impact of Current Commercial Solid Low-Level Radioactive Waste Disposal Practices on the Hydrogeologic Environment," paper submitted to The International Symposium on Underground Waste Management and Artificial Recharge, New Orleans, Louisiana, September 1973, Table 1.

[4]Pacific Northwest Laboratories, Battelle Memorial Institute. "Program for the Management of Hazardous Wastes," prepared for U.S. Environmental Protection Agency, Office of Solid Waste Management Programs, July 1973, p. 24.

[5]Papadopulos, Stavros S. and Isaac J. Winograd. "Storage of Low-Level Radioactive Wastes in the Ground: Hydrogeologic and Hydrochemical Factors," Reston, VA: U.S. Geological Survey, 1974, p. 5. (This report was published by EPA and is available as EPA-520/3-74-009.)

[6]Cherry, I. A., Grisak, G. E., and Jackson, R. E., 1973, Hydrogeological factors in shallow subsurface radioactive-waste management in Canada, in, Proc. Internatl. Conf. on Land for Waste Management, Ottawa, Canada, October 1-3, 1973.

[7]"Storage of Low-Level Radioactive Wastes in the Ground: Hydrogeological and Hydrochemical Factors," pp. 5-9.

[8]EPA. Environmental Statement Comments: Liquid Metal Fast Breeder Reactor Program, Washington, D.C.: U.S. Environmental Protection Agency, April 1974, p. 25.

[9]Radiation and Product Safety Branch, Bureau for Health Services. "Project Report: Six Month Study of Radiation Concentrations and Transport Mechanisms at the Maxey Flats area of Fleming County, Kentucky," Lexington, Kentucky: Kentucky Department for Human Resources, December 1974.

[10]Report of the Task Force on Radioactive Waste Management, "6th annual National Conference on Radiation Control, New Challenges, April 28-May 2, 1974, San Antonio, Texas," DHEW Publication (FDA) 75-8010, October 1974, p. 57.

[11]Letter from Manager, Radiation and Product Safety Branch, Bureau for Health Services, Department for Human Resources, Commonwealth of Kentucky, to Chief, Agreements and Exports Branch, U.S. NRC, received at NRC January 1975.

[12]Letter from Chief, Agreements and Exports Branch, U.S. NRC, to Manager, Radiation and Product Safety Branch, Bureau for Health Services, Department for Human Resources, Lexington, Kentucky, February 24, 1975.

[13]Transmittal memorandum from Director, NRC's Region III, to Deputy Director for Field Operations, forwarding report of November 26, 1974, inspection of the Sheffield, Illinois, burial site, p. 2.

[14]Letter from Atomic Energy Commission's Director, Directorate of Regulatory Operations, to Director of Regulation, January 16, 1975, p. 2.

[15]Memorandum from Director, NRC's Region III, pp. 1 and 2.

[16]10 C.F.R. 51.5, published in Federal Register, vol. 39, no. 139, July 18, 1974, pp. 26279-26286.

[17]Proposed amendment to 10 C.F.R. 20, published in Federal Register, vol. 39, no. 178, September 12, 1974, pp. 32921-32923.

[18]Clark, David T. "A History and Preliminary Inventory Report on the Kentucky Radioactive Waste Disposal Site" Radiation Data and Reports, October 1973, p. 578.

[19]Clayton Grant, James Hite, and Heyward G. Shealy. "Economic Analysis of Funding Arrangements for Maintenance, Surveillance, And Contingency Costs Associated With Burial of Low-Level Radioactive Wastes in South Carolina," Clemson, S.C.: Department of Agricultural Economics and Rural Sociology, December 1974.

[20]Ibid., pp. 13-25.

APPENDIX II

AREAS IN WHICH INFORMATION IS NEEDED TO DETERMINE SITE SUITABILITY

A 1974 USGS report on "Storage of Low-Level Radioactive Wastes in the Ground: Hydrogeologic and Hydrochemical Factors," lists 17 areas on which data is needed for evaluating whether proposed or existing sites are suitable for preventing the operation of mechanisms for releasing radioactivity to the environment. These areas are quoted below in approximate order of increasing difficulty and/or cost to obtain:

"(1) Depth to water table, including perched water tables, if present.
(2) Distance to nearest points of ground water, spring water, or surface water usage (Includes well and spring inventory).
(3) Ratio of pan evaporation to precipitation minus runoff (by month for period of at least 2 years).
(4) Water table contour map.
(5) Magnitude of annual water table fluctuation.
(6) Stratigraphy and structure to base of shallowest confined aquifer.
(7) Baseflow data on perennial streams traversing or adjacent to storage site.
(8) Chemistry of water in aquifers and confining beds and of leachate from the waste trenches.
(9) Laboratory measurements of hydraulic conductivity, effective porosity, and mineralogy of core and grab samples (from trenches) of each lithology in unsaturated and saturated (to base of shallowest confined aquifer) zone. Hydraulic conductivity should be measured at different water contents and suctions.
(10) Neutron moisture meter measurements of moisture content of unsaturated zone. Measurements to be made in especially-constructed holes; at least 2 years' record needed.
(11) *In situ* measurements of soil moisture tension in upper 5-10 meters of unsaturated zone; at least 2 years' record needed.
(12) Three-dimensional distribution of head in all hydrostratigraphic units to base of shallowest confined aquifer.
(13) Pumping, bailing, or slug tests to determine transmissivity and storage coefficients.
(14) Definition of recharge and discharge areas for unconfined and shallowest confined aquifers.
(15) Field measurements of dispersivity coefficients.

APPENDIX II

(16) Laboratory and field determination of the * * * movement of critical nuclides through all hydrostratigraphic units
(17) Rates of denudation and (or) slope retreat."

APPENDIX III

INFORMATION NEEDED AT SELECTED DISPOSAL SITES FOR PREDICTING RATE AND DIRECTION OF MIGRATION

The information below was summarized from geological and other reports on disposal sites and supplemented by discussions with, and comments by, officials and staffs of disposal site operators, ERDA, USGS, NRC, EPA, and various States. The information does not include every major disposal site and is not necessarily exhaustive for each site listed.

Disposal site	Major information needed related to the
Los Alamos Scientific Laboratory	--most likely paths of migration, --effects which layering and features may have on migration, --net water infiltration from precipitation (the amount of water that is not evaporated or transpired and is free to move downward), --rate that radionuclides are dissolved by water, --rate of erosion that might exhume some buried wastes, and --amount of water which might be contaminated.
Idaho National Engineering Laboratory	--extent and orientation of fracturing in the geology underlying the site, --rate and direction of water infiltration, and --most likely paths of migration through the geological formations
Hanford	--rate of infiltration, --rate and direction of ground water movement, and --interconnection between shallow and deep aquifers.

APPENDIX III

Beatty	--rate of infiltration and --direction and rate of ground water movement.
Barnwell	--extent of porous and permeable sand and gravel and --fluctuations in the water table.
Sheffield	--permeability of the soil, including geologic characteristics which may have high permeabilities, such as fissures in the glacial deposits, sand stringers, and coal seams; --depth to the water table and its fluctuations; and --direction and rate of ground water movement.
Maxey Flats	--extent and orientation of fracturing in the geology underlying the site and --direction and rate of ground water movement,
West Valley	--direction and rate of ground water movement, --source of water in and connection between sand deposits, --ion exchange capabilities of the soil, and --extent of fracturing.

APPENDIX IV

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 28, 1975

Frank Degnan, Audit Manager
U.S. General Accounting Office

GAO DRAFT REPORT ENTITLED "IMPROVEMENTS NEEDED IN THE LAND DISPOSAL OF RADIOACTIVE WASTES"

Enclosed are NRC's formal comments on the subject draft per GAO's request.

Thomas J. McTiernan, Director
Office of Inspector and Auditor

Enclosure:
As stated

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APPENDIX IV

OCT 2 8 1975

Thomas J. McTiernan, Director
Office of Inspector and Auditor

COMMENTS ON GAO DRAFT REPORT ENTITLED "IMPROVEMENTS NEEDED IN THE LAND DISPOSAL OF RADIOACTIVE WASTES"

In response to your memorandum of August 4, 1975, the subject draft report has been reviewed by the Offices of NMSS, NRR, and I&E. Our comments are directed primarily to those portions of the report that address matters which are the responsibility of NRC and the Agreement States, i.e., licensed commercial waste burial grounds. At a meeting on September 12, 1975, these comments were discussed with representatives of your office and GAO representatives, Messrs. Degnan, Griffiths, and Cortina.

As a general comment, it is our opinion that the lack of recognition of state, as opposed to Federal, responsibilities for burial sites is a major deficiency in the report. Five of the six commercial waste burial grounds are regulated by Agreement States, yet the report contains little discussion of the states' programs, interests, concerns or opinions regarding future regulation of commercial burial grounds. We also believe that the states should be actively involved in any studies of commercial burial grounds.

We find it confusing to have statements and comments appear side-by-side in the text of the report concerning contractor-operated burial sites that are regulated by ERDA, and commercial waste burial grounds that are regulated by NRC and the Agreement States. The activities that are conducted at ERDA regulated sites differ in most aspects from those at commercial burial grounds. We suggest that GAO consider dividing the report into two parts, one dealing with ERDA regulated sites, and the other dealing with commercial burial grounds regulated by NRC and the Agreement States.

The report states that some of the disposal sites show a potential for releasing radioactivity to the environment. It is our opinion that the suggested idea of no migration or zero radiation release is not realistic. It is doubtful that a site could be found that would not permit some migration from the burial trenches. Disposal sites should be selected and operated in such a way as to provide reasonable assurance that radioactivity will not be released to unrestricted areas. Criteria for evaluating migration or release of radioactivity from commercial burial grounds should be defined to assist in determining the acceptability of existing and future disposal sites and disposal practices.

It should be clearly stated in the report that no commercial waste burial sites were licensed by the AEC without a review and favorable response by the U.S. Geological Survey.

In addition to the general comments above, comments on each of the recommendations made by GAO in the report are provided in Enclosure 1 to this memorandum. Additional specific comments on other sections of the report are provided in Enclosure 2.

It should be noted that many of our comments refer to portions of the report that are summarized in the Digest (pages i, ii, and iii). The Digest should be revised to reflect any changes that are made in the body of the report.

Lee V. Gossick
Executive Director for Operations

Enclosures:
1. Comments on Recommendations
2. Specific Comments

GAO note: Specific comments are related to corrections, clarifications, updates, and other suggested changes to the report. The specific comments are not included in this appendix. They were considered in the preparation of this report.

ENCLOSURE 1

NRC COMMENTS ON THE RECOMMENDATIONS IN GAO DRAFT REPORT
"IMPROVEMENTS NEEDED IN THE LAND DISPOSAL OF RADIOACTIVE WASTES"

GAO Recommendations - Page 25

1. NRC and ERDA should jointly enlist the cooperation of other agencies with program responsibility or expertise and sponsor a comprehensive study of existing commercial and ERDA disposal sites to more adequately evaluate their ability to retain radioactive waste.

   NRC Comment - We question whether it is appropriate for NRC and ERDA to jointly sponsor a study of existing commercial and ERDA disposal sites. In our opinion, such jointly sponsored studies continue to encourage criticism relative to conflict of the missions of regulators and developers. The primary objective of the Congress in splitting AEC into two separate agencies was to eliminate this conflict. In addition, we also believe that the states should be actively involved in any studies of commercial burial grounds.

   As an alternative to such an NRC-ERDA study, we recommend establishment of a committee of experts in relevant technical areas to advise and guide a joint NRC and state study of commercial waste disposal sites and a separate ERDA study of contractor-operated sites. We recognize that there would be a need for close coordination between the two studies, and would expect that the support of USGS would be solicited in the planning and conduct of the studies.

   The comprehensive study of commercial sites should also investigate methods of enhancing the retention capabilities of disposal sites and evaluate the effectiveness of such methods.

2. NRC and ERDA should jointly use the results of the studies to develop site selection criteria to be used as a basis for determining the long-term suitability of existing disposal sites and for selecting future sites.

NRC Comment - We believe that sufficient information exists to establish site selection criteria now (before the comprehensive study of sites is completed) should an urgent need exist. What appears to be needed is R&D to provide better quantitative indices for several of these criteria (e.g., permeability of soil and geological formations, ion exchange capacity of the soil, etc.).

The USGS has already initiated field studies at three sites and laboratory studies to develop hydrogeological criteria for evaluating sites and to develop predictive waste transport models. It would appear that the nature, scope, and preliminary results of these USGS studies should be thoroughly considered before recommendations are made for further similar extensive studies by NRC and ERDA.

GAO Recommendations - Page 30

We recommend that the Administrator, ERDA, and the Chairman, NRC, have their staffs jointly develop standards for detecting and correcting radiation migration from disposal sites and issue such standards for universal application.

NRC Comment - It appears from the preceding text that the intent of this recommendation is that standards need to be developed for concentrations of radioactive material in environmental media, e.g., air, water, soil, vegetation, etc., against which the results of monitoring programs can be compared to detect and evaluate migration of radioactive material from burial grounds. If this is, in fact, the intent, we agree with this recommendation. However, it is not clear how such standards would "correct radiation migration from disposal sites."

GAO Recommendations - Page 36

We recommend that the Administrator, ERDA, and the Chairman, NRC, direct their staffs, in conjunction with the comprehensive site

studies previously recommended, to evaluate the effectiveness of monitoring programs at existing disposal sites, and redesign them as necessary.

NRC Comment - The environmental monitoring programs at burial sites should be directed not only at early detection of increases in environmental radiation that may be attributable to migration, but should also monitor the pathways of exposure to man. The monitoring programs generally should involve spot checks, split samples, etc., and the results obtained should be exchanged between Federal and state agencies.

We agree that the effectiveness of existing monitoring programs at certain sites should be reevaluated. We would like to emphasize, however, that we believe the states should have an active role in establishing and carrying out any needed improvements in the existing burial ground monitoring programs.

GAO Recommendations - Page 47

1. We recommend that the Chairman, NRC, direct the NRC staff to cooperatively develop and implement with the State of Kentucky a program for correcting the trench water problem at the Maxey Flats disposal site.

   NRC Comment - The NRC staff has already conducted an independent review of the Maxey Flats site and has provided the State of Kentucky with conclusions and recommendations for improving operations at the site. The Governor of Kentucky has committed to consider these recommendations for implementation of a program to correct the problem. The responsibility for correcting deficiencies in the operation of the site rests principally with the Commonwealth of Kentucky, since Kentucky is an Agreement State.

2. We recommend that the Chairman, NRC, direct the NRC staff to take the necessary administrative actions to determine whether site licenses should be renewed.

NRC Comment - NRC has the total regulatory responsibility for only the Sheffield burial site. The necessary administrative actions have been taken with regard to the renewal of the license for the Sheffield site.

3. We recommend that the Chairman, NRC, direct the NRC staff to arrange for the systematic exchange of monitoring results among the Federal and state agencies regulating or independently monitoring commercial disposal sites.

NRC Comment - We agree with this recommendation.

4. We recommend that the Chairman, NRC, direct the NRC staff to establish independent monitoring programs for NRC licensed disposal sites where there are no such programs or where existing monitoring programs are inadequate.

NRC Comment - We agree that some form of independent monitoring program or method of assessing the quality of existing monitoring programs should be established. We suggest that the criteria for monitoring programs should be established first and that the different modes of release should be clearly identified.

5. We recommend that the Administrator, ERDA, and the Chairman, NRC, direct their staffs to study ways to improve record keeping practices at commercial and Government owned disposal sites.

NRC Comment - While we agree with this recommendation, it should be recognized that there are practical limitations on identification of specific radionuclides and their chemical forms in waste materials.

GAO Recommendations - Page 56

1. We recommend that the Chairman, NRC, direct his staff to establish, in conjunction with Agreement States, long-term care requirements for commercial disposal sites and require that adequate funding be established to support [illegible] requirements.

NRC Comments - We agree that NRC should work cooperatively with the Agreement States in the development of criteria for long-term care and maintenance of the commercial waste burial grounds. The Conference of Radiation Control Program Directors' Task Force on Bonding, on which the NRC participated, has developed criteria for bonding and long-term care for use by the states. Furthermore, general criteria are presently available, although they should be specified in greater detail. However, since the requirements for each site will be different, the detailed criteria may need to be site specific.

2. We also recommend that the Chairman, NRC, and the Administrator, ERDA, develop a policy on Federal involvement in correcting migration problems at commercial disposal sites.

NRC Comment - We agree that NRC and ERDA should develop a policy on Federal involvement in correcting migration problems at commercial burial sites should such problems develop.

NRC funding of corrective action taken in the Agreement States would probably require additional statutory authority, since NRC's authority under the Atomic Energy Act to provide such funding is unclear.

APPENDIX V

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

OCT 1 1975

Mr. Henry Eschwege, Director
Resources and Economics Development Division
General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

We appreciate the opportunity to review the draft GAO report, "Improvements Needed in the Land Disposal of Radioactive Wastes." We are in general agreement with the conclusions and recommendations of the report and we plan to take appropriate action. We do recommend once again that the final report differentiate more clearly between ERDA and NRC, both with respect to the ongoing responsibilities of the agencies and with respect to the responsibility for taking action on the various recommendations of this report.

Sincerely,

M. C. Greer
Controller

PRINCIPAL OFFICIALS OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION AND THE NUCLEAR REGULATORY COMMISSION AND THE FORMER ATOMIC ENERGY COMMISSION RESPONSIBLE FOR ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION		
ADMINISTRATOR, ENERGY RESEARCH AND DEVELOPMENT:		
Robert C. Seamans, Jr.	Jan. 1975	Present
ASSISTANT ADMINISTRATOR FOR ENVIRONMENT AND SAFETY:		
James L. Liverman	Jan. 1975	Present
NUCLEAR REGULATORY COMMISSION		
CHAIRMAN, NUCLEAR REGULATORY COMMISSION:		
William A. Anders	Jan. 1975	Present
DIRECTOR, OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGAURDS:		
Kenneth R. Chapman	Mar. 1975	Present
Howard J. Larson	Jan. 1975	Mar. 1975
DIRECTOR, OFFICE OF INSPECTION AND ENFORCEMENT:		
Donald F. Knuth	Jan. 1975	Present
ATOMIC ENERGY COMMISSION		
CHAIRMAN:		
Dixy Lee Ray	Feb. 1975	Jan. 1975
James R. Schlesinger	Aug. 1971	Feb. 1973
Glenn T. Seaborg	Mar. 1961	Aug. 1971

APPENDIX VI

	Tenure of office			
	From		To	
GENERAL MANAGER:				
Robert O. Thorne (acting)	Jan.	1975	Jan.	1975
John A. Erlewine	Jan.	1974	Dec.	1974
Robert E. Hollingsworth	Aug.	1964	Jan.	1974
DIRECTOR OF REGULATION:				
L. Manning Muntzing	Oct.	1971	Jan.	1975
Harold L. Price	Sept.	1961	Oct.	1971

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D C 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS