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LOW-LEVEL WASTE MANAGEMENT

MASTER

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LIST OF FIGURES

LIST OF TABLES

LOW-LEVEL WASTE MANAGEMENT

Introduction

Thank you for this opportunity to discuss low-level waste management with you. Until recently, low-level waste management has received little attention, probably because it is scientifically less challenging or interesting than other waste management problems. I shall attempt to convince you that management of low-level waste is the current critical problem facing the nuclear industry today and the potential cornerstone of a waste management system.

I shall present an overview of the current situation in the United States and a look to the future. With this as a basis, I shall define the current problems, challenges, and opportunities. Finally, I shall look to the future and show you a half-full glass.

What is Low-Level Radioactive Waste?

The first thing we need to do is establish a common definition of low-level waste. In the United States, low-level waste is currently defined as all waste that is not high-level, that contains less than 10 nanocuries/gram transuranic nuclides, and is not mine or mill tailings. In other countries and at Oak Ridge National Laboratory, the low-level wastes with high concentration of radionuclides are classified as medium level wastes.

Low-level wastes may be solids, liquids, or gases and may be anything from general trash to special liquids to contaminated piping. Disposal in the United States is typically by shallow land burial. Other countries use sea disposal and mined cavities.

Processing or treatment is accomplished using standard technology. Techniques used include evaporation, filtration, ion exchange, compaction, and incineration. There is little basic technology differences between countries, but some large differences in application.

Current Situation - United States

During the year 1979, 79,914 cubic meters (or 2,824,000 cubic feet) of low-level radioactive waste were disposed of at the three operating disposal sites. In 1979, the Barnwell, South Carolina, site received 2,229,489 cubic feet or 79 percent of this waste. The Beatty, Nevada site received 225,771 cubic feet or 8 percent and the Hanford, Washington site, 366,878 cubic feet or 13 percent of the 1979 waste volume.

One-half of this waste was generated by commercial power plants. Another 9 percent was generated by government and military facilities. The remaining 41 percent was generated by industrial facilities, medical facilities and research institutions. Current information does not permit accurately separating these sources except in a few states, but using average values, 19 percent of the waste is generated by medical and research facilities and 22 percent by industrial activities.

New York, South Carolina, Pennsylvania, and Illinois are the top four generators on by-state basis in 1979. These states generated 38.6 percent of the amount of the low-level wastes. Nevada and Washington, two states which currently have disposal sites, together generated less than 2 percent of the low-level wastes.

Table I is a summary by state of low-level waste disposed of at the three commercial facilities during 1979. The full report of low-level waste generated for the year 1979 will be available soon and may be obtained from the Idaho Field Office, Department of Energy or EG&G Idaho, Inc.

There are currently three operating commercial low-level waste disposal sites in the United States. If the current restrictions on the disposal volumes at the Barnwell site continue, adequate disposal capacity for low-level waste will exist through about 1985. This assumes there will be no change at the Beatty and Hanford sites. If the Hanford sites is restricted to only Washington generated waste per the recent initiative, the Beatty site will fill about one year earlier, in 1983 or 1984. The state of Washington has 900 acres leased from the Department of Energy at the Hanford site. If this land were to become available for low-level waste disposal, sufficient capacity would be available well past the year 2000.

After this year, the Barnwell site will be limited to 1,200,000 cubic feet per year. This will handle only 42 percent of the waste generated in the United States in 1979. Thus, at least 58 percent of the waste will require shipment to the west, a distance of greater than 1000 miles in

many cases.

Projection of waste generation into the future is difficult because, as yet, the industrial and medical sectors are not well characterized and changing and because reactor plants come on-line somewhat unpredictably. Using the best information available, we estimate that amount of waste generated will more than triple by 1990. Figure 4 summarizes the estimates of waste production through 1990. These figures were generated before the 1979 survey and are probably too high.

Using the current Barnwell limit, 1,200,000 cubic feet of waste per year as the size of a disposal site and arbitrarily dividing the United States into 5 regions, one can estimate the number of sites needed. Six to eight sites would be needed depending upon the actual regions chosen. The south and midwest are the regions with the greatest needs. Figures 7 through 12 contain a summary of these results.

Transportation has become a critical issue in the management of low-level waste. The current problem is enforcement of regulations. States are and will continue to assume a more active role in enforcement.

In the long-term, transportation considerations are important for hazards reasons. The greatest risk to the public from low-level wastes occurs during transportation and results from normal vehicular accidents. Furthermore, costs associated with transportation are increasing very

rapidly. Therefore, it is important to minimize transportation of low-level waste.

Considering only transportation distance, one can project and locate new disposal sites that result in minimum transportation distances. New sites would be located in New York, 1983-1985; Missouri, 1987-1989; if the Hanford site continues to accept all wastes. If the Hanford site is limited to wastes generated in Washington, sites will be needed in 1983 or 1984.

One other important consideration for the future is the potential impact of volume reduction technology. The volume reduction technologies I refer to are methods, such as compaction, that would achieve greater volume reduction than techniques now widely in use.

The most cost effective method to reduce the volume of low-level waste is not to generate it. Government laboratories and commercial power plants have enacted waste generation reduction programs. These programs have been administrative in nature aimed at improving procedures and practices and educating personnel to the virtues of not generating low-level wastes. Such programs have resulted in 20 to 30 percent reductions of waste volumes. Continued management vigilance and attention is needed to maintain these results.

The volume restrictions at the Barnwell site, and the price increases at all the disposal sites and for transportation have resulted in a reduction of

the volume of low-level waste being shipped to the commercial disposal sites by about 5%, or 4000 cubic meters, for 1979 as compared to 1978. It should be noted that some of this reduction results from government generated waste being redirected to Department of Energy sites for the last quarter of 1979.

Another method to reduce the volume of waste requiring disposal that may be used for waste containing nuclides with short half lives is storage for ten half lives. The waste then may be treated as non-radioactive waste. Medical and research institutions may use this for much of their wastes. Examination of the 1978 and 1979 waste generation data indicates an increased use of this process.

The NRC has recently proposed regulations that would reduce the amount of low-level wastes for medical and research institutions. Wastes with less than 0.05 microcuries of carbon 14 and tritium per gram of medium used for liquid scintillation counting or per gram of animal tissue averaged over the animal would not be considered as radioactive for disposal purposes. The comment period on the purpose regulation ends November 24, 1980.

Reactor plant wastes constitute 50 percent of the disposed waste volume and as such, represent a prime target for the application of volume reduction technology. About half of reactor plant waste is combustible, that is, paper, cloth and rags. Such waste could be incinerated and the ash solidified with an average overall volume reduction of a factor of 8 to 10. This would reduce the amount of reactor plant waste by about 45 percent.

Another major constituent of reactor plant waste is evaporator bottoms. Evaporator bottoms are concentrated aqueous solutions of sodium sulfate or boric acid. The usual concentration is 25 weight percent which converts to 90 percent by volume water. If this solution could be processed to reduce all the water, there would be an overall reduction in the volume by about a factor of 9.

Then, using a new volume reduction technique, the volume of reactor plant waste requiring disposal could be reduced by as much as a factor of 5. It should be noted that with the current economic situation, it may not be cost effective to backfit new volume reduction equipment unless such equipment could be applied to multiple reactors or becomes less costly and smaller than currently available equipment. Incorporating volume reduction equipment into new plants is economically more attractive.

About half the medical waste and institutional waste is combustible. Some of the material is organic solvents contaminated with radioactivity and the rest is clothing and paper and rags. This waste could easily be burned in an incinerator, and, in fact, approximately 50 institutions are doing so today. The overall volume reduction should average about a factor of 10 or greater.

The only other technology currently being explored to achieve volume reduction is smelting. Metallic wastes either from reactor plants or other sources, e.g. accelerators, can be decontaminated and can have the final

volume reduced by smelting. This technology has been explored by the Department of Energy and two laboratories are now installing smelters.

Future Developments

The major need in establishing a sensible low-level waste management system in the United States is the development of a sensible system of regulations. Within the next year, the Nuclear Regulatory Commission is scheduled to issue draft regulations concerning the licensing of shallow land burial disposal sites. The regulations will permit establishment of new sites in this country to help cure the geographic imbalance between generation and disposal. As part of the new regulations, the NRC is also planning to issue a draft waste classification system. The waste classification system will relate the nature of the waste to the waste management practices required for safe handling and disposal of the waste. With the publication of the waste classification system, for the first time generators and waste disposal site operators will be provided some guidance on the nature of the operations needed to properly manage wastes. This should permit the development and employment of the proper level of technology without excessive economic penalties to meet the isolation requirements for the waste.

With the issuing of the draft regulations on disposal requirements and the activities occurring towards region formation, the future development of the required disposal sites is promising. However, the passage of the Washington initiative and the attempts to close the Beatty, Nevada site increase the likelihood that soon the United States will not have sufficient disposal

capacity for the low-level waste generated in the United States. The Federal Republic of Germany is currently in this situation and might provide some insight into the future for the United States.

With the closing of the Aase Salt Mine, the Federal Republic of Germany does not have any disposal capability for low-level waste. In order to continue those activities that produce low-level waste, a system of interim disposal facilities has been established throughout that country. Commercial power plants use on-site storage. Medical and other small generators transmit their waste to one of six storage facilities, all operated by Federal research laboratories. Waste generated by governmental activities are also stored at these storage facilities. Two of these facilities operate incinerators to burn the waste.

One of the most troublesome items and to some extent representative of the difficulties in the system, are animal carcasses. Radioactive animal carcasses must be disposed of as radioactive waste. In order to keep these carcasses from putrifying, they are stored in freezers until they are incinerated. Radioactive animal carcasses in Berlin are stored in freezers until a sufficient number of carcasses are accumulated. Then, still within the freezers, the carcasses are flown to Karlshrue for incineration. To say the least, it is a costly operation.

Perspective on Today

Currently, within the United States, organizations and individuals are

attempting to put together a rational system for the management of low-level waste. The first problem that must be addressed is a political/institutional problem. Without the proper institutional structure, a rational system cannot be established.

When the proper institutional structure is in place, appropriate technology must be supplied to support the political and regulatory rules. That technology does not completely exist today and must be developed during the interim.

Progress toward a solution began when President Carter established the Interagency Review Group, (IRG). Issuing the interim report in October, 1978, and the final report of March, 1979, provided the initial impedance for action. Subsequent to the issuing of the final IRG report, Governors Riley, Ray and List, of South Carolina, Washington, and Nevada, respectively, began to suggest to their fellow governors that other states take a more active roll in the low-level waste management system. Poor performance in complying with transportation regulations resulted in the closure of the Beatty, Nevada and Hanford, Washington sites in the summer of 1979. This combined with some very strong encouragement by the three governors turned the attention of some of the political bodies of the states to the low-level waste management issue.

In the fall of 1979 the National Governors' Association established a task force to develop and recommend policies related to the management of low-level waste. This group, chaired by Governor Babbitt of Arizona, provided

its recommendations in August of 1980. These recommendations were unanimously accepted by the governors and received favorable editorial comment in the New York Times.

Shortly after the National Governors' Association task force provided its recommendations, the National Council of State Legislators and the State Planning Council endorsed the report.

In September, 1979, the Department of Energy began development of its strategy for the management of low-level waste with the first meeting of the task force representing a wide spectrum of the country. This task force continued to meet through May of 1980 to develop the issues and recommend action. In September of 1980, the draft Department of Energy strategy prepared by the lead contractor, EG&G Idaho, was issued for comment and review.

The recommendations of the National Governors's Association, the National Council of State Legislators, the State Planning Council and the Department of Energy are all consistent with respect to the major issues. Basically these are that the states should be the primary governmental level with respect to low-level waste management and that disposal options should be exercised on a regional basis. Thus, it would seem that a national policy for the management of low-level waste is developing.

Having established national policy, the next step is the implementation, which is far more difficult. Governors List and Riley have begun this process

by sponsoring the first of a series of regional meetings to pursue the establishment of the regional solutions. Over the next year, similar meetings will occur throughout the country. These meetings will define the issues related to waste management on a regional basis and begin to develop the needed institutional framework.

Within the year, I expect the regulatory and political framework needed for disposal site selection process to be available. I would expect to see that in at least one region of the country some site screening work will begin within one year.

Each of us by virtue of our experience and background and interest is in a position to aid in the establishment of a sensible low-level waste management system. We can assist in helping establish the appropriate institutional and regulatory system. In doing so, we must be able to face up to the realities and the bad performances of the past and to deal with the future in a more honest and straightforward manner. The low-level waste disposal sites in Maxey Flats, Kentucky and West Valley, New York were closed because of legitimate concerns on the part of the states and the local populace. These sites did not perform as advertised and were not operated in a first-class manner. Future sites must be accurately and honestly described to the public prior to opening and must operate in a first-class manner.

There is today a body of governmental persons actually working to resolve the low-level waste management situation. The Department of Energy and private industry and the states are developing the new technologies needed. The

system from my perspective is coming together in a sensible manner and, saving some outside uncontrolled perturbation like Three Mile Island, will be established and functional within two years and will produce a new disposal site within five years.

I should like to close by sharing my perspective on the establishment of a low-level waste management system in terms of total national waste management needs. Low-level waste is the most benign and least challenging radioactive waste to manage. Low-level waste should be resolved first because it is technically and politically the most tractable and as a result will provide a success to build upon. Establishing a success with low-level waste management should provide the momentum and public confidence needed to continue on and to resolve the technical and politically more difficult waste problems. With patience, a system for the management of all radioactive waste can be constructed. Most importantly, such a system can provide better protection for the biosphere than the current situation and will have the confidence of the country.

For Further Information Contact:

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INEL-S-29 671

Low-Level Wastes are Described in Various Classifications or Categories

By source type

Defense — Commercial

- Fuel cycle
- Non-fuel cycle

By form

Liquid — Solid

- Compactable
- Non-compactable

Low-Level Waste Types
Solids

- Paper trash
- Clothing
- Laboratory glassware
- Radiopharmaceuticals
- Obsolete equipment
- Building rubble
- Ion exchange resins
- Filters
- Evaporator sludges
- Activated materials
- Shielding
- Solidified liquids
- Animal carcasses
- Incineration ashes
- Concrete containing ^{129}I, ^{14}C, ^{85}Kr
- Cylinders of ^{85}Kr
- Zeolites containing ^{85}Kr

Low-Level Waste Types
Liquids

- Process effluents
- Evaporator concentrates
- Liquid wastes from scrubbers for airborne wastes
- Tritiated water
- Scintillation organic liquids

Low-Level Radioactive Wastes Are Generated in Every State (1979 Volumes in Cubic Meters)

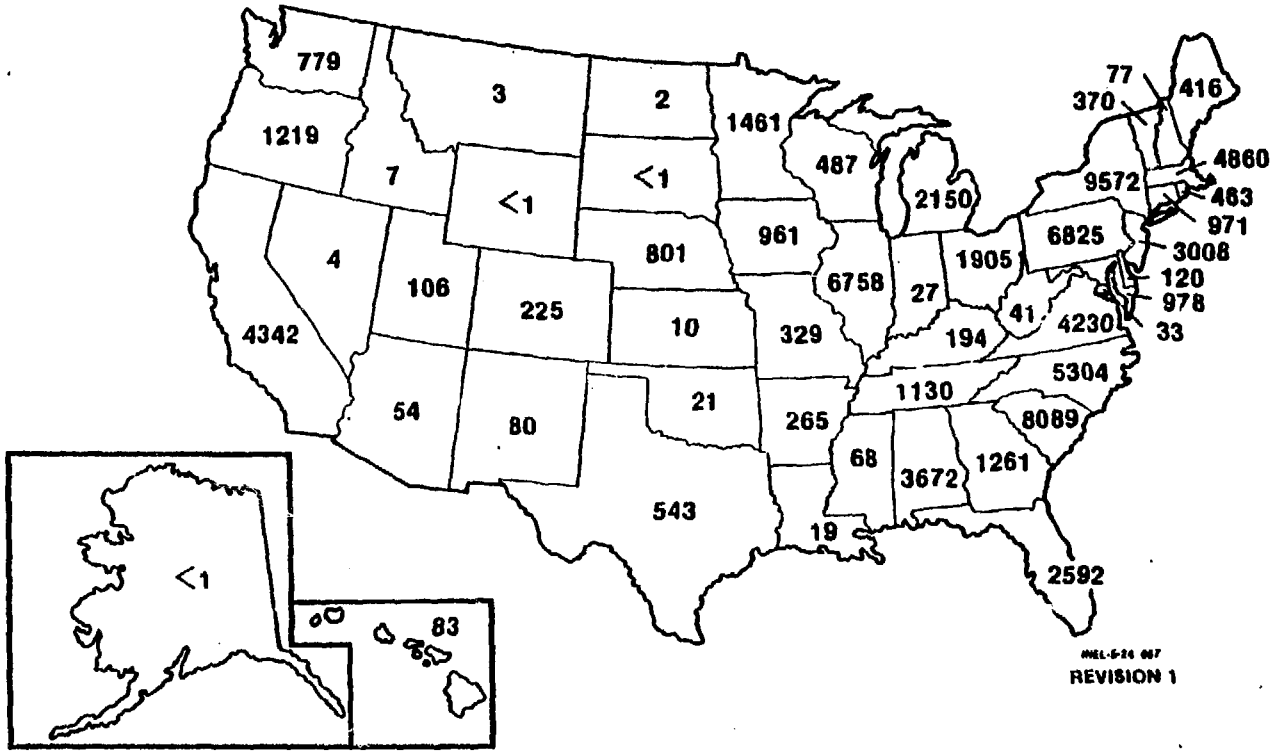

Figure 1

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Low-Level Wastes Are Generated From Several Sources

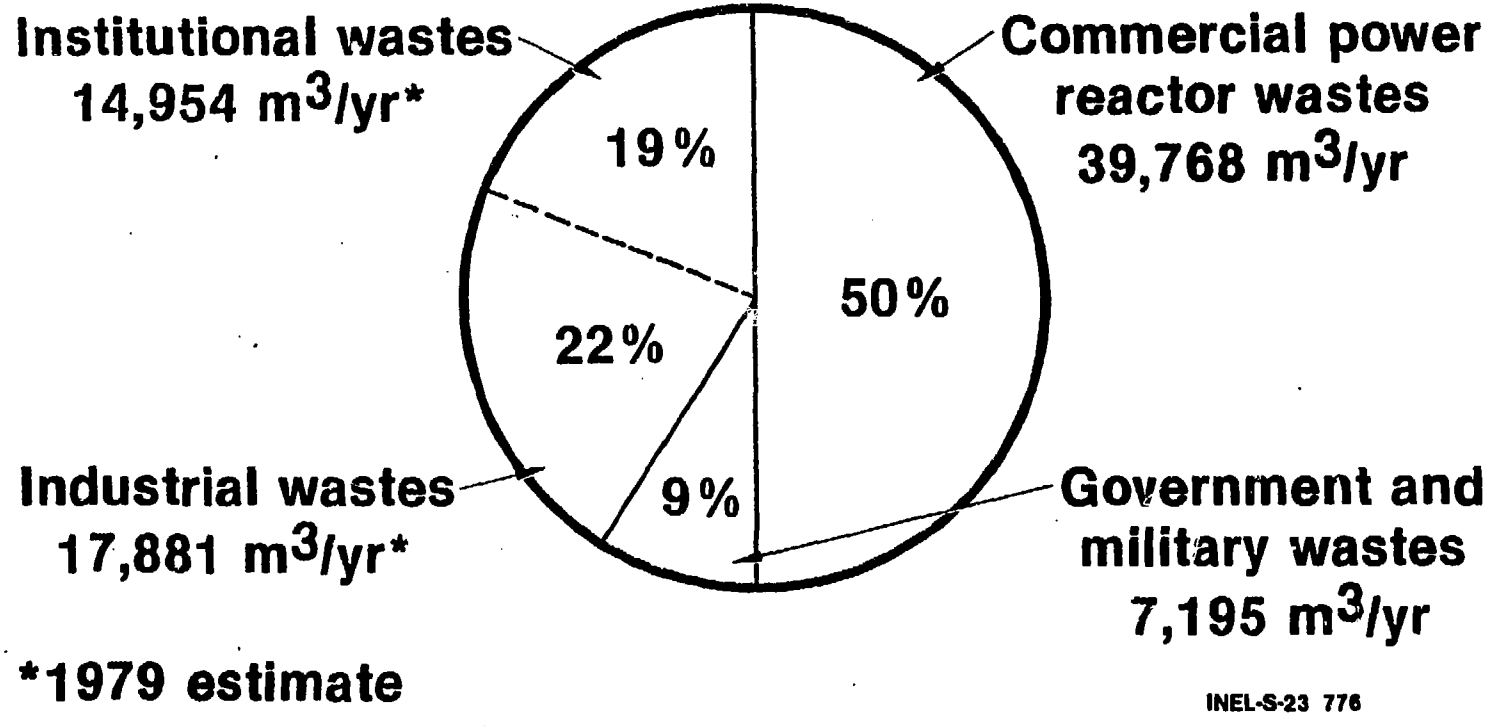
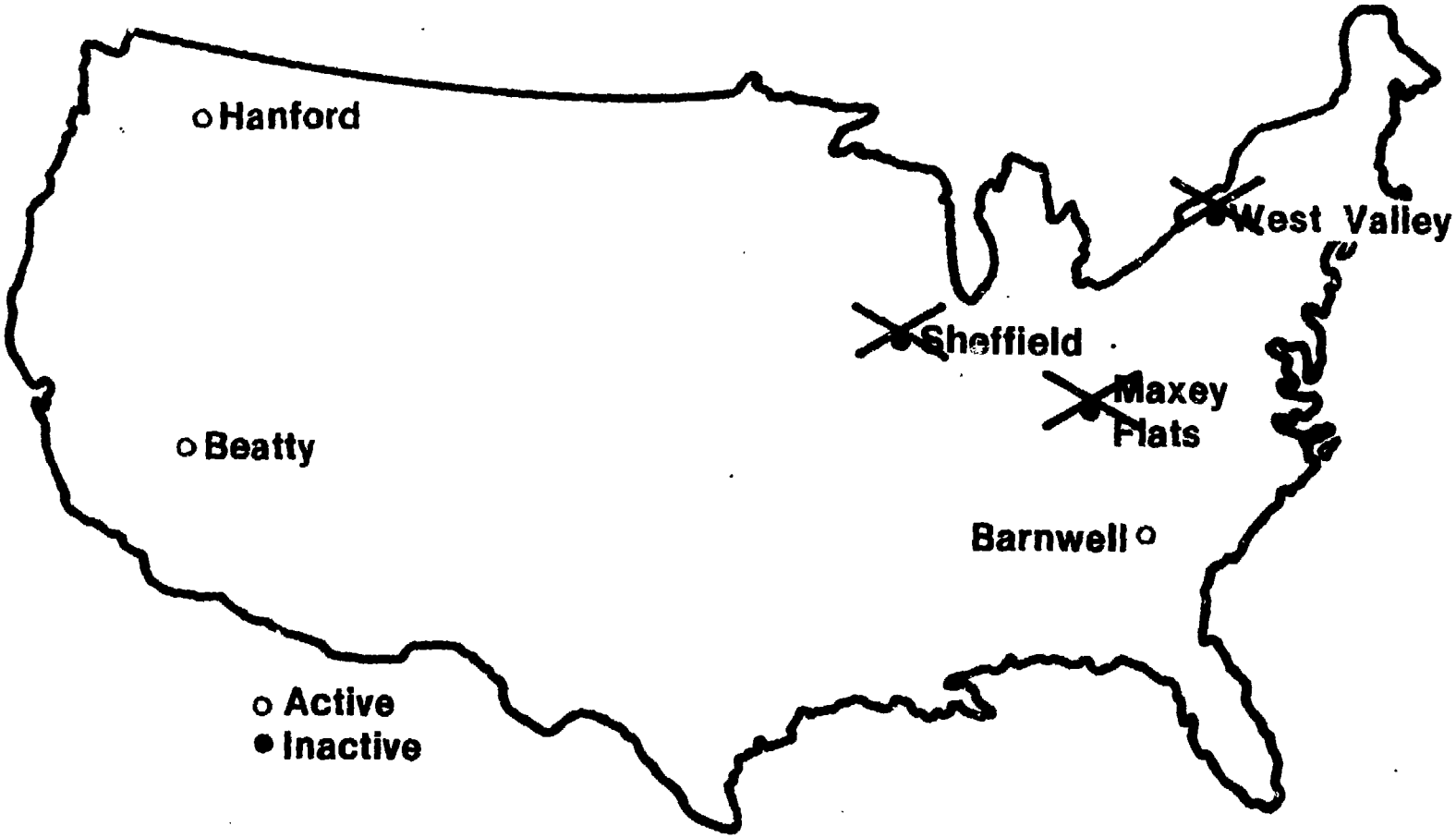


Figure 2



Locations of Commercial Waste Disposal Sites

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Figure 3

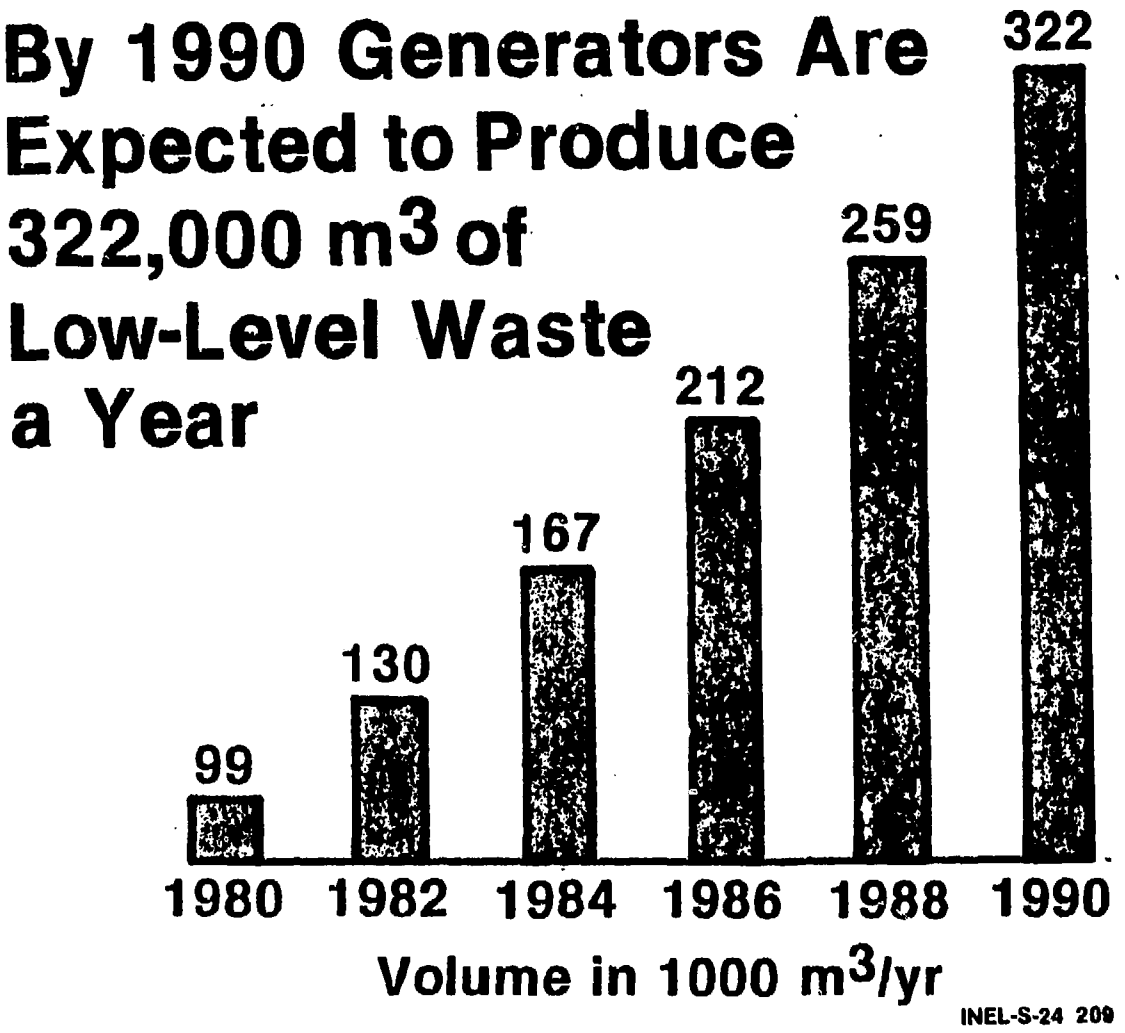
By 1990 Generators Are Expected to Produce 322,000 m3 of Low-Level Waste a Year
99
130
167
212
259
322
1980
1982
1984
1986
1988
1990
Volume in 1000 m3/yr
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Figure 4

Projected Capacities of Active Commercial Disposal Sites From Now Until 1995

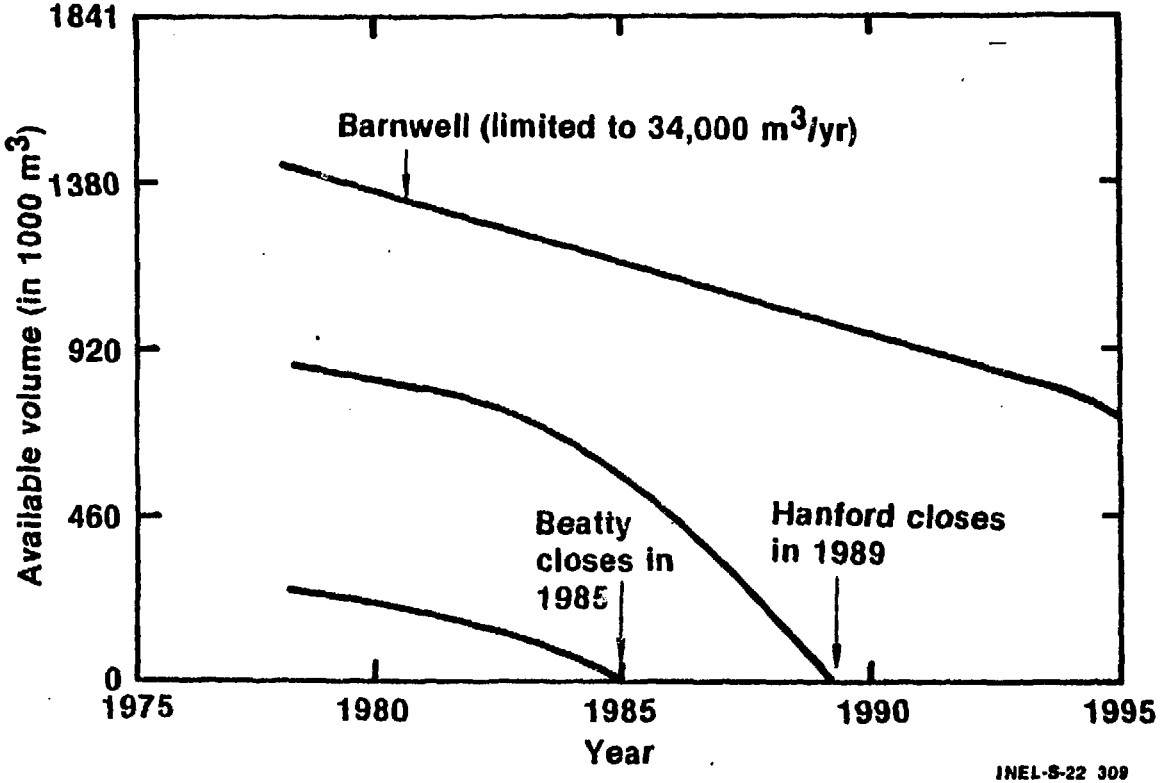

Figure 5

As a Tool to Evaluate National Disposal Needs, the Barnwell, South Carolina Disposal Site Can Be Used As An Example

A "Barnwell" has

- A disposal limit of 34,000 of waste per year
- 260 usable acres of land licensed for disposal
- A useful life for accepting waste of 70 years at a fill rate of 3.7 acres per year

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Figure 6

By 1990 the Nation will Need 9 3/4 Disposal Sites for Low-Level Waste

1980	Barnwell, Beatty and Hanford can handle the nation's low-level waste
1982	Hanford is lost as a national disposal site and 2 1/4 new sites are required in addition to Barnwell and Beatty.
1984	Beatty is filled to capacity and 2 more new sites are required.
1986	Only Barnwell remains open, 5 1/2 new sites are required.
1988	Barnwell is still open, but the national generation rate requires 7 additional sites.
1990	Barnwell and 8 3/4 additional sites are required.

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Figure 7

Dividing the Country into Five Regions is One Possibility

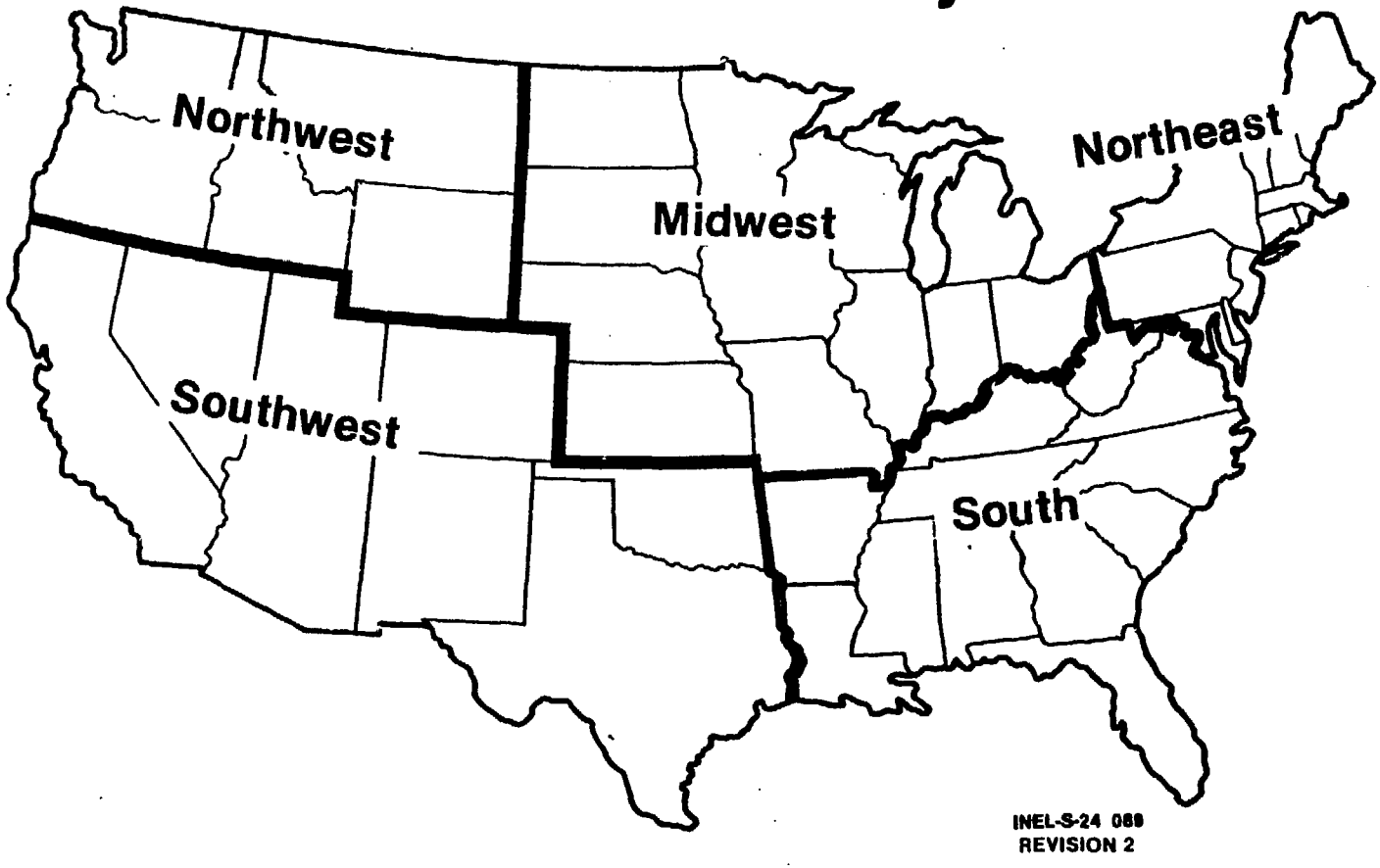

Figure 8

By Dividing the Country into Five Regions, No Region Would Need More Than 3 "Barnwell" Type Disposal Sites by 1990

	# Barnwell Sites Required				
Year	Northwest	Southwest	South	Northeast	Midwest
1980	1/4	1/2	1	1	3/4
1982	1/2	1/2	1 1/4	1 1/4	1
1984	1/2	3/4	1 1/2	1 1/2	1 1/4
1986	1/2	3/4	2	2	1 1/2
1988	3/4	1	2 1/4	2 1/2	1 3/4
1990	3/4	1 1/4	3	3	2 1/4

INEL-S-29 676

Figure 9

In the Eastern Region 7 3/4 "Barnwell" Type Disposal Sites Would be Required by 1990

Year	Waste Volume Generated m^3/yr	Total # Disposal Sites Required
1980	80,600	2 1/2
1982	105,220	3 1/4
1984	135,110	4
1986	170,430	5 1/4
1988	209,640	6 1/4
1990	261,950	7 3/4

INEL-S-29 673

Figure 10

In the Northwest Region Only 3/4 of a "Barnwell" Type Disposal Site Would be Required by 1990

Year	Waste Volume Generated m^3/yr	Total # Disposal Sites Required
1980	8,200	1/4
1982	9,950	1/2
1984	12,750	1/2
1986	16,770	1/2
1988	19,780	3/4
1990	23,320	3/4

INEL-S-29 674

Figure 11

The Southwest Region would Only Require 1 1/4 of a "Barnwell" Type Disposal Site by 1990

Year	Waste Volume Generated m^3/yr	Total # Disposal Sites Required
1980	10,520	1/2
1982	14,710	1/2
1984	19,590	3/4
1986	24,560	3/4
1988	29,910	1
1990	36,570	1 1/4

INEL-S-29 675

Figure 12

Transportation-Determined Regions Served by Low-Level Waste Disposal Sites (1983-1985)

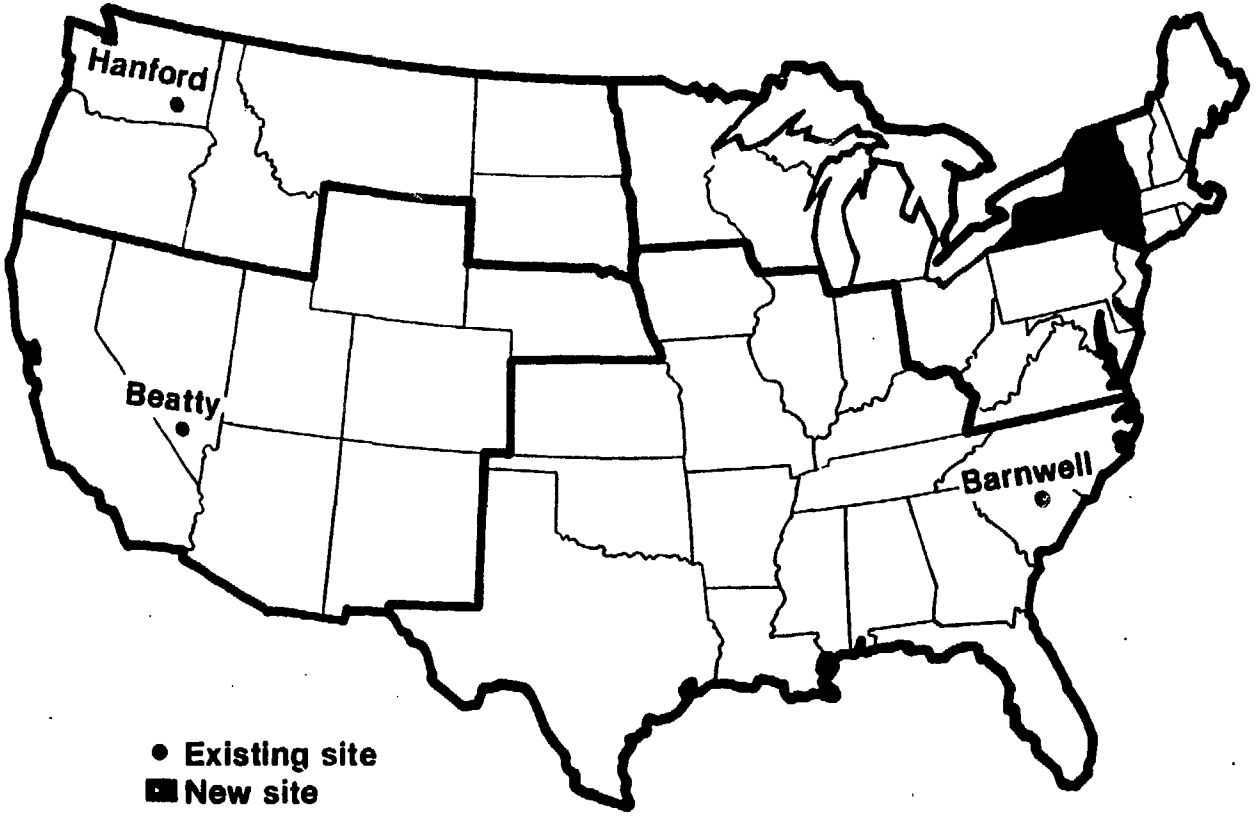

Figure 13

Transportation-Determined Regions Served by Low-Level Disposal Sites (1987-1989)

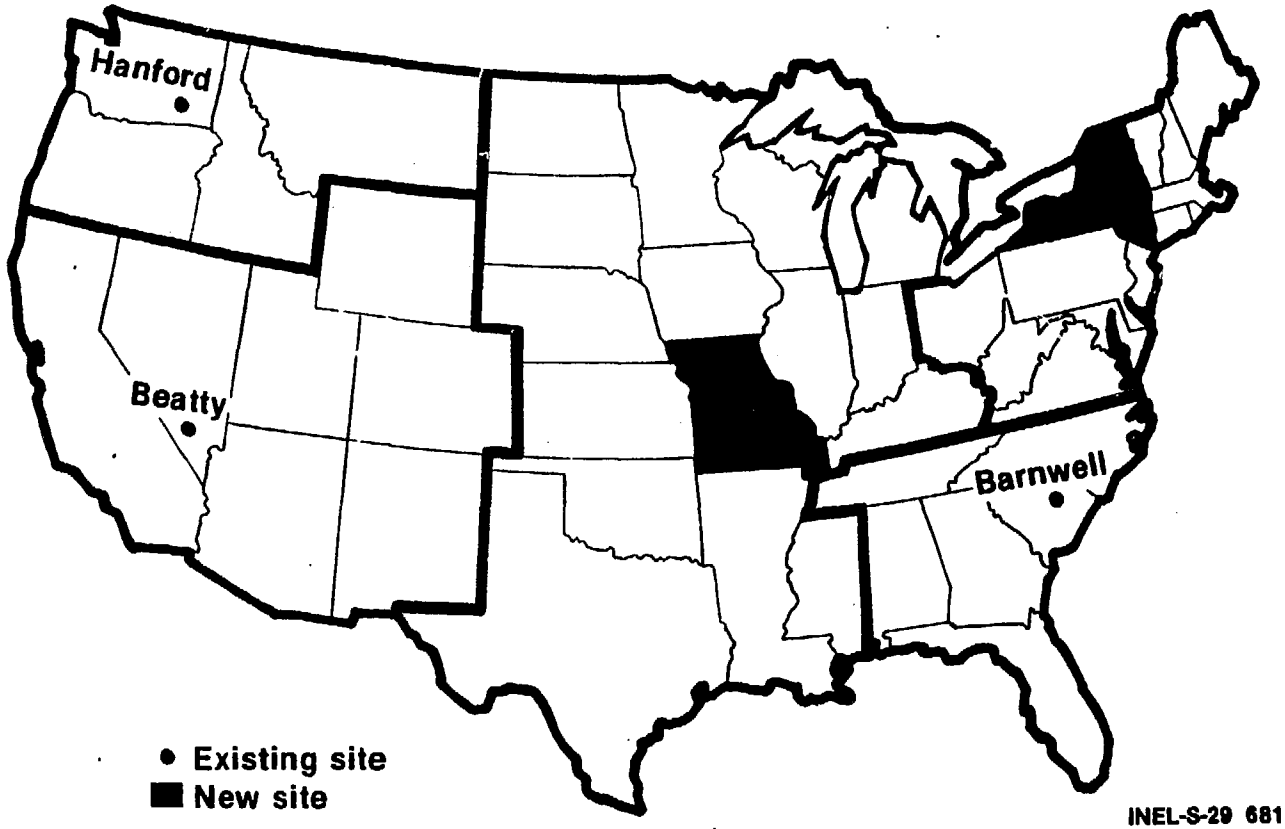

Figure 14

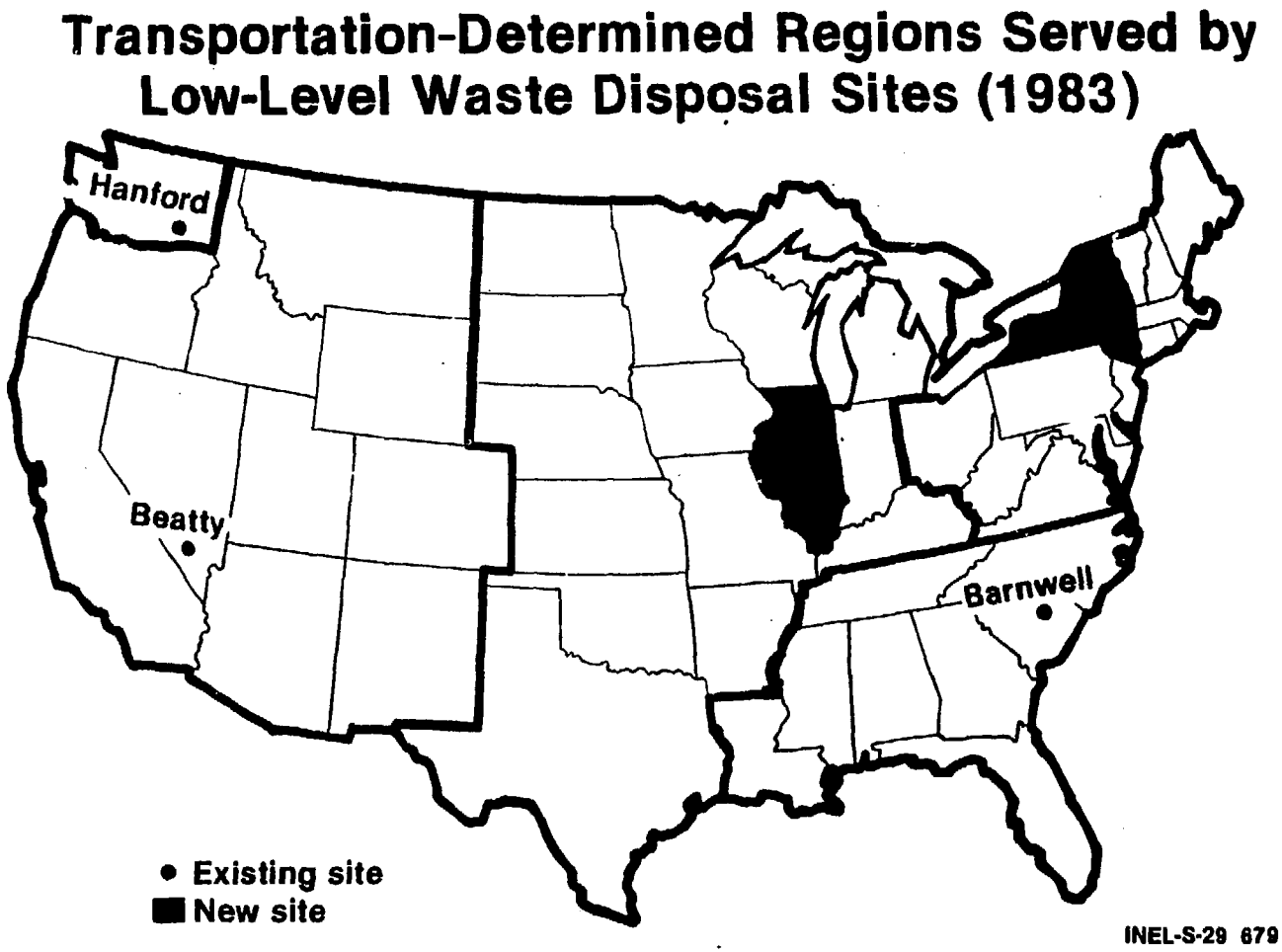
Transportation-Determined Regions Served by
Low-Level Waste Disposal Sites (1983)
Hanford
Beatty
Barnwell
• Existing site
■ New site
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Figure 15

Transportation-Determined Regions Served by Low-Level Waste Disposal Sites (1985-1986)

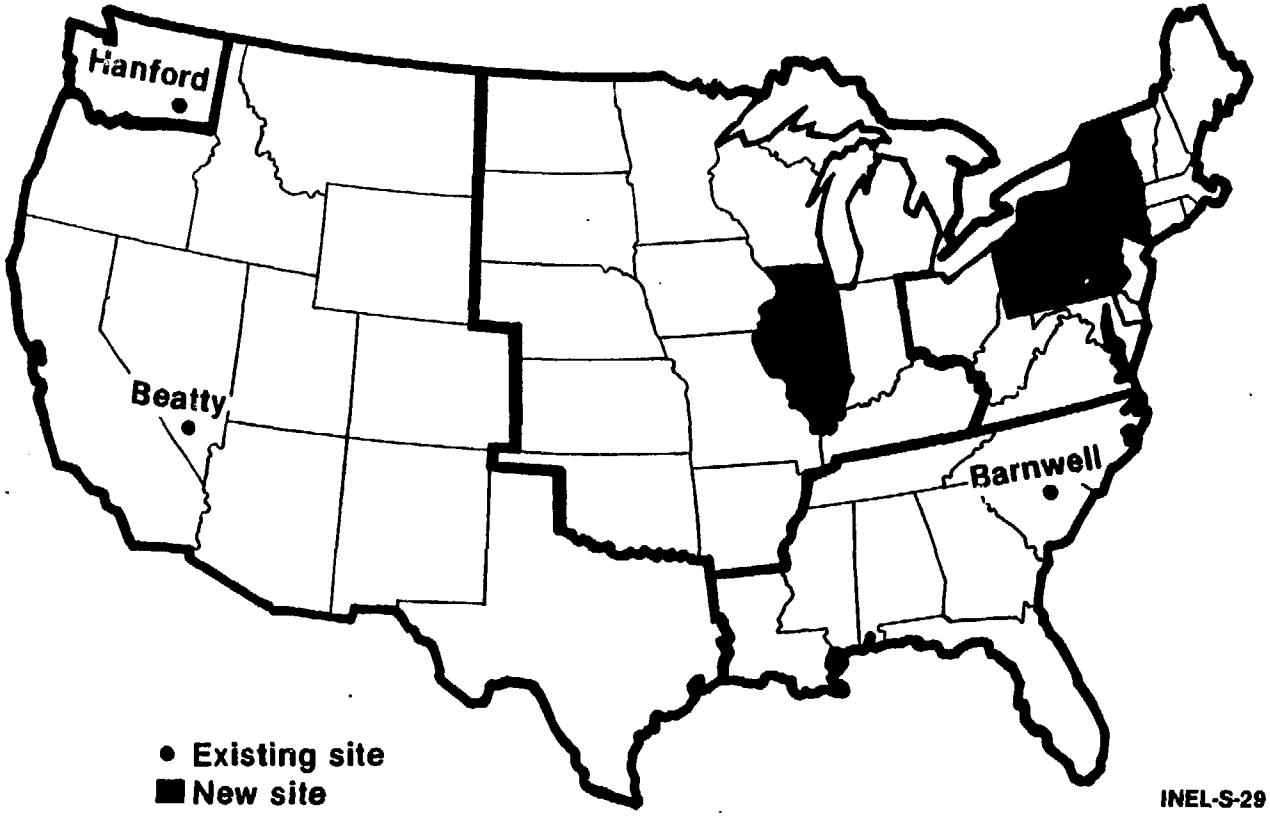

Figure 16

Transportation-Determined Regions Served by Low-Level Disposal Sites (1987-1995)

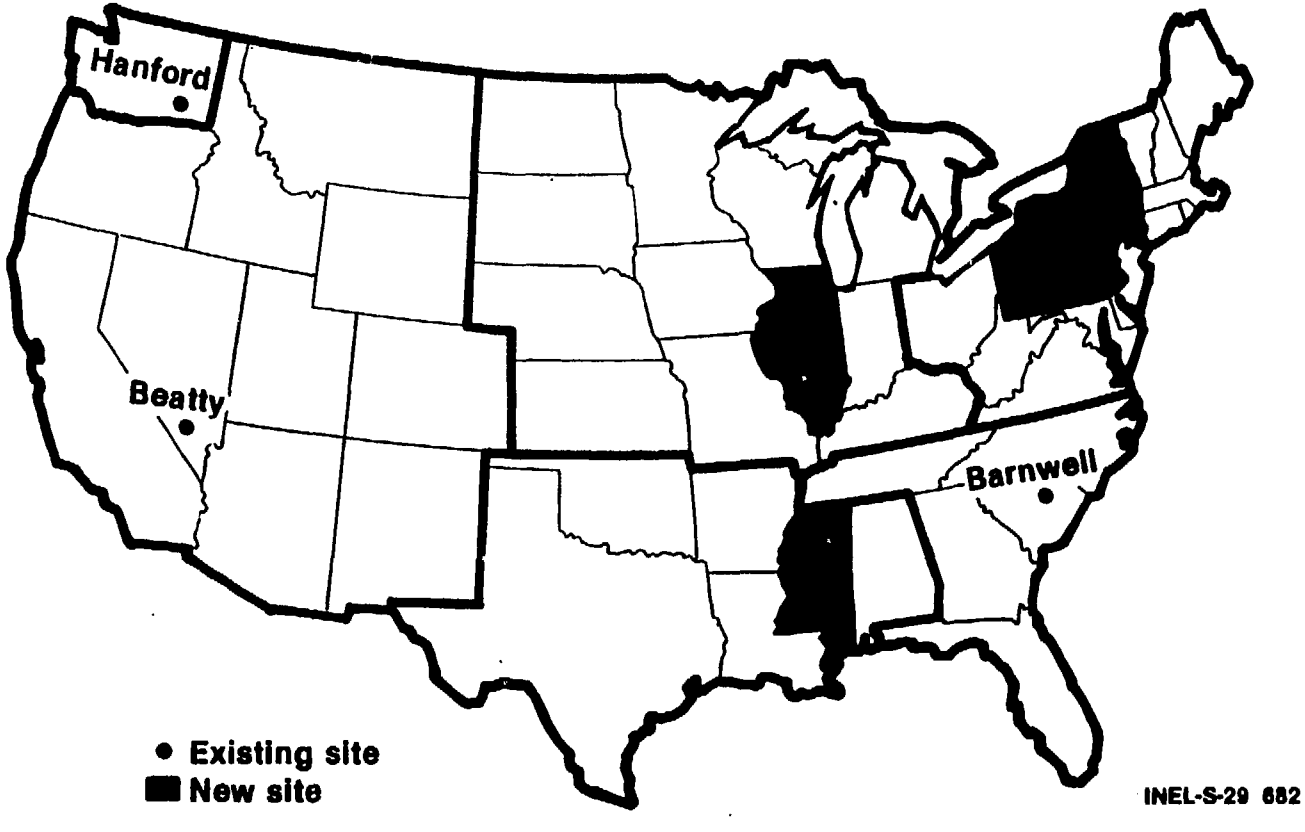

Figure 17

Table I

Waste Volume Comparison by State, 1978-1979

State	1978 Volume, percent	1979 Volume, percent	1978 Volume, m^3	1979 Volume, m^3
Alabama	4	5	3,072	3,672
Alaska	<1	<1	56	<1
Arizona	<1	<1	345	54
Arkansas	1	<1	858	265
California	8	5	6,727	4,342
Colorado	<1	<1	409	225
Connecticut	4	5	3,234	3,970
Delaware	<1	<1	89	120
District of Columbia	<1	<1	291	33
Florida	5	3	3,859	2,592
Georgia	2	2	1,577	1,261
Hawaii	<1	<1	228	83
Idaho	<1	<1	121	7
Illinois	8	8	6,812	6,758
Indiana	<1	<1	655	27
Iowa	2	1	1,531	961
Kansas	<1	3	469	10
Kentucky	<1	<1	537	194
Louisiana	<1	<1	469	19
Maine	1	<1	859	416
Maryland	2	1	1,592	978
Massachusetts	4	6	3,378	4,860
Michigan	4	3	3,108	2,150
Minnesota	2	2	1,336	1,461
Mississippi	<1	<1	499	68
Missouri	1	<1	979	329
Montana	<1	<1	150	3
Nebraska	2	1	1,308	801
Nevada	<1	<1	146	4
New Hampshire	<1	<1	327	77
New Jersey	4	4	2,976	3,008
New Mexico	<1	<1	317	80
New York	8	12	6,776	9,572
North Carolina	7	7	5,793	5,304
North Dakota	<1	<1	182	2
Ohio	3	2	2,134	1,905
Oklahoma	<1	<1	586	21
Oregon	<1	2	588	1,219
Pennsylvania	7	9	5,644	6,825
Rhode Island	<1	<1	160	463
South Carolina	6	10	4,940	8,089
South Dakota	<1	<1	184	<1
Tennessee	1	1	1,075	1,131
Texas	3	<1	2,163	543
Utah	<1	<1	275	106
Vermont	<1	<1	323	370
Virginia	2	5	2,003	4,230
Washington	2	1	1,265	779
West Virginia	<1	<1	501	40
Wisconsin	1	<1	952	487
Wyoming	<1	<1	142	<1
Total United States			83,800	79,914

Table II

In the Early 1970's the United States had 6 Commercial Burial Grounds In 1980, Only Three Remain Open

Site	Date Opened	Current Status
Beatty, Nevada	1962	Open
Morehead, Kentucky	1962	Closed 12/1/77
West Valley, New York	1963	Closed 1975
Richland, Washington	1965	Open
Sheffield, Illinois	1967	Closed
Barnwell, South Carolina	1971	Open

INEL-S-22 353
REVISION 1

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