Chapter 4
History of Waste Management: Setting the Stage

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When the 97th Congress convened in 1981, almost four decades into the nuclear era, about 160 U.S. commercial nuclear plants had been built or approved for construction, and approximately 6,700 metric tons (tonnes) of commercial spent nuclear fuel containing radioactive waste had already been generated. Yet the United States still had not decided how radioactive waste should be dealt with from point of generation to point of final isolation. As a result, a host of problems had arisen that both complicated the task of developing a credible and comprehensive waste management program and cast a cloud of uncertainty over the future of nuclear power in the United States.

The passage of the Nuclear Waste Policy Act of 1982 (NWPA) in the final hours of the 97th Congress represented a major watershed in the evolution of radioactive waste management policy in the United States. The decisions made in NWPA about how radioactive waste should be managed were influenced not only by technical and institutional capabilities but also by perceptions of those capabilities—perceptions formed by the historical experience of waste management. To understand how these perceptions affected the development of waste management policy and to avoid the pitfalls of the past in implementing that policy, it is necessary to examine the history and effects of past radioactive waste management policies and practices. [1] This chapter will provide that background. The provisions of NWPA will be described and analyzed in chapter 5.

[1] This chapter draws on *Radioactive Waste Management Policy Making,* a more detailed analysis of the history of the U.S. waste management program by Daniel Metlay, included as app. A of this report. For brevity, references to that appendix are omitted (except for direct quotations), and only references to other sources are cited in this chapter.

DEVELOPMENT OF FEDERAL WASTE MANAGEMENT POLICY AND PROGRAMS

Early History (1945-75)

Sources of Radioactive Waste

High-level radioactive waste was first produced on a large scale in the wartime effort of the early 1940's to produce plutonium for atomic weapons. Spent fuel from defense reactors was routinely reprocessed to recover uranium and plutonium, and liquid high-level waste from reprocessing was stored in storage tanks at Federal facilities-first at Hanford, Wash., and later at Savannah River, S. C., and Idaho Falls, Idaho. It was assumed that disposal could take place later, possibly at these same sites.

In *1954* the Atomic Energy Act opened the nuclear power industry to private enterprise, and the first contract for a commercial reactor was issued 2 years later. Unlike defense reactors, commercial reactors were designed primarily to produce electricity. Spent fuel discharged from commercial reactors was stored in water-filled basins at reactor sites, pending development of a commercial reprocessing facility.

Climate of Policymaking

Overseeing the burgeoning commercial nuclear industry was the Atomic Energy Commission (AEC), established by the Atomic Energy Act of 1946 to promote as well as regulate the nuclear industry's defense and commercial functions. AEC's five members were appointed by the President for 5-year terms. They in turn were overseen

by the congressional Joint Committee on Atomic Energy (JCAE).

During the 1950's and 1960's, waste management received relatively little attention from policymakers. Issues of waste management paled beside the exciting, pressing challenges of reactor development and research. In addition, the early regulators and developers of nuclear power viewed waste disposal primarily as a technical problem that could be solved when necessary by application of existing technology. This belief was buttressed by the 1957 report of the National Academy of Sciences (NAS), which concluded that high-level radioactive waste could be disposed of in a variety of ways and sites in the United States. * Testimony of Federal and civilian experts in the 1959 oversight hearings by JCAE further endorsed this view. Daniel Metlay describes the effect of such technical optimism:

> An illusion of certainty was created where, in reality, none existed. Over the years, the sense of technological optimism embedded itself in the attitudes and thoughts of important agency policymakers. It became, in a sense, an official doctrine at AEC. There is no evidence that its validity was ever seriously questioned until the mid-1970's, This optimism facilitated fragmentation by lulling policymakers; agency personnel never fully recognized that they might create in a sequential, incremental fashion an elaborate technological structure (civilian nuclear power), only to find that the last pieces could not be made to fit. The difficulties of integrating the whole were systematically underestimated.[3]

As a result of these beliefs and attitudes, commitments of budget and personnel to the management of radioactive wastes were woefully inadequate, forcing key personnel to make stopgap decisions. Moreover, key officials tended to ignore signs that a technical approach was not working and to discount the nontechnical factors that impeded progress. Later, when it became apparent that more comprehensive action was needed to isolate waste, the organizational and technical structures were not prepared to respond rapidly enough. Although some decisions made during this time later proved to be unfortunate, at the time they were made, many appeared at least reasonable and, given the constraints at work, the most appropriate possible.

Reprocessing and Storage

The country's first large-scale efforts in waste management were defense-related and involved the reprocessing of spent fuel and the storage of liquid wastes from that reprocessing in carbon steel tanks designed to last 50 to 100 years. From 1957 to 1973, however, premature corrosion of the tanks resulted in a series of well-publicized leaks at Hanford and Savannah River. An attempt at Hanford to prevent further leaks by solidifyng the wastes created a solid that remains in the tanks today and may be very difficult, if not impossible, to remove for ultimate disposal.

In 1963, AEC authorized the construction of the first commercial reprocessing plant, the Nuclear Fuel Services (NFS) facility at West Valley, N.Y. During its 6 years of operation (1966-72), the NFS plant experienced several problems. For one, the lack of enough commercial spent fuel forced the facility to reprocess well below capacity, and to reprocess defense fuel that it was not designed to handle, causing damage to equipment and other technical problems. In addition, the plant received adverse publicity about its offsite leaks of radioactive waste and about radiation exposure to some of its workers.

In 1970, AEC proposed new regulations that committed the Government to develop repositories on Federal land and required that, for safety, liquid high-level waste be solidified within 5 years of its generation and transported to the repository within 5 years after solidification. Partly to meet these new regulations, the NFS plant was closed in 1971 for modifications. For financial reasons the plant never reopened, and the 612,000 gallons of liquid wastes from its reprocessing operations remain in storage tanks at the site.

A second commercial reprocessing plant, built by General Electric at Morris, Ill., never operated because of technical and design problems. A third plant, the Allied General nuclear Services (AGNS) facility in Barnwell, S. C., was still under construction in April 1977, when commercial reprocessing was suspended indefinitely by the Carter administration. Since the operations ceased at West Val-

[2] National Academy of Science/National Research Council, *The Disposal of Radioactive Waste on Land, 1957.*

[3] App. A, Q. 203.

ley, no reprocessing of commercial spent fuel has occurred in the United States.

Disposal

AEC first addressed the problem of waste disposal in 1955 when it asked NAS how to structure research to establish a scientific base for the waste management program. Under the assumption that the waste to be disposed of would be dissolved at relatively low concentrations in liquid, NAS stated in its 1957 report that disposal was technologically feasible and that stable salt formations appeared to be the most promising repository medium. Such formations would theoretically prevent transport of liquid and would become self-sealing in the event of a fracture. The commitment to salt became a cornerstone of waste disposal policy for the next 20 years.

In the 1960's, improved reprocessing techniques reduced the volume and increased the thermal and radiation content of reprocessed wastes. To test the effect of these new characteristics on salt, 14 spent fuel assemblies and several heaters to raise the temperature of the salt were emplaced from 1965 to 1967 in the abandoned Carey Salt Mine at Lyons, Kans. The experiment, called Project Salt Vault, was conducted in an atmosphere of goodwill among Federal, State, and local officials: State and local officials were consulted about various aspects of the experiment, public tours of the mine were given during the experiment, and the wastes were removed at the end of the experiment, as promised. The results of this experiment showed no measurable evidence of excessive chemical or structural effects on the salt, a fact which became important 2 years later when the need suddenly arose to find a disposal site quickly.

In 1969, a fire at the Federal weapons components facility in Rocky Flats, Colo., left a large volume of low-level, plutonium-contaminated transuranic waste. Following standard procedures, officials sent the wastes to the National Reactor Test Station in Idaho for storage. Concerned that their State had become a dumping ground for waste from Colorado, Idaho's political leaders appealed to AEC Chairman Glenn Seaborg, who pledged to remove the waste by 1980. That promise, as well as the commitment to disposal expressed in the AEC regulations mentioned above, spurred AEC to search for a geologic repository site. The Lyons site was selected because:

- some, albeit very little, information had been gathered about the site during Project Salt Vault;
- a favorable reception by the local citizenry seemed likely; and
- investigations needed to prove the acceptability of the other sites would have delayed repository development by 2 years.

AEC announced in 1970 that, pending confirmatory tests, the Lyons site had been selected for the first full-scale repository. Although the degree to which AEC had consulted with State and local officials before this announcement is in dispute, AEC'S decision did not have full endorsement from these officials. Moreover, State and local political opposition to the Lyons site was intense, particularly when technical problems with the site became apparent. The Government abandoned plans for Lyons 2 years later because AEC was unable to convince critics that the many mining boreholes throughout the site could be plugged reliably and because no one could account for the disappearance of a large volume of water flushed into a nearby mine.

Left without a repository, AEC requested the U.S. Geological Survey (USGS) to search for additional repository sites for defense wastes. It also proposed building a series of aboveground structures, called retrievable surface storage facilities (RSSFs), to store commercial high-level wastes for a period of decades while geologic repositories were developed. The environmental impact statement issued by AEC in support of the RSSF concept drew intense criticism by the public and by the Environmental Protection Agency (EPA) because of concerns that the RSSFs would become low-budget permanent repository sites, As a result, AEC abandoned the RSSF concept in 1975,

Recent History

Climate of Policymaking

After the mid-1970's, significant changes occurred in waste management. EPA issued its first standards-those for the preparation of reactor fuel,

for reactor operations, and for reprocessing of spent fuel—and announced its intention to develop standards for the disposal of nuclear waste. The Energy Reorganization Act of 1974 abolished AEC and distributed its developmental functions to the new Energy Research and Development Agency (ERDA), later changed to the Department of Energy (DOE), and its regulatory functions to the new Nuclear Regulatory Commission (NRC). JCAE was disbanded and its role assumed by a variety of congressional committees. These events marked the change to a formal process of regulating the storage and disposal of high-level wastes. Thus, ERDA (later, DOE) would select a disposal site and design a facility to meet regulations promulgated by NRC in accordance with EPA standards.

By the late 1970's, the problem of waste isolation had captured the focus of the Federal Government, which began to allocate substantial personnel and funds to its solution. Although many decisionmakers still contended that managing high-level radioactive wastes was not technically difficult, they increasingly recognized the nontechnical aspects of the problem and worked to develop a firmer technical base from which to make decisions.

Disposal

DEFENSE WASTE

The abandonment of the Lyons site left the Government without a repository for the nuclear wastes from Rocky Flats. To fill that need, ERDA officials in 1974 selected a site near Carlsbad, N. Mex., for construction of the Waste Isolation Pilot Plant (WIPP), a pilot repository for defense transuranic waste. Initially, State and local officials supported WIPP because of its potential for boosting the economy of an area hard hit by the decline in the potash industry.

Then in 1977, the Government made the first of several dramatic changes in the scope and mission of WIPP: it considered the emplacement of defense high-level waste at the facility.[4] To ensure repository safety, ERDA also promised the licensing of the repository by NRC. Angered by the changes in scope, the New Mexico House of Representatives came with in three votes of passing a constitutional amendment banning disposal of out-of-State nuclear waste. 'Under fire, DOE promised New Mexico officials veto rights over WIPP.

Relations were further strained in February 1978 when DOE recommenced the emplacement of up to 1,000 commercial spent fuel assemblies at WIPP. Local opposition arose over the increased hazards promised by the inclusion of spent fuel; over the change in nature of the repository from pilot to permanent; and over the perception that New Mexico, which had no commercial reactors, would assume a disproportionate responsibility for the Nation's commercial nuclear waste. Moreover, critics accused DOE of putting aside technical considerations to use WIPP to satisfy laws, passed by California and under consideration in other States, requiring that a demonstrated high-level waste disposal technology approved by the Federal Government must exist before additional reactors could be constructed.

During 1978 and 1979, Congress rejected the proposals for NRC licensing and State veto powers for WIPP. These actions weakened the credibility of DOE, which had promised those provisions to New Mexico. In 1980 President Carter proposed that WIPP be terminated but that the site (now called the Los Medanos site) be retained as a candidate for a future repository. Congress refused to terminate WIPP, reactivating it as an unlicensed defense facility primarily for disposal of transuranic waste from Rocky Flats and for defense high-level waste research. Site characterization activities at WIPP, including the construction of a large shaft and exploratory tunnels, are now underway.

COMMERCIAL WASTE

For disposal of commercial high-level waste, ERDA developed the National Waste Terminal Storage (NWTS) program in 1975. The program involved a multiple-site survey of underground geologic formations in 36 States and was designed to lead to the development of six pilot-scale repositories by the year 2000--the first in salt, the rest in other geologic media. This change from preoccupation with salt reflected new views about what constituted an effective repository. As formally

[4]This discussion of the history of WIPP is drawn from Jackie L. Braitman, *Nuclear Waste Disposal: Can Government Cope?* (Santa Monica, Calif.: The Rand Corp., December 1983), pp. 116-121.

expressed in 1978 in "Circular 779"[5] by several USGS scientists and also in a study by the American Physical Society,[6] the effectiveness, or integrity, of a repository could be considered dependent on the combination of the emplacement medium ***and*** its environment, rather than on the emplacement medium alone. With that view, salt, although still a strong contender, might not be the only choice for a geologic repository. Moreover, the staff of NRC contended that "it would be highly desirable to place major, if not primary, importance on the waste form itself, its packaging, and the local waste-rock interface. [7]

The responses of State officials to DOE's plans for the NWTS program varied. Some States excluded ERDA from even exploring potential repository locations. Others were reluctant to welcome ERDA until further studies were completed. Thus, what began as a fresh start in the area of waste management soon got mired down in the reluctance of State officials even to contemplate a facility on their soil.

Because of lower-than-requested funding and political opposition from the States, schedules slipped repeatedly as the Government was forced to cut the program drastically. By 1980, active site evaluation research was being undertaken only in Louisiana, Mississippi, Nevada, Texas, Utah, and Washington.

Recent Waste Management Policy

THE CARTER ADMINISTRATION

Partly to ease the utilities' growing burden of spent fuel storage, President Carter announced in his spent fuel policy in 1977 that title to spent fuel would be transferred to the Government and that the spent fuel would be transported at utility expense to a Government-approved away-from-reactor facility for storage until a repository became available. A one-time fee for Government storage and disposal would be charged to the utility. To limit the availability of weapons-grade material, President Carter extended the moratorium on reprocessing, set in the Ford administration in 1976, by suspending indefinitely the reprocessing of commercial spent fuel in the United States. The policy also offered to provide limited storage and disposal of foreign spent fuel, if necessary to meet nonproliferation objectives, and committed substantial resources to development of mined geologic repositories.

To help develop his administration's policy on long-term nuclear waste management, President Carter established in 1977 the Interagency Review Group (IRG), composed of representatives from 14 Government agencies. IRG submitted its report in 1979, and in 1980 President Carter ratified the unanimous conclusions of IRG, recommending:

1. proceeding with the geologic disposal program;
2. increasing State and Indian tribe involvement in repository siting;
3. preparing a detailed National Plan for Nuclear Waste Management; and
4. developing better participation programs for the general public and the technical community.

In addition, he required characterization of more sites in a variety of media prior to submission of a license request to NRC, an issue on which IRG had been unable to reach a consensus.

To formalize the relationship between DOE and the States, IRG formulated the concept of 'consultation and concurrence, first proposed by the National Governors' Association. Under this concept, a State would be consulted by the Government and given the opportunity to concur with each step in developing a repository. By not concurring, a State could effectively exercise a veto. To advise the Federal Government on key radioactive waste management issues, President Carter created the State Planning Council (SPC), a 14-member council of Governors, State legislators, an Indian tribal government representative, an observer from NRC, and representatives from DOE, the Department of Transportation, and EPA. SPC recommended that a State's nonconcurrence be overridden, or preempted, by the Federal Government only through a Presidential determination backed by both Houses of Congress.

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[5] J.D. Bredehoeft, A. W. England, D. B. Stewart, N. J. Trask, and 1. J. Winograd, ' 'Geologic Disposal of High-Level Radioactive Wastes—Earth Sciences Perspectives, Geological Survey Circular #779, U.S. Geological Survey, 1978.

[6] "Report to the American Physical Society by the Study Group on Nuclear Fuel Cycles and Waste Management," *Reviews of Modern Physics*, vol. *50, No. 1,* pt. 11, January 1978.

[7] App. A, p. 219.

96TH CONGRESS

Nearly 50 bills concerning waste management were introduced in the 96th Congress. The Senate passed a bill which emphasized development of long-term, monitored storage facilities that permitted the retrieval of the emplaced waste. The House passed a bill that focused on a timetable for development of mined repositories. However, no acceptable compromise could be reached between the two bills, largely because of disagreements about the power States should be given with respect to siting of defense waste repositories. [8] As a result, the effort to pass comprehensive high-level radioactive waste management legislation during the 96th Congress failed.

THE REAGAN ADMINISTRATION

In 1981 the Reagan administration declared its support for nuclear power and declared an ' 'intent to demonstrate the permanent storage of high-level radioactive waste as soon as possible. The administration lifted the ban on commercial reprocessing, and DOE adopted the assumption that the reference waste form for disposal would be solidified high-level waste rather than spent fuel. However, DOE efforts to encourage private investment in reprocessing have been unsuccessful. The Reagan administration also withdrew the Carter administration's offer to provide Federal storage facilities for spent fuel and left utilities with the primary responsibility for storing spent fuel until reprocessing or disposal facilities are developed.

With regard to repository siting, the Reagan administration reduced to three the number of sites that were to be examined prior to selecting a first site for licensing; the Carter administration had planned to evaluate four to five sites before making the selection. The three sites were expected to be in basalt formations at Hanford, in volcanic tuff at the Nevada Test Site, and in a salt formation at a site to be determined in 1983. Construction of exploratory shafts for in situ testing was planned to begin in 1983. After completion of the shafts in 1985, one of the three sites was to be selected for the development of an unlicensed test and evaluation facility for development of waste emplacement technology. This facility was planned to be ready to accommodate up to 200 to 300 packages of solidified high-level waste by 1989.

The first license application for a full-scale facility was expected to be submitted to NRC by 1987 or 1988. Review of the license application would be conducted by NRC in parallel with further development of the unlicensed test and evaluation facility. The first repository was expected to be constructed and licensed for operation between 1998 and 2001. [10]

[8] Both Houses agreed that the host State's objection would be sustained with regard to a repository for commercial high-level waste if either the House of Representatives or the Senate affirmatively concurred, but they were unable to agree to a procedure for dealing with a State's objection to a repository for defense high-level waste.

'This description of the waste management policy of the Reagan administration is drawn from the statement of Kenneth Davis, Deputy Secretary of Energy, before the Subcommittee on Energy and the Environment, Committee on Interior and Insular Affairs, U.S. House of Representatives, July 9, 1981.

[10] A similar schedule was ultimately incorporated in NWPA and is discussed at greater length in chs. 5 and 6.

PROBLEMS FOR WASTE MANAGEMENT POLICY

Key Policy Issues

Two major related waste management issues faced the 97th Congress when it began to consider radioactive waste legislation in 1981:

1. What to do about final isolation of the highly radioactive waste produced by nuclear reactors, which is contained for the present in the spent fuel discharged by those reactors.
2. What to do with the growing inventories of that spent fuel now stored at the reactors, given the uncertainties about when (or even whether) it would prove worthwhile to reprocess them, and when final isolation facilities would be available.

Final Isolation

The central issue that was to be resolved concerning final isolation was how strong a commitment to make to the development of a waste disposal technology that, unlike storage, would not require continued human control and maintenance to assure safe isolation.[11] Some argued that a disposal system should be developed with all deliberate speed. Others argued that a long period of interim storage (many decades) should be planned before developing a disposal system so that more options could be made available and uncertainties about the economic value of spent fuel could be resolved before selecting a disposal techology for development. Still others argued that storage itself is a satisfactory approach to final isolation, so no disposal system is needed. Although DOE made a formal decision to proceed with the development of mined geologic repositories, this decision had not yet been endorsed by Congress, and a bill passed by the Senate in the 96th Congress contemplated extended storage in monitored retrievable storage facilities as an alternative to rapid development of a disposal system. OTA's analysis indicated that until there was a clear resolution of this issue in law, continued instability in the direction of the waste management program was possible. *[2]

There was considerable disagreement over the degree to which the future use of nuclear power should depend on the development of an acceptable program for final waste isolation. Some argued that the United States should make no significant new commitments to nuclear power—and hence to the generation of more waste—until the safe and final isolation of nuclear waste could be demonstrated. Others argued that the technology for safe, final isolation was available and that there was no technical justification for restricting waste generation. Nonetheless, they argued that a demonstration of final isolation was needed to allay public concerns that threatened the continued growth of nuclear power. From either point of view, it was seen as important to resolve the existing uncertainties about final isolation of radioactive waste.

Even among those who agreed that developing the capability to dispose of—rather than store—radioactive waste was necessary to stop the issue from becoming an encumbrance on the use of nuclear power, there was substantial disagreement about how to demonstrate this capability and about the urgency of doing so. Some believed that the current basis of knowledge about mined geologic repositories was adequate to permit an acceptably safe repository to be sited and constructed quickly. They argued for rapid development of a repository (and perhaps an earlier unlicensed demonstration facility into which a small amount of waste would be emplaced) to allay what they perceived to be unfounded public concerns about waste disposal. Others believed that more time would be needed to develop sufficient confidence in a repository design and site. They contended that emplacement of waste in a demonstration facility would not by itself allay public concerns and feared that pressures for rapid action could lead to a premature commitment to an inadequate repository site or design or, at the very least, would lead to actions that would jeopardize the credibility of the Federal waste disposal program.

Some argued that resolving disagreements about the technical feasibility of waste disposal would not, in itself, be enough to remove disposal as an issue affecting the use of nuclear power, Demonstrating the Federal Government's ***institutional*** capacity to carry out the difficult effort required to build and operate a safe and reliable waste isolation system may be as important as demonstrating the ***technical*** capacity to dispose of waste.

Interim Spent Fuel Storage

The fact that neither reprocessing nor a Federal waste repository was likely to be available for a decade or longer meant that it would be necessary to provide interim storage for large quantities of spent fuel for at least the rest of the century. This posed two key problems for utilities, which led some to seek Federal assistance in providing that storage. First, reactors were running out of storage space, and it was clear that some might have to shut down by the mid-1990's unless more storage space were made available—even if existing basins were expanded as much as possible and if utilities were allowed to ship spent fuel to unfilled basins at other

[11] An extensive discussion of this subject is found in issue 1 of app. B.

[12] OTA testimony before the House Committee on Science and Technology, Subcommittee on Energy Research and Production, Oct. 5, 1981.

reactors. [13] Some utilities would face serious problems by the late 1980's if such shipment were not allowed. Because of the relatively long leadtimes needed for the construction and licensing of new storage facilities, these utilities needed to know within a few years whether they would have to provide such facilities themselves.

Second, the fact that there was no firm schedule for either reprocessing or turning spent fuel over to the Federal Government left the utilities completely in the dark about how much additional storage capacity they would have to provide, when they would be able to end their liability for the growing inventories of spent fuel, and how much the total cost would be for storing and disposing of that fuel. There was increasing opposition to efforts to provide additional storage capacity because of fear that easy availability of interim storage would reduce the pressures for developing a Federal disposal system, thus turning interim storage facilities into permanent waste repositories. This opposition, in turn, had increased utilities' fears that they might not be able to gain approval for additional storage facilities quickly enough to prevent reactor shutdowns.

Concern about the utilities' capacity to provide additional interim storage quickly enough to prevent reactor shutdowns, especially in the face of the Government's failure to develop disposal facilities, led some to argue that the Federal Government should provide away-from-reactor storage facilities to give utilities one sure way to get rid of spent fuel once their existing basins were full. [14] Others argued that the utilities should be responsible for interim storage, while the Federal Government concentrated on the disposal program. While the Carter administration proposed that the Federal Government acquire an away-from-reactor facility, the 96th Congress did not authorize it, and the Reagan administration focused, instead, on helping the utilities provide their own additional storage.

Complicating Factors

Linkage to Broader Issues

Resolution of disagreements about commercial waste management policy has been complicated by linkages to broader issues: the use of nuclear power, the future of reprocessing, and the disposition of high-level waste from defense activities. OTA's review of the history of waste management showed that disagreement over these broader issues was a major reason for the past inability of the Federal Government to devise a stable policy for dealing with commercial wastes, and suggested that successful adoption and implementation of such a policy would be easier if the policy were neutral regarding the resolution of these broader issues.

THE USE OF NUCLEAR POWER

In the mid-1970's, the public began to challenge the wisdom of developing a nuclear power industry unconstrained by the status of waste management. As noted in a memorandum for a JCAE policy session:

> . . . the uncertainties concerning the location of the repository are already adversely affecting public acceptance of nuclear power, and it is possible that this aspect of the overall nuclear program could become an unnecessarily important negative factor in the Nation's ability to consider its nuclear option to power generation. [15]

While there is strong disagreement about whether there should be any formal linkage in Federal law between progress in developing a final isolation program and the operation of nuclear reactors, there already is such a linkage in some State laws and in NRC policy. In 1976 California passed a law, upheld by the Supreme Court in 1983,[16] that made the siting of reactors in that State contingent upon Federal Government assurance that the demonstrated technology or means for disposal of high-level waste existed. In addition, the Natural Re-

[13] Such shipment between reactor pools is referred to as "transshipment."

[14] An extensive discussion of this issue is found in issue 4, app. B.

[15] *@p. A, p. 225.*

[16] *Pacific Gas & Electric CO. v. State Energy Resources Conservation and Development Commission, 1* U. S. L. W. 4449 (Apr. 20, 1983).

sources Defense Council petitioned NRC to conduct a rulemaking proceeding to determine if high-level waste could be disposed of without undue risk to the public health and safety and to refrain from licensing reactors until such a determination was made. In denying the petition, a position upheld in court, NRC stated that it ''would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely. "[17] In 1981 NRC announced its intention to conduct a generic proceeding ''to reassess its degree of confidence that radioactive waste produced by nuclear facilities will be safely disposed of, determine when any such disposal will be available, and whether such wastes can be safely stored until they are safely disposed of. As a result of this "Waste Confidence' proceeding, NRC concluded in 1984 that there is reasonable assurance: 1) that safe disposal of high-level waste and spent fuel in a geologic repository is technically feasible, and 2) that one or more mined geologic repositories would be available in the 2007-2009 time frame. [18]

An analysis of the merits of proposals to limit the use of nuclear power pending progress on waste disposal involves questions of energy policy that are beyond the scope of this OTA study. [19] However, currently operating reactors, which have already discharged more than 10,000 tonnes of spent fuel, would generate around 55,000 tonnes by the end of their operating lives, even if no additional reactors were licensed for operation. The waste in this spent fuel must be isolated safely, regardless of the future of nuclear power. However, the nuclear waste problem is only one of a number of difficulties inhibiting the expanded use of nuclear power,[20] and resolution of that problem by itself may not be sufficient to sway decisions in favor of new reactor orders. [21] Nonetheless, if the other difficulties are resolved, it appears likely that the degree of progress in the final isolation program in the next decade could affect decisions about the future use of nuclear power, whether or not there is a formal linkage between the two subjects. If a policy can be adopted, maintained, and implemented steadily and successfully over an extended period it can be expected to have a positive effect on attitudes about nuclear power. Continued delays and shifts of direction, or discovery of major unforeseen technical problems, could have a negative effect on the willingness of utilities to invest in new reactors.

[17] App. A, p. 227.

[18] U.S. Nuclear Regulatory Commission, 10 CFR Parts 50 and 50, ''Waste Confidence Decision, " *Federal Register, vol. 49, No. 171,* Aug. *13, 1984,* pp. *34658-34688.*

[19] This issue *was* not addressed in the NWPA.

[20] *Nuclear Power* in *an* Age *of Uncertainty* (Washington, D. C.: U.S. Congress, Office of Technology Assessment, OTA-E-216, February 1984). See also Graham Allison et al., "Governance of Nuclear Power" (Cambridge, Mass.: Energy and Environmental Policy Center, Harvard University, December 1981).

[21] Allison et d., op. cit., p. 43.

REPROCESSING AND THE POTENTIAL ECONOMIC VALUE OF SPENT FUEL

In OTA's view, the uncertainty about when, if ever, it will become economical to reprocess spent fuel has unnecessarily complicated Federal decisions about interim spent fuel storage and about final waste isolation. Some have argued, for example, that because spent fuel is a potentially valuable resource, the capacity to dispose of spent fuel need not— and should not—be developed until a clear decision on reprocessing is made. Extended or permanent storage has been proposed instead of disposal as a means of ensuring that the potential economic value of spent fuel is indefinitely preserved. However, the development of a disposal capacity will take more than a decade, and even when it is developed, spent fuel does not have to be disposed of irretrievably. Thus, the major decisions facing the 97th Congress did not concern the advisability of disposing of spent fuel, since the capacity to do so did not yet exist; rather, they concerned when and at what rate the capacity to dispose of waste would be made available, and what provisions would be made for the storage of spent fuel and any reprocessed waste in the meantime.

If the economic value of spent fuel remains uncertain once a disposal capacity has been developed, the decision can be made at that time whether to continue storing spent fuel or to dispose of it. As discussed in chapter 3, storage could be accomplished at a repository site by using the repository's packaging and handling facilities to receive and prepare waste for storage *on* the surface. Developing the capacity to dispose of both spent fuel and reprocessed waste may, in fact, be the best way to ensure that the decision to reprocess or dispose of spent fuel is based mainly on the resource value

of the spent fuel and not on the lack of a capacity to dispose of either spent fuel or high-level reprocessed waste .22

The question of when it might be desirable to dispose of spent fuel irretrievably, therefore, is quite distinct from the question of when it will be desirable to have the technical capacity to do so, although the two are frequently confused in discussions of waste management policy. The only irreversible decisions that can be made now are those related to the availability of technical capacity for disposal, since the longer the development of disposal facilities is deferred, the longer future waste managers will have no choice but to continue storage.

DEFENSE WASTE POLICY

The defense and commercial high-level radioactive waste programs, merged under the Carter administration, were separated by the Reagan administration. Disagreements about whether the same procedures for siting commercial waste repositories should also apply to repositories for defense wastes were a major reason the legislation dealing with high-level radioactive waste did not pass in the 96th Congress.

In this regard, some people argued that no matter what is done with military waste, the Federal Government had an obligation to get on with the resolution of the commercial waste management problem. They pointed out that the Government had, by law, reserved for itself the responsibility and the authority to dispose of high-level waste[23] and, thus far, had failed to fulfill its responsibilities. They argued that efforts to deal with commercial wastes should not be impeded by disagreements about policies for managing defense waste, as occurred during the 96th Congress. They also contended that separating the commercial and defense programs could allow more rapid progress in commercial waste disposal, which would, in turn, make it easier to deal with defense wastes by providing usable technology and sites. They noted that there were no compelling public administration arguments to have a single organization dealing with the two problems and cited precedents for separating military and civilian programs with similar technical requirements, such as assigning the civilian space program to the National Aeronautics and Space Administration. Moreover, some viewed a different institutional approach to siting repositories for defense waste as justified because they believed the balance of Federal authority should be greater in an activity associated with national defense.

Those who favored handling commercial and defense wastes in a unified program cited the similarities between their technical and environmental needs for long-term isolation. Such an integrated approach, they argued, would be necessary for gaining public acceptance of a national repository program and would discourage deferral of progress on disposal of defense wastes or the use of less stringent procedures in the defense program. Those who disagreed cited the fact that, since Federal law already provided that any repository for high-level waste, whether defense or commercial, would have to be licensed by NRC to meet the same environmental standards, separation of the programs would not necessarily lead to a less stringent approach with defense wastes.

Federal Credibility and Mutual Distrust

The most formidable problem that NWPA had to address was the intense level of mutual distrust among various concerned parties, a distrust that threatened to lock the waste disposal effort in a state of virtual and continual paralysis. The single most critical factor in that distrust was the severe erosion of public confidence in the ability of the Federal Government—on the basis of its past record—to create and carry out an effective waste management program.[24] The utilities and the nuclear industry doubted that the Federal Government would ever meet a schedule or stick to a policy. Environmentalists doubted that the Federal Government would deal adequately with safety concerns. States doubted that the Federal Government would deal openly and fairly with them.

[22] This is discussed in issue 3, app. B.

[23] William C. Metz, "Legal Constraints on Repository Siting," *Nuclear Waste: Socioeconomic Dimensions of Long-Term Storage,* Steve H. Murdock, F. Larry Leistritz, and Rita R. Harem (eds.) (Boulder, Colo.: Westview Press, 1983).

[24] National *Research Council, Social and Economic Aspects of Radioactive Waste Disposal:* Considerations for Institutional *Management* (Washington, D. C.: National Academy Press, 1984), p. 38.

To the degree that a Federal law alone can do so, NWPA went a long way toward meeting many of the specific concerns of the various parties and toward strengthening the credibility of the Federal effort. Below is a brief discussion of the main reasons why the credibility of the Federal program was so low before the passage of NWPA and of some of the remaining problems of mutual distrust that could complicate the effort to implement the Act.

POLICY INSTABILITY

The Federal waste management effort had been plagued by many major shifts of policy, making steady progress difficult and undermining public confidence in the effort.[25] A major cause of policy instability had been the failure of the Federal Government to consider a broad enough range of viewpoints, or to address adequately the legitimate technical and nontechnical concerns of major interest groups. This left some groups with a strong incentive to try to thwart or change the policies.

As a result, changes in administration had often meant abrupt changes in waste disposal policy. In 1976, for example, President Ford responded to concerns about the need to demonstrate progress in waste disposal by announcing a 1985 target date for the first repository, a policy that led to an almost exclusive focus on salt as a disposal medium and on sites that had already been studied or were regarded as easy to secure. The Carter administration, responding to the resulting concerns that an accelerated schedule could lead to premature commitment to a medium or site, adopted a new policy involving the review of four to five sites in two to three media and an anticipated repository target date of 1997 to 2006. The Reagan administration abandoned the Carter policy for one of examining three sites in two media, the minimum requirements of NRC, with earlier development of demonstration facilities. With respect to interim storage, the Carter administration proposed that the Government acquire an away-from-reactor facility and offered to accept spent fuel from utilities for interim storage prior to disposal. The Reagan administration rescinded the offer and announced that utilities would be responsible for interim storage. In view of such shifts, some observers questioned whether any policy could be expected to outlast a change of administration.

FEDERAL CAPACITY TO IMPLEMENT A POLICY[26]

The history of the waste management program raised questions about the institutional ability of the Federal Government to implement any waste management policy successfully, even if the policy could be stabilized for an extended period. There were several reasons for this concern.

First, until the mid-1970's, the waste management effort was starved for the stable and sufficient resources—both people and money—needed to ensure a successful waste management effort. Not until 1972 did waste management exist as a distinct bureaucratic entity with its own independent budget, and not until 1977 did the program receive substantial funding. Increases in the number and expertise of the staff that the waste program needed to meet its responsibilities did not keep pace with increases in funds. Moreover, history suggested that the normal Federal budget process may not assure the adequate and stable long-term funding needed to enable timely development of final isolation facilities. For example, inadequate funding of the Federal Government's geologic repository development program had limited the number of alternative technologies and sites that were investigated, increasing the likelihood that an acceptable system would not be developed in a timely manner and heightening concerns about the technical adequacy of the program.

Second, past problems in the final isolation program had raised questions about the capabilities of the DOE waste management program. These questions will burden its future efforts, even though the problems reflected not the competence of the people carrying out the program, but the low priority placed on the effort, the lack of resources, and the sharp and frequent shifts of policy. Although generally regarded as technically competent, the DOE program did not appear to have enough people with the skills needed to handle the social, political, and institutional issues that concern States,

[25] The State Planning Council recommended that "national planning for radioactive waste management should avoid abrupt changes in direction to prevent further deterioration of program credibility and loss of time." State Planning Council on Radioactive Waste Management, *Recommendations on National Radioactive Waste Management Policies: Report to the President, 1981,* p. 29.

[26] These issues are discussed at greater length in ch. 7.

local communities, and groups outside of DOE or to handle the broad policy and strategic issues. The failure to go beyond the strictly technical questions and address these kinds of issues had undermined much of the credibility of the waste management program.

Finally, the development and implementation of a comprehensive waste management policy will require an unprecedented degree of coordination within both the executive branch and Congress. At present, no single Federal agency or congressional committee has the jurisdiction to deal with the wide range of activities required to manage radioactive waste safely. Six major executive agencies and about 12 congressional committees have jurisdiction over different aspects of waste management. Experience suggests that coordinating the activities of all these Government entities will be difficult. Also, agencies have consistently failed to meet deadlines to implement policies according to schedule, perhaps, in part, because waste disposal is only one of the many activities for which they are responsible. For example, NRC's draft technical regulations for high-level waste, scheduled for issue in 1977, were actually issued in 1981; EPA's overall standards for waste disposal, due since 1977, were not even published for discussion until the end of 1982. These delays have raised questions about the ability of the Federal Government to meet a long-term schedule requiring the coordinated actions of independent agencies.

PERCEPTIONS OF TRUSTWORTHINESS

Justified or not, States and others had developed strong doubts that the Federal Government could be counted on to keep its word on waste management matters and that, in general, it could be trusted. One example of the basis for this distrust is the series of policy reversals concerning WIPP discussed above.

State Concerns[27]

To make technical progress in waste disposal, the Federal Government must have access to potential disposal sites in order to perform the detailed study and evaluation needed to determine site suitability. However, several States have sought to prevent DOE from conducting initial site investigations, and 18 States have enacted restrictive legislation that bans high-level radioactive waste management activities within their borders without State approval.[28] Other States may feel obligated to adopt similar restrictions to make certain they do not, by default, end up with waste storage or disposal facilities.

In addition to general concerns about Federal trustworthiness, State opposition to Federal siting activities has two main sources:

- ***The Inherent Costs and Risks Involved in Waste Disposal.*** –-The presence of any amount of radioactive waste and the various steps involved in storage and disposal pose potential radiological risks and have adverse social and economic impacts on States and localities. Although these impacts can be controlled or mitigated, there is no assurance that they can be eliminated, Even if States had no other concerns about waste disposal, they would probably be reluctant to take on such costs and impacts. In its extreme form, the desire not to bear the costs involved in waste disposal can lead to what has been called the "not in my backyard" or "anywhere but here' attitude, which may underlie at least some State opposition.
- *Fear* ***of Unfairness*** in Siting Decisions.—Many States fear that they could become a national dumping ground for waste—that they will be forced to take waste generated in other States or even from the entire Nation, thus bearing a disproportionate share of the waste disposal burden. Related to this fear is that of the "foot in the door'—the concern that if the Federal Government succeeds in siting any waste management facility, even a small research facility, it will try to save money and avoid fighting new siting battles by attempting to expand that facility, eventually creating a repository at that site. A related State fear is

[27] State issues are discussed at greater length in ch. 8.

[28] Sarah Daneman, "State Legislation on High-Level Nuclear Waste Disposal (as of 9/15/82)," published in The Radioactive *Exchange, vol.* 1, Nos. **14 and 15,** Part II, September/October 14, 1982, pp. 15-21. Some laws have banned activities involving waste from other States; others have required State approval prior to storage or disposal of all commercial high-level waste. DOE has so far not challenged the legality of these restrictions in court.

that Federal siting decisions will be based too heavily on considerations other than technical safety criteria, such as a desire to site a repository quickly to remove waste disposal as an obstacle to the use of nuclear power or a desire to avoid the difficulties of dealing with restrictive State legislation.

Although restrictive State legislation may not stand up to Federal court challenges, the legal processes entailed in such challenges could delay siting efforts. DOE had been reluctant to contest State restrictions and had sought, instead, to conduct waste management activities at sites where it was likely to encounter the fewest obstacles—either in time, cost, or political opposition. That approach can be defended on the grounds that, if it speeds up the process, and if the site eventually selected is technically sound, then it matters little how the site is chosen. However, that approach may increase resistance to Federal siting activities for two reasons. First, no site selection process is likely to be perceived as equitable or technically credible if it chooses, or appears to choose, sites mainly because they are the easiest to obtain. Second, the approach feeds State fears that the Federal Government will increasingly follow a "path of least resistance in seeking repository sites and thus strongly encourages those States that have not yet adopted restrictive or prohibitive measures to do so. No State wants to be last in the race to make certain that the path of least resistance does not lead straight into its borders.

Overall Impacts of History

NWPA is the first Federal law that sets out an explicit national policy and schedule for the disposal of high-level radioactive waste. It also contains a number of provisions aimed at overcoming some of the major concerns that have hampered the waste disposal effort in the past. But a law alone, no matter how well framed, cannot by itself wipe out the long legacy of problems and false starts and the deep distrust it has generated among the principal parties involved and concerned with waste disposal.

A law alone cannot demonstrate that the Federal Government has the capacity to deal fairly with the States in the selection and development of sites, to take the surest and safest route to waste disposal instead of the most expedient, or to demonstrate to the satisfaction of the regulatory authorities and the concerned and affected parties that an adequate waste disposal technology exists. Nor can a law alone dispel, however much it may allay, the distrust that decades have built up among the various parties.

That distrust may, indeed, be the single most complicating factor in the effort to develop a waste disposal system that is acceptable technically, politically, and socially. For, if Federal credibility—its capacity to show the various parties that it can and will do the job competently, fairly, and on schedule—remains the most critical factor in a successful waste disposal effort, it is not Federal credibility alone that is in question. States, environmentalists, and others may, indeed, fear that the Federal Government and industry will cut corners just to be able to say that the problem is solved. But there is the correlative concern that not all State forces or environmentalists are acting in good faith: that, whatever their express concerns with safety or other matters, some environmentalists seek to block and stall waste disposal efforts solely because they are opposed to the use of nuclear power, and some in the States seek only to prevent any and all waste disposal activities from occurring within their borders.

In short, some believe that no matter how well the Federal Government does its job in carrying out the Act—no matter what pains it takes to remove any legitimate grounds for opposition—there are those in the States and elsewhere who will do everything possible to slow or stop its efforts. Whatever the basis for this belief, it only makes it all the more necessary for the Federal Government to remove the legitimate grounds for opposition by carrying out the Act in ways that address the honest concerns of States and others and that seek to avoid past mistakes.

The waste management program has improved substantially over time in resources, breadth of organizational commitment, and technical and institutional sophistication. It has laid a solid technical groundwork for the development of mined geologic repositories. Furthermore, resolution of the key policy issues regarding interim storage and final isolation through enactment of NWPA should provide stability to waste management policy that has

been lacking in the past. Nonetheless, the burden of past problems will complicate the task of developing an effective and acceptable waste disposal system. Moreover, after more than three decades of struggling with nuclear waste, there is only a limited tolerance for failures. Any major failures—real or perceived—could have grave consequences for both the waste management program and the future use of nuclear power.