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NUCLEAR WASTE

DOE Should Provide More Information on Monitored Retrievable Storage



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Resources, Community, and
Economic Development Division

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The Honorable Morris K. Udall
Chairman, Committee on
Interior and Insular Affairs
House of Representatives

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy
and Power
Committee on Energy and Commerce
House of Representatives

As you requested in your March 18, 1985, letter and as agreed in subsequent meetings with your staffs, we have evaluated the Department of Energy's plans for monitored retrievable storage of spent nuclear fuel. As agreed, this report addresses issues relating to the need for, costs and benefits of, and viability of potential alternatives to a monitored retrievable storage facility. The report presents our findings, conclusions, and recommendations regarding the adequacy of the Department of Energy's analysis of these issues as presented in its monitored retrievable storage proposal.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees; the Secretary of Energy; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

This work was performed under the direction of Keith O. Fultz, Associate Director, Resources, Community, and Economic Development Division. Other major contributors are listed in appendix III.

J. Dexter Peach
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Executive Summary

Purpose

The Nuclear Waste Policy Act of 1982 established a program for the permanent disposal of radioactive wastes in mined geologic repositories. The act also directed the Department of Energy (DOE) to submit to the Congress a proposal for constructing a monitored retrievable storage (MRS) facility.

The Chairmen of the House Committee on Interior and Insular Affairs and the Subcommittee on Energy and Power, House Committee on Energy and Commerce, requested that GAO assess whether DOE's proposal provides sufficient information for the Congress to decide if it should authorize the integration of an MRS facility into the waste management system established by the act.

Background

The act focuses primarily on the development of two geologic repositories for the permanent disposal of nuclear wastes. However, the act also addresses another option for managing nuclear wastes—long-term storage in a facility that would allow continuous monitoring and easy access, or monitored retrievable storage. The Congress found that long-term storage in MRS facilities is an option for safe and reliable waste management, and that the Congress and executive branch should consider a proposal for building one or more facilities for this purpose.

DOE provided its MRS proposal to the Congress on March 31, 1987. DOE's proposal recommends that an MRS facility be constructed in Oak Ridge, Tennessee, to prepare, package, and temporarily store spent (used) nuclear fuel until shipment to a repository for permanent disposal. The facility's primary function would be waste handling and packaging rather than long-term storage as envisioned in the act. DOE does not maintain that an MRS facility is essential for safe handling and disposal of nuclear wastes. It believes, however, that an MRS would provide (1) greater system flexibility and reliability, (2) improved transportation, (3) earlier acceptance of spent fuel from utilities, and (4) public confidence in DOE's management of the waste program.

Results in Brief

For the Congress to decide the merits of an MRS, GAO believes that sufficient data should be available to compare the system proposed by DOE—with an MRS—with the currently authorized waste management system improved to maximize its efficient, effective, and safe performance. The Congress needs to be aware of the consequences of not approving an MRS as well as the implications of authorizing it. DOE's proposal does not

identify the most effective configuration of the authorized waste management system for the Congress to use as a basis for comparison in deciding if the benefits of the proposed MRS facility are worth its added cost to the waste program.

Further, DOE has not fully developed important MRS cost elements, such as payments for state and local taxes and aid to mitigate MRS' impacts. DOE does not plan to determine these costs until after the Congress has approved the proposal.

GAO's Analysis

The MRS concept outlined in the act emphasizes long-term waste storage. However, DOE is proposing an MRS whose principal role would be waste preparation rather than long-term storage. GAO believes that the difference between the purposes assigned to the MRS by the act and by DOE is one of the factors to be considered in evaluating DOE's proposal.

DOE's proposal does not demonstrate how the authorized waste management system (i.e., the system approved by the act which includes only a repository) could be improved so as to most efficiently, effectively, and safely function if an MRS were not included in the system. This information is needed as a basis for comparison with a system containing an MRS. Analysis of alternatives has not been sufficiently developed to determine whether the benefits attributed to the MRS can be achieved by other means, and at what cost.

Analysis of MRS Alternatives Is Incomplete

DOE's proposal does not analyze potential alternatives for improving the waste management system other than an MRS—such as expanding storage at reactor sites or the repository or improving the transportation system—to the same extent as the MRS. For example, DOE did not analyze the potential transportation improvements in sufficient detail to determine the costs or effects of each option. In addition, DOE has analyzed the various options in terms of how each option individually might affect the system. DOE has not, however, determined the combined effect of these options in achieving the most effective and efficient improvement in the authorized system (without an MRS), nor the costs of such a system in comparison to a system with an MRS. DOE also has not determined whether utilities are willing or able to implement various improvements in lieu of the MRS.

DOE acknowledges that additional information is needed on some of the options for improving the waste management system. Studies are

underway at DOE which may contribute to a better understanding of alternatives to an MRS.

Full Costs of MRS Are Not Yet Known

DOE estimates that integrating the MRS into the waste management system would increase total system costs by about \$1.5 billion to \$1.6 billion. According to DOE, however, these costs could be partially offset by savings of up to \$1 billion in spent fuel storage costs of reactors.

DOE has identified additional costs that are not included in its estimates such as payments for state and local taxes and aid to mitigate the impacts of constructing and operating the facility. DOE's Independent Cost Estimating staff also assessed MRS costs. This staff agreed that the estimates do not include all costs of constructing and operating an MRS and stated that some of the unquantified costs could be substantial.

Matters for Consideration by the Congress

DOE is seeking congressional authorization to construct an MRS facility primarily for waste preparation and packaging rather than for long-term waste storage. The Congress needs to recognize that the MRS concepts embodied in the Nuclear Waste Policy Act and DOE's proposal are different.

Recommendations

GAO recommends that DOE identify the best configuration of the authorized waste management system, combining the most feasible alternatives for maximizing the effectiveness, efficiency, and safety of the system in lieu of an MRS, and present the Congress with the benefits and costs of this system to aid in judging the merits of an MRS. GAO also recommends that DOE estimate the cost of all elements associated with the MRS. Additional recommendations are offered in chapter 5.

Agency Comments

The state of Tennessee concurs fully with the report's conclusions and recommendations. DOE disagrees with the report's conclusions and recommendations on the need for additional information on MRS costs and alternatives for improving the waste management system. DOE stated that it has estimated all appropriate costs, and that it is inappropriate to estimate costs for impact assistance and tax payments at this time.

Nothing in DOE's comments causes us to change our position that DOE needs to provide more complete information on MRS costs and alternatives. Further, we continue to believe that DOE has not quantified the full

costs of an MRS and needs to do so for the Congress to make an informed decision on the facility. DOE's comments are addressed in chapter 5.

DOE's and Tennessee's comments have been incorporated into the report, where appropriate. Their comments are reprinted in appendixes I and II.

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Abbreviations

DOE	Department of Energy
EI	Edison Electric Institute
GAO	General Accounting Office
ICE	Independent Cost Estimating staff
MRS	monitored retrievable storage
MTU	metric tons of uranium
NRC	Nuclear Regulatory Commission
OCRWM	Office of Civilian Radioactive Waste Management
PRDA	Program Research and Development Announcement

Introduction

Currently, 107 commercial nuclear power plants, located in 27 states, are licensed to generate electricity; another 13 plants are in various stages of construction. In 1985, approximately 16 percent of the electricity produced in the United States was provided by nuclear power.

Nuclear power plants use uranium as fuel to heat water and produce steam. The steam, in turn, spins a turbine and generator to produce electricity. The uranium fuel is fabricated into pellets, which are inserted into rods. These rods are then bundled together to form fuel assemblies, which are placed in reactors. A nuclear power plant can use about 38,000 uranium fuel rods, grouped into about 215 fuel assemblies, to produce the required steam. When fully loaded, a reactor contains over 200,000 pounds of uranium.

As steam is produced by the reactor, some of the energy contained in the uranium fuel is consumed. Approximately every 12 to 18 months, about one-third of the fuel in most reactors has to be replaced with fresh uranium fuel. When the uranium has been consumed, the remaining material—called spent fuel—is removed from the reactor. The spent fuel is then transferred and stored underwater in a large pool at the reactor site. Almost all the spent fuel from commercial nuclear power reactors remains in storage at each reactor location.

A Change in Direction

The Nuclear Waste Policy Act of 1982 (Public Law 97-425, Jan. 7, 1983) was a milestone for commercial nuclear power because, for the first time in the 30-year history of the industry, a national strategy was put in place for disposing of spent fuel. In addition to addressing the waste needs of the commercial sector, the act also requires the President to evaluate how to dispose of the high-level radioactive wastes produced by the nation's defense programs. The waste management system established by the act—referred to by the Department of Energy (DOE) as the "authorized system"—is primarily composed of two elements: commercial nuclear power reactors, which generate waste in the form of spent fuel, and a geologic repository, a deep, mined structure in which the spent fuel will be disposed. The act also provides for the development of a transportation system for moving the waste from reactors to the repository, and if needed, Federal Interim Storage for a small quantity of spent fuel—1,900 metric tons of uranium (MTU).

The act outlines the following radioactive waste management responsibilities:

- The federal government has the responsibility for the permanent disposal of high-level radioactive wastes and spent fuel produced by commercial nuclear reactors in a mined geologic repository. The act established the Office of Civilian Radioactive Waste Management (OCRWM) within DOE to carry out this responsibility.
- Those who produce and own radioactive wastes are responsible for paying for storage and disposal of the wastes.

The Nuclear Waste Policy Act established the Nuclear Waste Fund to ensure that the costs of a safe and environmentally acceptable program are fully funded. The fund is financed through fees collected from the owners and generators of nuclear waste. Although the act did not stipulate how payments would be made for the disposal of defense wastes, it required commercial reactors to pay into the Nuclear Waste Fund a fee of 1.0 mill (one-tenth of a cent) per kilowatt-hour of electricity generated by the spent fuel. The Fund had a balance of \$1.4 billion by the end of fiscal year 1986; utilities still owe about \$1.21 billion in one-time fees for the disposal of wastes produced prior to April 7, 1983. The balance, plus accrued interest, will be paid either in quarterly installments or as a single lump-sum payment before the transfer of spent fuel to the federal government.

Developing an Option for Waste Management

Although the act's primary focus is to develop deep, mined geologic repositories for the permanent disposal of spent fuel and high-level radioactive wastes, Section 141 of the act presents another option for spent fuel management called monitored retrievable storage (MRS). According to the act, the Congress found that "... long-term storage of high-level radioactive waste or spent nuclear fuel in monitored retrievable storage facilities is an option for providing safe and reliable management of such waste or spent fuel." According to the act, the MRS should be designed to provide several functions, including

- storage and monitoring of spent fuel and waste "for the foreseeable future" and
- retrieval of the spent fuel and waste for further processing or disposal.

The Congress also found that it and the executive branch should proceed as expeditiously as possible to consider fully a proposal for constructing one or more MRS facilities to provide for such long-term storage. The act requires the Secretary of Energy to complete a detailed study of the need for and feasibility of an MRS and to submit to the Congress a proposal for the construction of one or more MRS facilities. The

act did not authorize the construction of such a facility; DOE must receive specific authorization from the Congress to construct an MRS. The act states, however, that disposal of nuclear wastes in a repository should proceed whether or not an MRS facility is constructed.

The Role of MRS

DOE presented its initial plans for an MRS in the waste program's April 1984 draft Mission Plan. At that time, DOE envisioned MRS as a facility to provide "backup" storage should there be significant delays in the availability of the repository. Under these plans, an MRS facility would be used to store spent fuel until the repository was ready to receive it. When the repository was available, spent fuel would be shipped to the repository site, where waste preparation and packaging activities would be performed.

In the summer of 1984, DOE began reassessing the role of the MRS in the waste management system authorized by the act. On the basis of this reassessment, DOE concluded that the MRS should be an integral part of the waste management system by incorporating most of the waste-handling and packaging activities that otherwise would be located at the repository. In March 1985, DOE reprogrammed waste program funds in order to develop a proposal for an "integral" MRS. DOE stated in the June 1985 final Mission Plan for the nuclear waste program that the primary function of this integral MRS facility would be to prepare waste for disposal in the repository; its role in providing backup storage would be secondary, although it would allow DOE to begin accepting spent fuel from utilities in 1998 and could provide temporary storage if the repository is further delayed.

The MRS Proposal

Reflecting the results of its reassessment of MRS roles, DOE has developed a proposal recommending that the Congress approve construction of an MRS in Tennessee that would receive and prepare the spent fuel from reactors located east of the Rocky Mountains (approximately 90 percent of the commercial reactors) for later emplacement in a repository. The MRS would begin operation in 1998 and have a 31-year service life. The spent fuel from the reactors located in the western states, as well as high-level defense-related radioactive wastes, would be shipped directly to the repository for emplacement. DOE has outlined the following principal functions which could be performed at the MRS facility:

- Extracting the spent fuel rods from their assemblies and consolidating them into a more compact configuration which would provide greater efficiency in handling, storage, transportation, and disposal.
- Loading the spent fuel into canisters for temporary storage at the MRS or shipment to a repository.
- If necessary, providing for storage of spent fuel for longer periods in sealed concrete containers which would allow for radiation monitoring and retrieval for later shipment to a repository.
- Providing a location where dedicated trains³ could be assembled to ship the spent fuel to a repository.

DOE has concluded that although an MRS facility is not required to safely manage nuclear wastes, several advantages could be realized by making the MRS an integral part of the waste management program. In citing these advantages, DOE noted that there are other ways to achieve some of the benefits attributable to an MRS; DOE concluded, however, that none of the alternatives examined provides the same range of benefits to the system that an MRS could while also providing equivalent advantages in terms of feasibility, flexibility, system development, and managerial control. The following summarizes the advantages which DOE stated may be provided by an MRS:

- DOE could begin detailed planning for and implementation of a major part of the waste management process—waste acceptance, transportation from reactor sites, consolidation, and sealing in canisters—earlier if these functions were located at an MRS rather than the repository. The waste transportation system could be developed sooner because approval of the MRS would allow specific routing, logistics, and equipment requirements to be determined up to 8 years earlier. According to DOE, the early accomplishment of these waste management steps would enhance confidence in the schedule for operation of the entire system.
- If, as DOE plans, an MRS begins operation before a repository, DOE could be able to receive spent fuel from utilities sooner than under the authorized (repository-only) system. The MRS, therefore, could reduce the need for temporary storage at reactor sites. DOE now plans to have the MRS operating in 1998 and the repository in 2003. According to DOE's proposal, the MRS would be critical to DOE's ability to accept waste for disposal in 1998 as committed in the waste disposal contracts with utilities.
- The reliability and flexibility of the waste management system could be improved because spent fuel could be removed from the storage pools at

³Dedicated trains transport only a particular type of cargo—in this case, spent fuel.

the reactor sites regardless of whether a repository is capable of emplacing the wastes.

- The waste-handling requirements at the repository could be simplified because the steps required to prepare spent fuel for emplacement in the repository would be performed at the MRS. According to DOE, the repository would receive fewer shipments, canisters received would be uniform in size and free from radioactive surface contamination, and the rate of waste transfer to the repository could be better controlled.
- The transportation system could be improved because the MRS would serve as the spent fuel shipment center. Dedicated trains would be used to move the spent fuel from the MRS to the repository. This would reduce the number of cross-country routes and shipments of spent fuel to the repository to be located in the western United States. This would also reduce the potential for public exposure to transportation accidents.
- Institutional benefits could be gained. Experience from interactions with the state of Tennessee—the intended host state for the MRS facility—may be applied in the future when working with states and tribes in the repository program. Further, the MRS would present the opportunity for DOE to demonstrate earlier that the waste facilities can be safe, and that DOE can be a “responsible corporate citizen and neighbor.” Through the MRS, DOE could develop the needed momentum to implement the entire waste system and may be able to gain public acceptance and confidence that it is able to accomplish the program.

MRS Proposal in Litigation

DOE identified three sites in Tennessee that it considered favorable for an MRS facility and indicated the canceled Clinch River Breeder Reactor site, located in the Roane County portion of Oak Ridge, as the preferred location. In April 1985, DOE formally notified the Governor of Tennessee that it had completed an initial evaluation of candidate sites for an MRS facility and that all three of the sites were in Tennessee. DOE also advised the governor that the evaluation of the sites would have to be completed to submit the MRS proposal to the Congress.

At that time, DOE announced in the Federal Register that it had identified the candidate MRS sites and indicated that it planned “. . . to study these sites for inclusion in a proposal to Congress for the construction of an MRS facility.” DOE indicated that it would prepare an environmental assessment required by the act and requested that by July 1, 1985, states, affected Indian Tribes, and the public provide information which may be useful in preparing the assessment.

In June 1985, DOE provided the state of Tennessee with a grant of \$1.4 million to perform an independent evaluation "... of the role and function of an MRS facility in the nuclear waste disposal program and DOE's proposed locations of such a facility."

On August 20, 1985, the state of Tennessee filed a complaint with the United States District Court for the Middle District of Tennessee at Nashville, which argued that the MRS proposal should not be submitted to the Congress because the Secretary of Energy had failed to consult with the state pursuant to Section 117 (b) of the act. The Secretary sought to have the state's suit dismissed, but the District Court agreed with the state, denied DOE's motion, and enjoined DOE from submitting its proposal to the Congress.

Several motions and appeals were filed by DOE and the state of Tennessee in this case. On March 6, 1986, the United States Court of Appeals for the Sixth Circuit denied DOE's appeal for a summary reversal of the lower court's decision to enjoin DOE from submitting its proposal to the Congress. The case was heard on July 24, 1986, and on November 25, 1986, a three-judge Appeals Court Panel reversed the District Court's ruling and dismissed the state's petition for review of DOE's actions.

On December 4, 1986, Tennessee filed for a review of the judges' decision by the full 12-judge Court of Appeals. On December 31, 1986, the petition for rehearing was denied, and on January 5, 1987, the state of Tennessee requested a stay of the court's mandate in order to prepare an appeal to the U.S. Supreme Court. The Court of Appeals granted a stay for 30 days on January 7, 1987, and on February 5, 1987, the state of Tennessee petitioned the Supreme Court to review the case. On March 30, 1987, the Supreme Court denied the petition, thus removing the legal restrictions preventing DOE from submitting the MRS proposal to the Congress.

On March 31, 1987, DOE submitted the MRS proposal to the Congress, seeking the authorization to begin constructing the MRS facility.

Objectives, Scope, and Methodology

Objectives and Scope

In a March 18, 1985, letter, the Chairmen of the House Committee on Interior and Insular Affairs and the Subcommittee on Energy Conservation and Power, House Committee on Energy and Commerce, requested that we review and evaluate DOE's proposal to integrate an MRS into the nuclear waste management system. The request contained seven questions addressing the purpose of an MRS, the impacts it would have on the cost and development schedule of the repository, alternatives to the MRS that DOE has examined, the siting and transportation impacts of the proposal, and whether DOE has adequately addressed all of these issues to provide for a congressional decision on the proposal. On July 22, 1986, Representative Marilyn Lloyd also requested that we evaluate certain aspects of the cost and need for an MRS facility.

On May 8, 1986, we provided the Chairmen with a fact sheet² containing information on the purpose, advantages, and disadvantages of the proposal; the role of the state of Tennessee in the program; and the results of our survey of utilities' plans for expanding their spent fuel storage capacity and their views on the need for, and benefits of, the MRS.

On August 15, 1986, we provided another fact sheet³ to the Chairmen on DOE's cost estimates for the MRS as of February 1986. The fact sheet stated that although DOE had estimated that the cost of integrating the MRS into the overall waste management system ranged from \$1.6 billion to \$2.6 billion, additional costs had been identified which could be substantial but which, according to DOE, could not be quantified at that time.

This report addresses the remaining questions posed by the Chairmen regarding how well DOE has analyzed (1) the need for and benefits of the MRS and (2) alternatives for providing the benefits attributed to the MRS. It also responds to the issues raised by Representative Lloyd relating to the cost and need for an MRS. The primary objective of our review was to determine whether DOE's proposal provides sufficient information for

²Nuclear Waste: Monitored Retrieval Storage of Spent Nuclear Fuel (GAO/RCED-86-104FS, May 8, 1986).

³Nuclear Waste: Cost of DOE's Proposed Monitored Retrieval Storage Facility (GAO/RCED-86-198FS, Aug. 15, 1986).

the Congress to weigh the merits of an MRS and decide whether to incorporate the facility into the waste management system authorized under the Nuclear Waste Policy Act. We did not independently assess the merits of building and operating an MRS facility.

General Methodology

We obtained most of the information for this report from documents provided by DOE. We reviewed the December 1985 "Review Copy" of DOE's proposal, as well as the final proposal submitted to the Congress in March 1987. (The final proposal is essentially the same as the "Review Copy," with revisions in a few areas to reflect changes to the waste management program included in OCRWM's January 1987 Draft Mission Plan Amendment.) We also reviewed (1) DOE's April 1986 analysis of the nuclear waste program's total system life-cycle cost and (2) various internal DOE memoranda and contractor studies supporting the proposal or relating to the costs and benefits of the MRS and alternatives. In addition, we used the information developed for our two earlier fact sheets in the analysis contained in this report.

We also obtained information and views on the MRS from officials of (1) OCRWM, (2) the Nuclear Regulatory Commission (NRC), from which DOE must obtain licenses before constructing and operating an MRS facility and a permanent waste repository, (3) the Edison Electric Institute (EEI), an organization representing investor-owned electric utilities which serve about 73 percent of all electricity customers, and (4) the American Nuclear Energy Council, an organization representing the nuclear industry.

Our review was performed in accordance with generally accepted government auditing standards. Our review was generally conducted from March 1985 through September 1986; however, in April 1987, we reviewed DOE's final MRS proposal and updated our analysis as required.

Survey Methodology

Chapters 2 and 3 of this report discuss results of a survey we conducted in November 1985 in which we asked the chief executive officers of the 74 utilities that either own or operate nuclear power plants for their plans to accommodate growing inventories of spent fuel and their views on DOE's plans for an MRS. Our questionnaire included a brief description of the purpose and functions of the integral MRS as presented by DOE at that time. We concluded that the level of detail included in that description—in conjunction with the information on the MRS publicly available

from DOE at the time—was sufficient to permit utility officials to complete our survey from an informed base. In November 1985, a number of DOE documents discussing the MRS plans were publicly available: The Need for and Feasibility of Monitored Retrievable Storage—A Preliminary Analysis (DOE/RW-0022) April 1985; Screening and Identification of Sites for a Proposed Monitored Retrievable Storage Facility (DOE/RW-0023) April 1985; and Mission Plan for the Civilian Radioactive Waste Management Program (DOE/RW-0005) June 1985. In addition, on several occasions prior to November 1985, DOE officials had testified before congressional committees and delivered presentations before nuclear industry forums on DOE's MRS plans and its benefits. While not containing the detail and technical information that the final MRS proposal contains, these documents contained sufficient information to allow utility officials to answer our questionnaire without our having to provide more detailed information in the survey itself. In addition, while our questionnaire was still in the hands of many respondents, DOE's "Review Copy" of the MRS proposal became available.

Our survey was divided into two sections: questions regarding utilities' spent fuel storage plans and questions on utilities' views on DOE's MRS plans. We considered the focus in the first section of the questionnaire on spent fuel storage to be important because the MRS, regardless of its primary purpose in the context of the overall waste management system, would most directly affect utilities' through its effect on spent fuel storage—the MRS would have a bearing on when spent fuel would be removed from reactor sites and, therefore, utilities' plans for accommodating their own at-reactor spent fuel storage needs. In addition, the section of the questionnaire seeking utilities' views on the MRS specifically asked about utilities' ability to perform some of the functions on-site—which DOE is proposing to conduct at an MRS—such as rod consolidation, standardized packaging, centralized transportation to a repository, and long-term storage.

We prepared and conducted our survey in accordance with GAO's policies relating to data collection methodologies to ensure that the results are accurate and unbiased. The results of our November 1985 survey, however, now appear to conflict somewhat with recent resolutions and positions of nuclear industry organizations and some utilities which indicate strong support for DOE's MRS proposal. EEI and other organizations, as well as representatives of some individual utilities, have recently endorsed DOE's MRS plans. However, changes in the nuclear waste management program since our survey was conducted—in particular, the delay in the repository operation date until 2003—may have changed

utilities' opinions of the MRS. The MRS has now become critical for DOE to meet its commitment to begin accepting spent fuel from utilities in 1998. With a delay in the repository until 2003, the only alternative to an MRS facility may be for utilities to store their spent fuel at reactor sites for an additional 5 years before DOE will begin removing it. These developments may make the MRS appear more attractive to utilities than it did in November 1985. However, we continue to believe that, regardless of present circumstances and utilities' current views on the MRS, our survey accurately reflects the views of utility officials at that time.

Chapter 2 of this report discusses the benefits of an MRS identified by DOE. Chapter 3 discusses limitations of DOE's evaluation of potential alternatives to an MRS, and chapter 4 discusses DOE's MRS cost estimates. Chapter 5 summarizes our views on the proposal, presents our conclusions and recommendations, and addresses DOE and state of Tennessee comments on this report.

Comments by DOE and the State of Tennessee

A draft of this report was submitted to DOE and the state of Tennessee for comment. DOE officials' comments were of two types: (1) specific technical and editorial comments aimed at enhancing the report's accuracy and (2) general comments on the principal conclusions and recommendations of the report. DOE's technical comments have been incorporated into the report where appropriate. In general, DOE disagreed with the report's conclusions and recommendations relating to the completeness of the MRS proposal and the need for DOE to quantify all MRS costs and perform further work on alternatives to the MRS. DOE's general comments on the key messages of the report are summarized and addressed at the end of chapter 5. DOE's complete comments are included in appendix I.

The state of Tennessee also provided comments on our report. (See app. II.) Tennessee officials agreed with the conclusions and recommendations of the report and provided additional comments, which are also discussed in chapter 5.

DOE Concludes That the MRS Will Provide Benefits but Is Not Required to Dispose of Nuclear Wastes

Although DOE recommends in its proposal that the Congress approve construction of an MRS, DOE has concluded that nuclear wastes can be safely managed without an MRS. Nevertheless, DOE believes that several improvements could result from the integration of the facility into the nuclear waste management system authorized by the Nuclear Waste Policy Act. According to DOE, one of the principal benefits of an MRS is that it would allow the federal government to accept nuclear wastes from commercial reactors regardless of whether a repository is operational or capable of emplacing the wastes. DOE states that the MRS facility would be critical to DOE's ability to accept waste for disposal in 1998. DOE also believes an MRS could provide for packaging of waste material and enhance the efficiency and flexibility of the waste transportation system.

While DOE has acknowledged that some of the waste management system improvements attributable to an MRS could be realized through other means, its position is that no other alternative or combination of alternatives provides the same level of managerial control or ease of implementation as the MRS.

In order to ensure that an MRS does not hinder the development of a geologic repository, DOE is proposing that the Congress establish a link between the operation of the MRS and the construction of a repository. This linkage provides that no waste will be accepted at the MRS until NRC issues a license to construct the repository.

Based on a survey of nuclear utility companies we conducted in November 1985, there is a range of utility opinion regarding the MRS. Although EEI has stated its support for an MRS, it is not in favor of linking the acceptance of nuclear wastes at the MRS to construction authorization for the repository.

DOE Believes the MRS Option Would Allow Earlier Acceptance of Nuclear Wastes

According to DOE, activities authorized by the act can provide for the permanent disposal of spent fuel and high-level radioactive waste. The act provides for (1) the development and operation of two repositories, (2) implementation of a transportation system to move the wastes to the repositories, (3) federal interim storage of no more than 1,900 MTU for "civilian nuclear power reactors that cannot reasonably provide adequate storage capacity at the sites of such reactors when needed to assure the continued, orderly operation of such reactors," and (4) a program to cooperate with private industry to develop technologies that will enhance spent fuel storage capacity at reactors.

Utilities are currently responsible for the on-site storage of spent fuel until DOE takes title to the spent fuel at the reactor sites. DOE, as required by the act, contracted with utilities to begin disposing of spent fuel no later than January 31, 1998. DOE expects the first repository to begin operation in 2003. DOE has stated that, once the repository is in full-scale operation, the waste acceptance rate at the repository will closely approximate the rate at which the waste is placed in the underground facility. Consequently, only a small amount of storage capacity—about 750 MTU—will be provided at the repository. This storage capacity is intended to act as a buffer in the event that emplacement of the wastes is slowed or interrupted. In February 1987, DOE announced that the first repository would be delayed until 2003. According to DOE, with a delay in the startup of the repository, spent fuel will have to stay at the reactor sites in the absence of an MRS. According to DOE, an MRS would allow acceptance of nuclear wastes 5 years earlier than would be possible with only a repository. DOE now believes that because of the delay in the repository schedule, the MRS is critical to DOE's ability to begin accepting spent fuel in 1998 as agreed in the disposal contracts.

DOE has concluded that some additional storage capability may be needed in the waste management system for several years after the repository begins operations because the inventory of spent fuel at reactors may grow faster than it can be received and emplaced at the repository. From its analysis of future utility spent fuel storage requirements, DOE has determined that adding the MRS to the authorized waste management system would eliminate the need for additional storage capacity at between 16 to 24 of more than 100 commercial reactors.

The MRS as Part of the Waste Management System

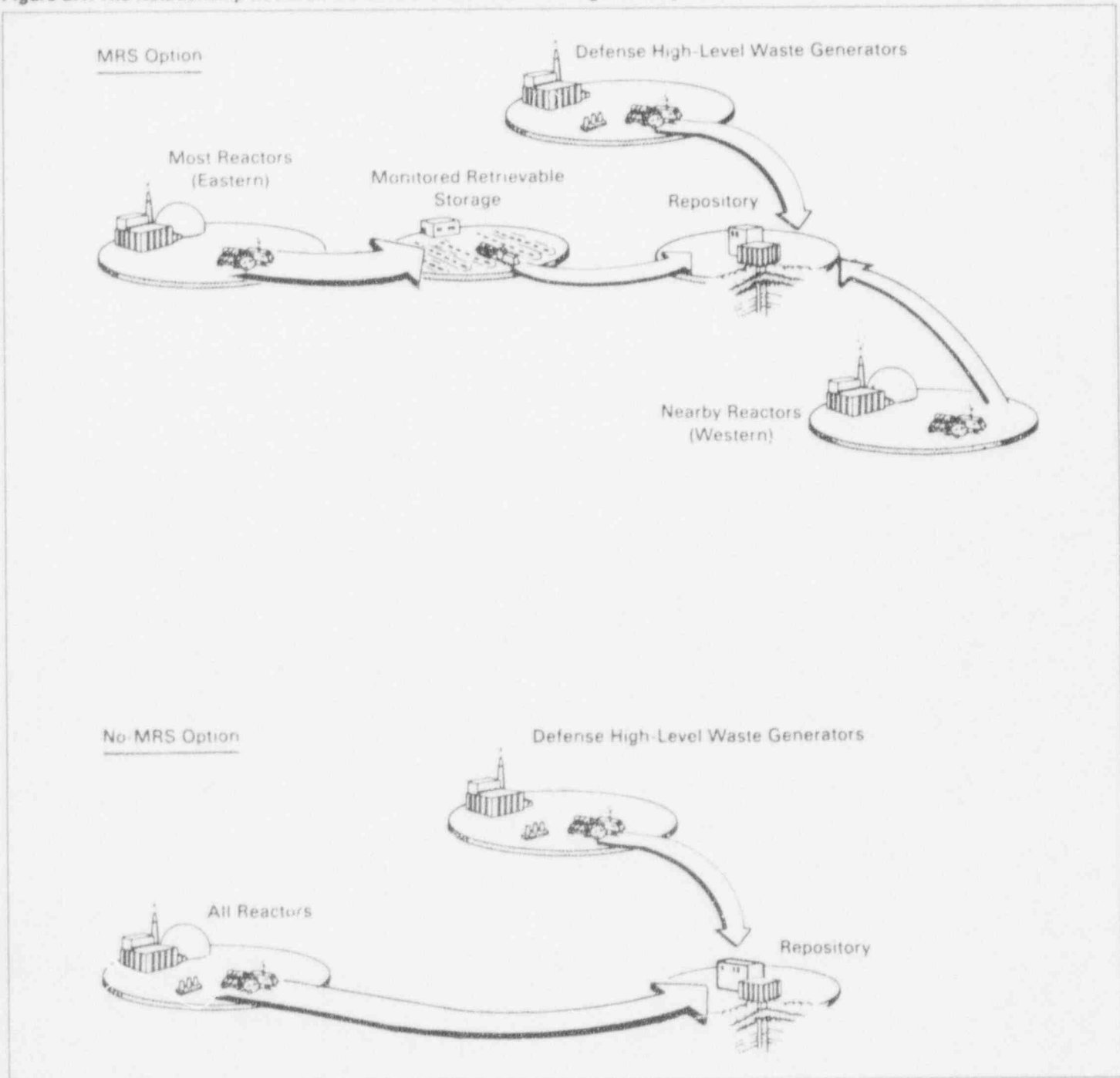
The MRS would service all commercial reactors located east of the Rocky Mountains. Nuclear wastes produced by defense-related activities and spent fuel from reactors located in the west generally would be sent directly to the repository for emplacement. However, according to DOE, the MRS would accept spent fuel from western reactors "if contractual requirements necessitate."

The Nuclear Waste Policy Act limits the first repository's capacity to 70,000 MTU until a second repository is operational. According to DOE, 59,800 MTU of spent fuel would be processed through the MRS facility and sent to the first repository over a 31-year period. The remaining 10,200 MTU of spent fuel to be placed in the repository would consist of 5,600 MTU of spent fuel from western reactors and the equivalent of

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4,600 MTU of defense-related wastes. Figure 2.1 illustrates the relationship between the MRS and the waste management system authorized by the act.

Figure 2.1: The Relationship Between the MRS and the Waste Management System



Source: DOE.

Functions to Be Performed at the MRS

In the currently authorized waste management system, many of the steps which will be required to prepare spent fuel for emplacement in a repository will have to be performed either at reactor sites or the repository. However, if the MRS is integrated into the waste management system, the receipt and processing of most spent fuel would be performed at a location which would be central to most eastern commercial reactors. According to DOE, performing these functions at an MRS would reduce the preparation and packaging requirements at the repository. The following describes the primary functions which would be performed at the MRS.

Receipt and Handling of Spent Fuel

The MRS would include a spent-fuel receiving and handling building, which would be the main operating area of the MRS facility. Spent fuel from commercial reactors would be shipped to the MRS either by truck or train in heavily shielded transportation casks. Upon receipt, the spent fuel would be unloaded in the receiving and handling building, processed, and inserted into canisters for eventual emplacement at the repository. The spent fuel would be either shipped immediately to the repository or stored at the MRS until it could be accepted at the repository.

Rod Consolidation

An important aspect of DOE's plan for processing spent fuel is rod consolidation. When used in a reactor, nuclear fuel is contained in hollow rods, which are inserted into spacers, brackets, and other related hardware to form square fuel bundles. During the rod-consolidation process, the individual fuel rods would be removed from the hardware that holds them together and rearranged in a tighter array. This process reduces by about one-half the amount of space required to store spent fuel. The consolidated fuel rods would then be loaded into stainless-steel canisters, which could be either shipped to the repository or stored temporarily at the MRS. The remaining structural hardware would be compacted, packaged in containers, and shipped to the repository for disposal.

While DOE believes that rod consolidation would provide benefits to the waste management system, it has not yet decided whether this process will be a required part of the system. If rod consolidation is included in the waste management system at the MRS, the process will be performed in a specially designed facility known as a hot cell, which will be located

in the receiving and handling building. The hot cell is necessary to provide protection from the high levels of radiation emitted by the spent fuel.

Temporary Storage

DOE believes that if an MRS is integrated into the authorized waste management system, beginning in 1998, spent fuel could be transported to the facility for temporary storage until shipment to the repository. DOE has selected surface storage in sealed concrete casks as the preferred method for providing storage at the MRS. An alternate method is in-ground drywell storage. These techniques are illustrated in figures 2.2 and 2.3, respectively.

The above-ground cask is a steel-lined reinforced concrete cylinder which contains the stainless-steel canisters of spent fuel. The lid of the cask is welded shut and closed by a thick concrete plug. Temperature probes and air-sampling tubes will allow continuous monitoring of the casks' interior. The casks will range from 17 to 22 feet in height, measure 12 feet in diameter, and weigh up to 220 tons when loaded. They will be placed vertically in rows on concrete pads in the storage area. The environment of the storage area will be continuously monitored to detect any failure of the casks to contain radiation.

The alternative drywell method stores the spent fuel in metal enclosures which extend about 20 feet into the ground. The drywell's metal cavity and surrounding soil provide a radiation shield and a medium to conduct the heat away from the canister containing the spent fuel. The area surrounding the drywell will also be monitored to detect any radiation escape. According to DOE, this storage method has been used safely in many parts of the world for the last 20 years.

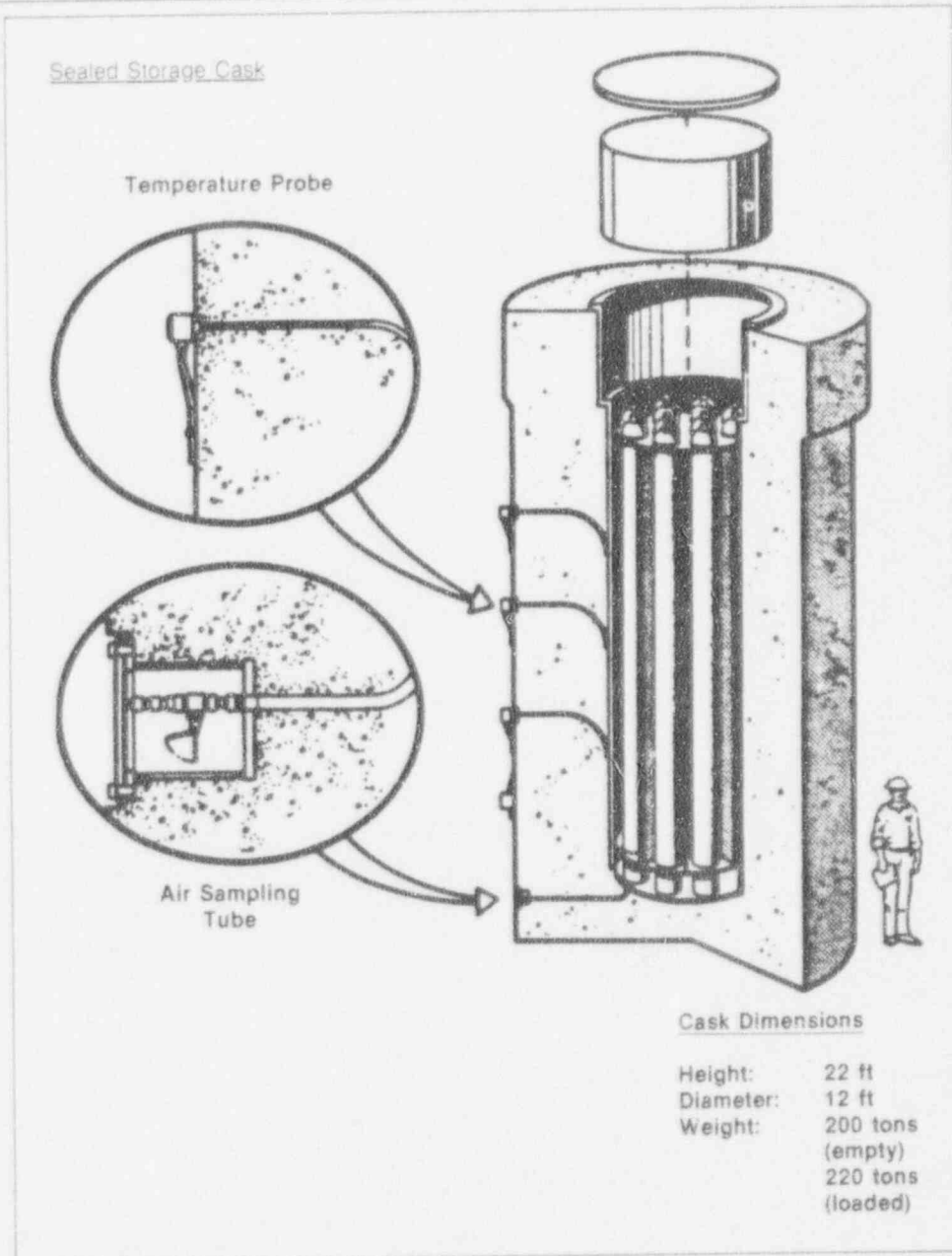
In addition to the above storage methods, the MRS would be able to accommodate steel storage casks, which can also be used for transporting spent fuel. Utilities could use these dual-purpose casks to solve storage problems that may occur at their reactor sites prior to the startup of the MRS or repository.

According to DOE, the above-ground and drywell storage methods have been used for a number of years, are low in cost, and are simple and flexible to design. By using one of these methods, DOE believes the MRS would be able to receive and process 2,650 MTU annually and have an inventory of 14,700 MTU of spent fuel. This would provide flexibility in accepting spent fuel from reactors and would afford some contingency

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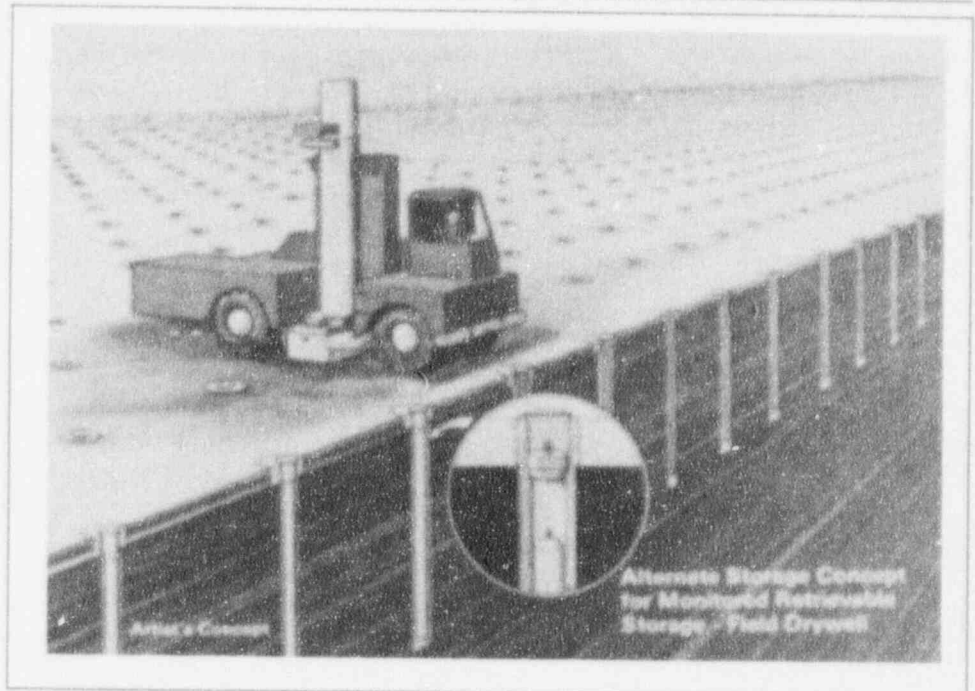
storage capacity if problems are encountered in the repository's ability to accept and emplace nuclear wastes. DOE is therefore of the opinion that the temporary storage which could be provided by an MRS would provide a greater degree of reliability to the overall waste management system.

Figure 2.2: DOE's Proposed Above-
Ground Storage Process



Source: DOE

Figure 2.3: DOE's Alternative Drywell
Storage Process



Source: DOE.

The Impact of an MRS on the Nuclear Waste Transportation System

In addition to processing spent fuel, DOE believes that an MRS would assist in the development of a transportation system to move the spent fuel from the reactors located east of the Rocky Mountains to the repository located in the West. DOE has estimated that while an MRS could reduce the impact to the general public of shipping nuclear wastes, there would be an increased number of shipments in the areas leading to and surrounding the MRS facility. On the basis of DOE's estimates, if the MRS were to process 3,600 MTU annually, approximately 1,200 trucks and 360 trains would be received at the MRS. This would be a daily average increase in overall traffic of about eight trucks (four arriving and four leaving) and up to three trains. Depending on the capacity of the shipping cask, approximately 30 dedicated train shipments of nuclear waste from the MRS to the repository would be made annually. DOE has also estimated that the increase in local commuter traffic in the vicinity of the MRS could result in some local traffic problems because many potential routes already have near-capacity traffic flow.

DOE Believes the MRS Should Be an Integral Part of the Waste Management System

DOE has concluded that an integrated MRS would provide a wide range of benefits to the waste management system and believes that the need for an MRS is based on its ability to "... improve the overall performance of the waste management system with small and acceptable adverse effects." While acknowledging that the waste management system could be operated safely without an MRS, DOE states that the facility would improve its ability to develop and operate the functions of the system. DOE has concluded that some of the benefits associated with an MRS

"... are not quantifiable, but none is more difficult to quantify than the value of having a portion of the waste-management system operational ahead of the waste-acceptance date mandated by law."

DOE has cited the following systemic improvements which it believes are attributable to the MRS:

- The MRS would provide a focal point to plan for waste receipt, packaging, and transportation. DOE would have more flexibility and control over the waste management system, with less opportunity for delay in the development of schedules for spent fuel acceptance, transportation, and packaging. The development of the MRS would also result in the availability of more certain information on the design and schedule for key decisions regarding routing and logistics.
- DOE would have more flexibility and control over the schedules for unloading spent fuel from commercial reactor spent fuel storage pools and for emplacing spent fuel in the repository.
- DOE would be able to (1) exercise greater control over the transportation logistics, (2) have an earlier and clearer identification of potential routes, and (3) work with states and local governments to resolve institutional issues related to transportation. DOE expects that the reduction in transportation impacts should further enhance public confidence.

DOE Has Linked Operation of the MRS to Construction of the Repository

According to DOE,

"... the history of the waste management program suggests that the credibility of any interim storage measures will be suspect unless there is confidence that a permanent repository will be available within a reasonable period of time."

DOE believes that an MRS could affect the development of the repository program by (1) allowing the system to more easily respond to changes in the repository schedule and (2) altering opinion regarding the national commitment to a repository for permanent disposal of nuclear wastes.

In order to alleviate concerns that if the Congress approves the MRS, the schedule for the repository may be relaxed or impeded, resulting in a detrimental affect on its operation, DOE has proposed a link between the MRS and the repository. The linkage provides that the MRS will be precluded from accepting nuclear wastes until NRC grants construction authorization for the repository.

DOE has also imposed a storage capacity limit of 15,000 MTU on the facility. DOE believes this capacity is sufficient to accommodate the potential spent fuel storage needs for approximately 5 years.

According to DOE, the integration of an MRS into the waste management system would reduce the potential for delays in the operation of the repository. Uncertainties regarding spent fuel acceptance, transportation logistics, and institutional arrangements could be resolved during the implementation phase of the MRS. DOE believes, therefore, that the operation of the repository would be less vulnerable because many of these preplacement activities would be accomplished through the MRS.

EEI supports the MRS and cites several advantages of integrating the facility into the waste management system. According to EEI, the principal advantage of an MRS is that it would require DOE to mobilize its waste management development efforts several years before they would be required for a system with only a repository. EEI believes this early focus is essential because of the duration and cost of the program.

EEI is not in favor, however, of the linkage that DOE has proposed between the MRS and the repository. In EEI's opinion, the certainty for utility spent fuel storage planning may not be realized with this linkage in place. EEI has therefore urged that the MRS be permitted to accept "a significant quantity of spent fuel" prior to NRC's authorization to construct the repository.

Utilities' Opinions Vary on the Need for an MRS

In November 1985, we asked the chief executive officers of the 74 utilities that either own or operate nuclear power plants for their views on DOE's plans for an MRS and their plans to accommodate growing inventories of spent fuel. We received 54 completed responses to our questionnaire covering 71 utility companies.¹ On May 8, 1986, we published the results of the survey in a fact sheet issued to the Chairman, House Committee on Interior and Insular Affairs, and the Chairman, Subcommittee on Energy Conservation and Power, House Committee on Energy and Commerce.²

On the basis of the responses we received, most utilities then believed that with some effort, they could arrange for functions such as rod consolidation, standardized waste packaging, and centralized transportation. While 11 of the utilities (20 percent) were neutral, 24 (44 percent) supported an MRS and 17 (31 percent) opposed it. Eight utilities (15 percent) anticipated a gap between their ability to provide spent fuel storage and the availability of a repository. Most companies indicated that as of early 1986, they did not believe that a repository would be available before 2003. This belief was subsequently borne out by DOE's February 1987 announcement that the first repository will be delayed until 2003.

Almost all of the utilities that responded to our questionnaire said that they could provide for their own spent fuel storage needs until 1998. They added, however, that after 1998, it would be more difficult for them to provide storage. If a repository is not available then, 28 utilities (52 percent) indicated they would prefer their spent fuel to be stored at an MRS instead of at their reactor. Thirty-eight of the responding utilities (70 percent) indicated that they were willing to pay a share of the MRS costs, provided that the MRS would not increase their current waste disposal fee. In addition, the utilities said that they were unwilling or uncertain about paying for these costs if (1) they have already incurred substantial investment for on-site storage or (2) their spent fuel would not be shipped to an MRS.

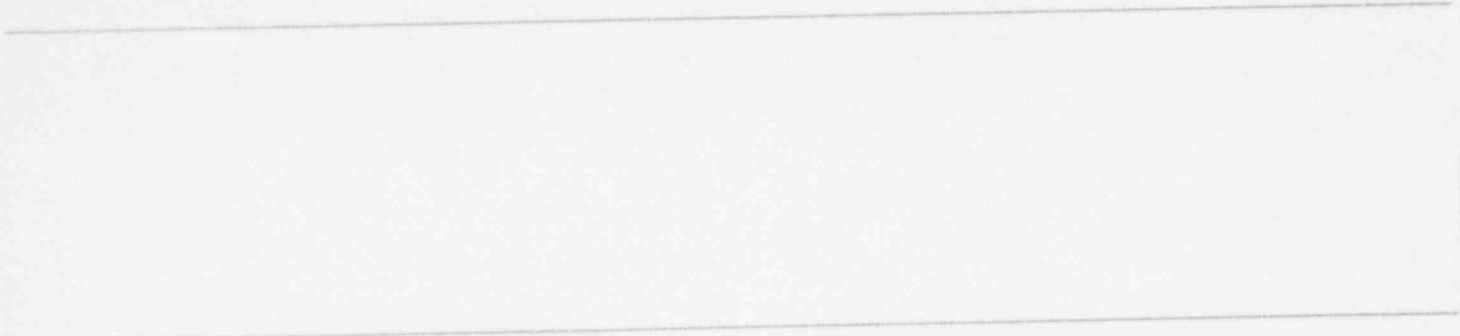
As discussed in chapter 1, the results of our survey now appear in conflict with recent nuclear industry positions indicating strong support for

¹Of the 74 utilities sent questionnaires, 54 completed them; 17 did not complete the questionnaire because they are minority owners and other companies (among the 54) responded for them; 2 companies provided their comments in letters, and 1 company did not reply. All percentages are based on the 54 responses.

²Nuclear Waste: Monitored Retrievable Storage of Spent Nuclear Fuel (GAO/RCED-86-104FS, May 8, 1986).

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DOE's MRS proposal. In this regard, changes in the nuclear waste management program since our survey was conducted—in particular, the delay in the repository operation date until 2003—may have affected utilities' views on the MRS, because the only alternative to an MRS facility may be for utilities to store their spent fuel at reactor sites for an additional 5 years before DOE will begin removing it. These developments may make the MRS appear more attractive to utilities than it did in November 1985.



DOE's Analysis of MRS Alternatives Is Incomplete

In the MRS proposal, DOE has identified various options for improving the authorized waste management system (excluding an MRS) which may provide a wide range of advantages and disadvantages. DOE has concluded, however, that none of the improvements, either alone or in combination, could provide the same benefits to the authorized system as an MRS.

DOE's evaluation of these options was limited in that (1) each potential alternative was not analyzed in detail and (2) DOE did not determine the effect that combinations of these alternatives would have on the operations and cost of the authorized waste management system. In some areas, available information was not sufficient to permit detailed analyses of individual options. In addition, the various alternatives were analyzed in terms of how each option individually could improve the waste system authorized by the act. However, DOE has not determined what combinations of these or other options would most effectively improve the operation of the authorized waste management system, and at what cost, if an MRS is not available. DOE has several studies underway that may provide more information on individual alternatives to the MRS.

DOE Identified Waste-Handling Improvements Achievable Without an MRS

DOE has studied three types of alternatives for improving the authorized waste management system to determine if the benefits of an MRS could be achieved by other means. On the basis of its analyses, DOE concluded that the authorized system without an MRS could be improved to provide some benefits similar to those which have been attributed to the facility. DOE also concluded, however, that no single improvement or combination of improvements to the authorized system would provide the same level of benefit to the system as the MRS. The following summarizes the alternative system improvements which have been analyzed.

Expanded Lag Storage at the Repository

As currently proposed by DOE, some receiving and storage activities would occur at both the MRS and the repository. DOE believes that expanding spent fuel storage capacity at the repository, however, could (1) allow DOE to begin accepting wastes from utilities sooner and (2) accommodate delays which may occur between the acceptance and emplacement of spent fuel once the repository begins operation (i.e., provide lag storage).

If expanded lag storage is provided at the repository, DOE estimated that the costs for the authorized system could be lower than those for a

system including an MRS because the receiving and storage functions that would be performed at the MRS would instead be done only at the repository. On the basis of its assumption that comparable amounts of storage capacity (12,000 MTU) would be provided under either alternative, DOE estimated in December 1985 that the overall cost of a waste management system with expanded repository storage would be about \$1.2 billion to \$1.6 billion less than a system with an MRS.

Limitations and Disadvantages of
Expanded Lag Storage Cited by
DOE

According to DOE, if storage facilities at the repository can be licensed separately from and earlier than the facilities needed for disposal of the wastes, this alternative would allow DOE to receive spent fuel from utilities earlier than the opening of the repository. If storage could not be approved earlier, however, the rate at which spent fuel could be received would then depend on how quickly an operating license could be obtained for the entire repository facility. DOE has estimated that the licensing process for the repository could take between 27 and 108 months.

DOE believes that it would be difficult to achieve the full benefits of this option because NRC may not authorize construction and operation of a separate storage facility before the entire repository is licensed. According to DOE, NRC could view construction of storage at the repository site as an investment in the site that would prejudice NRC's review of the site license application. We discussed this issue with the Chief of NRC's Advanced Fuel and Spent Fuel Licensing Branch. He agreed with DOE's assessment and stated that in his opinion, NRC would not authorize the construction of lag storage at the repository until the entire facility has been approved.

In addition to potential difficulties associated with obtaining an early license for this option, DOE believes that construction of this facility could be viewed as a violation of Section 141(g) of the Nuclear Waste Policy Act, which precludes the establishment of a repository and an MRS in the same state.

DOE has concluded that since all the facilities at the repository are subject to a common license, expanding lag storage at the repository would not allow the waste acceptance, transportation, and packaging functions to become operational before the repository is ready to begin disposal activities. Consequently, this option would not allow DOE to receive spent fuel earlier or in greater quantities than would otherwise be possible. According to DOE, however, even if the use of expanded lag storage

has to await the licensing of the entire repository facility, it could improve the reliability and efficiency of the waste management system. It would allow independent operation of waste acceptance and disposal activities at the repository, thereby permitting continued receipt of spent fuel in the event of a disruption in waste emplacement operations.

Expanded Storage at Reactor Sites

According to DOE, utilities could choose from among several contingency storage methods to accommodate their growing inventory of spent fuel.

Dry Storage

Excess spent fuel could be stored at reactor sites in metal casks, drywells, silos, or vaults. According to DOE, the use of these alternative storage methods would result in lower total system costs than would the MRS for limited storage durations. However, incremental costs of dry storage at reactors—paid directly by the utilities—would be greater than at an MRS.

Through its Energy Information Administration, DOE has developed information which indicates that as of December 1984, only 34 (26 percent) of the 133 reactors then operating or under construction had studied the use of on-site dry storage. Ten facilities identified impediments to this storage method, 20 found no constraints, and 4 had not determined whether they would be able to use this option. DOE has not collected information, however, to determine to what extent utilities are willing or able to utilize this technology.

In our November 1985 survey, we asked utilities about their plans to use the dry storage option. Of the 54 responses we received, 34 (63 percent) stated that dry storage was not currently under consideration to augment existing storage capacity. Fifteen respondents (28 percent) indicated they are currently considering this option, and 2 (4 percent) stated they have plans to use this technology to meet their additional spent fuel storage needs.

Limitations and Disadvantages of Dry Storage Cited by DOE

DOE believes that the dry storage option has two principal disadvantages—high incremental cost and the requirement for each reactor to obtain a license from NRC to perform this activity. According to DOE's estimates, dry storage at the reactor could cost up to \$110 per kilogram of uranium, compared with \$35 to \$40 per kilogram for incremental

storage at the MRS. Based on DOE's estimates, integrating the MRS into the system could result in utility savings of up to \$1 billion.

In order to use the dry storage option, each utility would be required to obtain a license from NRC, whereas the MRS will require only a single license. DOE is currently participating in dry storage demonstration projects with two utilities as part of its efforts to facilitate the licensing of this technology. The amount of difficulty which would be encountered to obtain licenses for the widespread use of dry storage either on-site at reactors or at the MRS is unknown.

Rod Consolidation

According to DOE, spent fuel rods could be consolidated as one means of alleviating utility storage problems. If this technology is incorporated into the waste management system, it could be performed either at each reactor location, the MRS, or the repository. DOE believes that some cost savings may be associated with consolidating spent fuel rods at reactors because a new site would not have to be developed to perform this function. In addition, these activities could be tailored to the needs of each reactor and, because of the more compact waste form, fewer spent fuel canisters would have to be handled and shipped.

Limitations and Disadvantages of Rod Consolidation Cited by DOE

DOE has identified the following factors which could adversely affect rod consolidation at reactors:

- DOE may lose some managerial control over the consolidation process at each location. Because the procedure would be performed by many different individuals and groups at varied locations, it may be conducted with varying degrees of safety and competency. We discussed this aspect of the rod consolidation program with representatives from EEL, and they agreed with DOE's assessment that some measure of control over the process would be lost if each utility performs rod consolidation. The representatives were also reluctant to endorse this approach because the process could be subject to a wide range of quality control programs at each utility.
- The operating license granted by NRC for each reactor would have to be amended to permit large-scale consolidation and storage of spent fuel. This could be a time-consuming process that utilities may be reluctant to undertake.
- If utilities agree to consolidate their spent fuel to meet DOE's needs instead of their own, contractual agreements outlining responsibilities and liabilities may be required between DOE and each participating

utility. Some companies may also raise equity issues if DOE uses the Nuclear Waste Fund to pay for rod consolidation because benefits to utilities may accrue unevenly.

- With rod consolidation performed at each utility, there is some risk of greater radiation exposure to workers. A central facility such as an MRS could more readily make use of remote handling and heavy shielding for personnel protection.

Utilities May Be Reluctant or
Unable to Perform Rod
Consolidation

DOE does not believe there is any assurance that utilities will be willing or able to perform rod consolidation at their reactors. DOE also has not yet determined the extent to which factors such as space or structural limitations or cost would preclude the implementation of this option.

In 1984, DOE directed the Pacific Northwest Laboratory to determine the extent to which utilities have considered rod consolidation as a solution to their spent fuel storage problems. The contractor found that 24 of the 36 companies contacted had investigated the feasibility of performing rod consolidation; 18 of these 24 companies indicated that they would seriously consider this option if faced with a critical shortage of storage capacity. The contractor did not determine the willingness or technical capability of each utility to perform this function.

In our November 1985 survey, we asked utilities about their current plans for using various spent fuel storage options, including rod consolidation. Twenty-eight respondents (52 percent) indicated that, at that time, they were not considering this technology as an alternative; according to 15 (28 percent), however, this option was "under consideration." Eight others (15 percent) reported that they have either planned and budgeted for this process or have tentative plans for using it in the future.

We also asked utilities if they would be able to provide or arrange for consolidation of their spent fuel without an MRS. Three respondents (6 percent) indicated they would not be able to perform rod consolidation, and 17 (31 percent) indicated that this process would require "great effort." Nine respondents (17 percent) indicated that they could accomplish rod consolidation with minimal effort, while 18 (33 percent) stated "moderate" effort would be required.

Cost Estimates for Rod
Consolidation Are Uncertain

DOE has estimated that it could cost between \$28 and \$38 to consolidate and store each kilogram of spent fuel at reactors. This estimate does not

include, however, costs that would be incurred for the required seismic analyses, structural upgrading of the spent fuel storage pool and handling equipment, the replacement of existing spent fuel storage equipment, disposal of low-level wastes associated with the process, or the license amendment process that would be required at each reactor. According to DOE, the total system cost impact of rod consolidation at each reactor would depend on the number of utilities that elected to perform this function on-site.

DOE has contracted with Roy F. Weston, Inc., to analyze the full range of costs and impacts associated with rod consolidation. The study is scheduled for completion by mid-1987.

DOE Identified Potential Improvements to the Waste Transportation System

DOE has attempted to determine whether alternative methods for improving the transportation of nuclear wastes in the authorized waste management (repository-only) system could provide benefits similar to an MRS. DOE has identified a series of potential modifications that could reduce the number of cross-country shipments and the total number of miles that each shipment will have to travel. DOE believes that all the transportation improvements which it identified could also further improve a waste management system that includes an MRS. DOE has acknowledged, however, that because of the additional information which would be required, the transportation options have not been sufficiently developed to estimate their cost. The following summarizes the potential transportation improvements identified by DOE.

Increased Rail Use

DOE believes that by increasing the use of trains to transport spent fuel, the number of miles traveled and the number of shipments made can be reduced in both the authorized (no-MRS) and MRS systems. This reduction would occur because the spent fuel shipping casks which would be used for rail transport could hold about seven times more spent fuel than could be carried in truck casks. DOE states that because of the proximity of reactors to rail lines, about 70 percent of the spent fuel could be moved by rail without further improvements to increase rail shipments. DOE has identified the following methods for increasing rail shipments.

Improve Reactor Sites to Accommodate Direct Rail Access

DOE believes that the total number of shipments and miles traveled by nuclear wastes can be reduced by upgrading reactor sites to provide direct rail access. This improvement could also reduce transportation

costs because for long shipments on a per-unit basis, trains are less expensive than trucks.

DOE directed the Pacific Northwest Laboratory to analyze direct rail access at reactors. The 1985 study found that out of 127 reactors surveyed, 41 are currently limited in their ability to accommodate the casks that would be used to transport spent fuel by rail. The limitations include inadequate lifting capacity for heavy loads, the lack of rail spurs onto the site or into the reactor building, and structural limitations in the spent fuel storage pools.

Twenty-nine of the reactors studied are currently limited to truck shipments because they do not have rail access to the site; to make these facilities suitable, additional rail spurs ranging from 1 to 50 miles would have to be built. For the remaining 12 reactors, extensive structural modifications would be required to upgrade their rail capability.

The study performed for DOE did not determine how many of these reactors with limited capability for handling rail casks would be willing or able to improve their facilities. DOE is currently studying the suitability and cost of upgrading these reactor sites.

Rail Cask Transfer Equipment

The size and weight of rail casks may preclude some reactors from placing these casks in their storage pools to load the spent fuel. In these circumstances, reactors would be required to load the spent fuel into smaller containers in the pools and move them to a special on-site handling facility where the spent fuel would be transferred to the rail casks. Reactors with rail access would then ship the cask off-site.

According to DOE, this alternative would shift spent fuel shipments from truck to rail, thereby decreasing the number of shipments, distance traveled, and potential transportation impacts. This approach would, however, require additional handling of spent fuel at or near the reactor facilities and could lead to increased worker exposure to radiation. Transportation-related costs could also increase because of the added equipment and handling activities that would be required.

Truck Shipments to Rail Access Points

DOE believes that reactors which do not have direct rail access could move rail casks by truck to nearby rail access points to be loaded onto rail cars for shipment. This alternative would increase the amount of

spent fuel shipped by rail, thereby decreasing the total number of shipments and distance traveled. As in the rail cask transfer alternative, however, transportation-related costs would increase because of added handling activities and equipment.

The Use of Extra-Large Rail Casks

According to DOE, when compared with the standard 100-ton rail cask, two to three times more spent fuel could be transported by using extra-large rail casks weighing up to 150 tons. This could result in reduced transportation costs and fewer shipments.

On the basis of DOE's analysis, however, the majority of reactors currently capable of handling rail casks can only accommodate casks weighing up to 125 tons because of limitations of storage pool structures and existing cask lifting equipment. The use of larger rail casks would therefore require additional cask transfer equipment and a greater amount of cask handling, resulting in disadvantages similar to those encountered when rail transfer equipment is used.

Multi-Cask Shipments for Trucks and Trains

According to DOE, if each shipment is comprised of a large number of spent fuel casks, the total number of shipments would be reduced. DOE has identified the following alternatives as means of meeting this objective.

Using the Reactor Site to Marshal Multi-Cask Shipments

Casks loaded with spent fuel could be held at each reactor site until a sufficient number have been accumulated to comprise a shipment. While the use of this option would reduce the total number of shipments from the reactor, it would require a larger fleet of shipping casks to serve the needs of all reactors.

Truck Convoys

Truck shipments of spent fuel could be marshalled at either individual reactors or a centralized location; the combined shipments would then travel as a convoy to the repository. DOE believes that while this alternative could reduce the number of individual highway shipments, logistical planning and scheduling would be more complicated.

Marshalling Rail Shipments

This concept is similar to truck convoys. Spent fuel would be shipped by rail from each reactor to centrally located marshalling yards. The rail cars would then be assembled into shipments to the repository.

DOE believes that while this approach may minimize the cask waiting time at the rail yards, it would require approvals by local governments to queue and safeguard the loaded rail cars at public and private locations. The use of this option could also result in longer idle periods for rail cars at the repository because a relatively large number of loaded cars would be arriving at once. DOE has acknowledged that this would lengthen the time required to unload the rail cars and return them for other shipments; this longer turnaround time would also increase the size of the shipping fleet.

Use of Overweight Truck Shipments

According to DOE, the total number of truck shipments could be reduced by increasing the amount of spent fuel carried on each shipment. If this practice is employed, the shipments would exceed the standard or legal weight limit of each affected state or local government; it could also, however, result in reduced transportation costs because a larger amount of spent fuel would be transported in each shipment.

Using overweight truck shipments could cause complex scheduling and logistical problems, according to DOE, because of the varied and inconsistent weight limit regulations of each state that the shipments would pass through. States may also require additional permits, thereby increasing administrative costs, or impose restrictions such as operating only during nonwinter months, certain times of the day, or at reduced speeds. If imposed, these requirements could affect the route selection and timing of the shipments.

Although DOE has not quantified the costs and impacts of overweight truck shipments, it is continuing to investigate the regulatory compliance issues associated with this option.

DOE Has Considered Other Improvement Options, but Final Results Were Not Included in the MRS Proposal

DOE has evaluated several other technologies which might improve the authorized waste management system and provide some of the same benefits as an MRS. This effort—separate from the MRS proposal—was conducted under its Program Research and Development Announcement (PRDA) initiated in 1984. While DOE stated that its evaluations of improvement options “were enhanced by the availability of draft results from the PRDA activities,” the final results of these studies have not been included in DOE’s analysis of alternatives to the MRS.

The PRDA studies are intended to identify various concepts which could enhance the overall performance of the waste management system. DOE

solicited and contracted with companies which are involved in the nuclear waste business to submit proposals and designs for systems which could be integrated into utility operations. The contractors submitted draft reports to DOE through the summer of 1985. Beginning in November 1985, the reports were evaluated by a DOE nuclear waste office "working group." The results of the group evaluation were published in an April 1986 report. The following summarizes the contractors' proposals and the evaluation made by the working group for each project.

Universal Canisters

GA Technologies, Inc., proposed development of a universal or standardized canister. Unlike existing canisters designed specifically for either storage or transportation, universal canisters could be used to store, transport, and dispose of spent fuel. If employed, this concept could minimize the handling and repackaging of spent fuel and may result in savings of up to \$800 million.

The working group determined that this design would offer little benefit because it was not compatible with spent fuel storage equipment currently in use at reactors or planned at the repository.

Rectangular Canisters

The NUS Corporation offered a rectangular design intended to maximize the use of space required to store, transport, and dispose of spent fuel. According to NUS, this design would assist in the development of a truck cask which would have 50-percent greater carrying capacity than current casks; it would also make rod consolidation more attractive for reactors which must ship their spent fuel by truck.

DOE's working group determined that the economic benefit of this design depends on the extent to which reactors will use rod consolidation and truck transportation. The group also concluded that not all reactors may be able to accommodate this type of canister in their existing storage equipment; this option may therefore be more beneficial if used at the MRS instead of at individual reactors. DOE is currently studying the application of this concept at the MRS.

"Portable" Dry-Consolidation Facility

Transnuclear, Inc., proposed a portable facility which could be moved from reactor to reactor on an as-needed basis to consolidate spent fuel rods in a dry environment. The company believes that mobile equipment is technically feasible and would pose less interference with other

reactor functions than the current in-pool (wet) rod consolidation process.

The working group concluded that this concept should not be pursued further at this time because additional support facilities and equipment may be required, which would increase the cost and complexity of the concept.

Storage Cask Concepts

Transnuclear, Inc., offered several designs for extra-large storage casks and a canister, which would maximize the amount of spent fuel that could be stored in these casks. According to the company, this concept would provide at least a 20-percent savings when compared with conventional 100-ton casks. DOE's working group concluded, however, that Transnuclear's design needed further examination.

The Westinghouse Electric Corporation submitted proposals for (1) a waste package for storage, transportation, and disposal (a self-shielded universal waste package), (2) a container for storage and shipment of spent fuel (a dual-purpose cask), and (3) a thin-walled cask, manufactured at each reactor site, that would be ready for direct emplacement in the repository. Westinghouse contended that both the self-shielded and dual-purpose casks are economically competitive with conventional casks, and the self-shielded cask could provide additional flexibility, which would enhance the performance of the repository.

DOE's working group determined that the data provided by Westinghouse did not support its claims that the universal self-shielded cask offers a significant advantage to the waste system. The group concluded that because the size of the universal cask proposed by Westinghouse may present handling problems at the repository, further study of this concept is not warranted. The group also determined that while some benefits may be attributable to dual-purpose casks, further study is required to determine the exact nature of these benefits.

DOE's Analysis of MRS Alternatives Has Limitations

DOE states in its proposal that its analysis of potential MRS alternatives is limited. Designs and plans for many potential improvements to the authorized waste management system were not developed to the same extent as the MRS option. According to DOE, extensive operating experience with these alternatives is lacking. DOE's evaluations of potential improvements were, therefore, based primarily on existing information and engineering judgment. Further, the alternatives identified by DOE

have been analyzed with regard to how each option individually could improve the authorized system. DOE has not determined the net effect of combinations of these options on the waste management system. DOE has not firmly concluded that the individual alternatives studied are infeasible or that the costs and disadvantages outweigh their advantages. DOE does not present sufficient information in its proposal documents to make such a determination. DOE has a wide range of studies ongoing that may provide more information on alternatives to the MRS.

DOE Has Not Collected
Reactor-Specific
Information

According to DOE, there is no assurance that all utilities will agree or be able to consolidate spent fuel, use on-site dry storage, or upgrade their rail access. However, DOE has not uniformly collected information from individual utilities to determine the extent to which they would be willing or able to implement the potential alternatives that DOE has cited.

DOE also has not determined whether individual utilities have identified other viable alternatives for improving the waste management system not discussed by DOE that may be preferable to an MRS.

Analysis of Transportation
Improvements Is Incomplete

DOE has stated that the impacts and costs of various potential transportation improvements need to be better understood. DOE has acknowledged in its proposal documents that it did not develop the alternatives for improving transportation in the authorized waste management system in sufficient detail to perform cost analyses or determine the impacts of each option. Although DOE described the relative advantages and disadvantages that may be achieved by including each transportation improvement in the waste system currently authorized by the Nuclear Waste Policy Act, it did not compare each of these options' benefits and costs with the potential benefits and costs of an MRS.

For example, in determining the potential transportation impacts of these improvements, DOE has not (1) quantified the number of shipments or miles that would have to be traveled in the authorized system, including these transportation improvements, or (2) compared these data with similar information for a system containing an MRS. DOE also has not quantified the potential system benefits that could result from combining some or all of these transportation improvements with other potential system enhancements such as rod consolidation.

Final Results of PRDA Studies Were Not Included in MRS Analysis

Some of the technologies and concepts for storing and transporting spent fuel that were reviewed in DOE's PRDA program might provide improvements similar to those identified in the MRS proposal. Although DOE stated that the evaluation of alternatives was "enhanced by the availability of draft results" of these studies, it did not state how or to what extent this information was used. In addition, neither the final results of these studies nor DOE's evaluation of the completed studies was incorporated into its analysis of potential options to improve the authorized (no-MRS) system.

DOE Is Continuing Work That May Better Define MRS Alternatives

DOE realizes that complete information on some of the options for improving the waste management system authorized by the act is not available. Although being conducted under OCRWM's Systems Integration activities rather than the MRS program, the following studies and activities, covering a wide range of spent fuel storage and transportation topics, are currently underway and may contribute to a better understanding of potential improvements to the authorized system:

- A survey of the suitability and cost of upgrading reactors to accommodate increased transportation of spent fuel by rail.
- A study of using dedicated trains to ship spent fuel either directly from reactors to a repository or from the MRS to the repository.
- A study of using truck convoys to transport spent fuel from reactors to either a repository or an MRS.
- The development of preliminary designs for spent-fuel shipping casks and a feasibility study of casks which could be used in more than one mode of transportation.
- Studies of potential rail bed and highway damage from using overweight rail and truck casks, respectively, to ship spent fuel.

DOE expects to complete many of these studies during 1987.

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MRS Cost Estimates Have Not Been Fully Developed

DOE's proposal estimates that an MRS facility would cost about \$3.2 billion and would result in a net increase in total waste program costs of between \$1.5 billion and \$1.6 billion. DOE has identified additional costs that are not included in its estimates—and which DOE officials say cannot be estimated at this time—such as the payment of revenues equivalent to state and local taxes and aid to affected localities to mitigate the impacts of constructing and operating the facility. According to DOE's Independent Cost Estimating staff, several of these costs could be substantial, and operating costs for the MRS may be underestimated by 10 to 15 percent.

MRS Cost Estimates

The Nuclear Waste Policy Act requires DOE to develop an MRS proposal that includes at least three alternative sites and at least five alternative combinations of sites and facility designs. The three sites DOE identified—all in Tennessee—are the former Clinch River Breeder Reactor location in Oak Ridge, the former site for a proposed nuclear power plant in Hartsville, and DOE's Oak Ridge Reservation. All are located on land owned and controlled by the federal government; the Clinch River and Hartsville sites are in the custody of the Tennessee Valley Authority. DOE identified the former Clinch River Breeder Reactor location as the preferred site and the aboveground sealed storage casks illustrated in figure 2.3 as the primary method for storing spent fuel.

DOE contracted with an engineering firm to prepare detailed cost estimates for the facility's engineering and construction portion of the program. DOE then developed nine program elements that it considered necessary for an MRS and estimated the costs that would be incurred for each element. Included in five of the facility-related elements was a contingency allowance of 20 percent. The following summarizes the nine program elements and required activities that DOE used to develop the MRS cost estimate:

- Environmental Evaluations: Costs incurred to compile and verify ecological, hydrological, meteorological, and socioeconomic site data and to interact with NRC to prepare an environmental report.
- Design: Costs required to complete designs and drawings, specifications, and engineering studies for the primary and support buildings and facilities. A contingency of 20 percent was included in this element.
- Regulatory Compliance: Costs incurred by DOE to prepare applications for permits and licenses at the local, state, and federal levels throughout the life of the MRS. Included in this element are the costs for preparing

and submitting a decommissioning amendment to the operating license when the facility has reached the end of its service life.

- Construction: Costs that would include labor, equipment, materials, support services, and site improvements that are required to construct the facility. These costs fall into three categories: (1) direct costs paid to construction contractors, (2) costs for construction management and support services, and (3) contingency costs of 20 percent for unexpected events or requirements.
- Training and Testing: Costs incurred before completion of the facility and required to ensure that the staff are prepared to perform their functions safely. Training will be provided in mock-up facilities before actual spent fuel is processed. A 20-percent contingency is included in this element.
- Operation: Costs for the salaries and benefits for operating and maintenance personnel as well as for continual environmental monitoring, facility improvements, and storage casks and canisters. Included in this element is a contingency of 20 percent.
- Decommissioning: Costs that will begin to be incurred about 4 years before the end of MRS operations. Included in this element are the costs to unload and decontaminate the storage casks, decommission the spent fuel-processing and support buildings, and improve or reclaim the site. A contingency allowance of 20 percent is also included.
- Institutional Interactions: Costs that will be incurred from providing information on all aspects of MRS operations to the public and to state and local governments. The cost of providing financial assistance for the effects of constructing and operating the MRS have not been included because agreements for this assistance need to be negotiated with the state of Tennessee. DOE expects to sign these agreements within 6 months after the Congress approves the proposal.
- Program Management: Costs for system engineering, project planning, management of subcontracts, and other services such as procurement, quality assurance, and program office staff. These costs will be incurred during the period between congressional approval and operational demonstration of the facility.

After the cost elements were identified, DOE developed cost estimates for the preferred MRS option and the five alternatives. Table 4.1 summarizes, in constant 1986 dollars, the life-cycle cost estimates for the MRS; it also illustrates that the primary difference between these elements is the projections for construction and operation.

Table 4.1: Summary of DOE Cost Estimates for Each MRS Option

Dollars in millions

Cost element	Location					
	Clinch River		Hartsville		Oak Ridge	
	Cask	Drywell	Cask	Drywell	Cask	Drywell
Environmental evaluations	\$5.5	\$5.5	\$5.5	\$5.5	\$5.5	\$5.5
Design	98.8	98.8	98.8	98.8	98.8	98.8
Regulatory compliance	28.4	28.4	28.4	28.4	28.4	28.4
Construction	655.0	751.2	662.0	727.2	643.5	736.5
Training and testing	62.8	62.8	62.8	62.8	62.8	62.8
Operation	2,218.1	1,959.5	2,218.1	1,959.5	2,218.1	1,959.5
Decommission	83.0	83.0	83.0	83.0	83.0	83.0
Institutional interaction	2.2	2.2	2.2	2.2	2.2	2.2
Program management	70.8	70.8	70.8	70.8	70.8	70.8
Total	\$3,224.5	\$3,061.9	\$3,231.5	\$3,038.0	\$3,213.0	\$3,047.2

DOE Identified Other Costs Not Included in the MRS Estimate

In addition to the nine program elements listed in table 4.1, DOE has identified other costs that could affect the MRS, but it has not yet determined what impact these additional costs may have. The following summarizes these additional MRS costs:

- Aid to the affected localities for mitigating the impacts of constructing and operating the MRS facility. As stated earlier, financial assistance agreements are expected to be signed within 6 months after the Congress approves the proposal. When the agreements are reached, they will be included in the life-cycle cost estimates for the MRS.
- Grants equal to taxes. DOE recommends that the Congress direct that Tennessee and the affected units of local government receive revenues equivalent to those that would be received if a commercial facility were built on the site. When these costs have been identified, they will also be included in the life-cycle cost estimates for the MRS.
- Costs for consultation and cooperation agreements. According to DOE's final MRS proposal, Subsections 117(b) and (c) of the Nuclear Waste Policy Act stipulate that consultation and cooperation agreements will be sought with Tennessee within 60 days after the MRS is approved by the Congress. These agreements would involve costs for such activities as DOE assistance with independent state monitoring and testing activities at the MRS site and in resolving state and local concerns regarding emergency preparedness and health issues. When approval of the MRS

has been granted and the costs are determined, they will be included in the life-cycle cost estimates.

- Licensing and permitting fees levied by federal, state, and local governments. DOE has stated that there is no clear indication of whether other federal agencies involved in the proposal will make these costs part of their budget appropriation requests or whether they will seek reimbursement from the waste fund directly. In addition, the state and local permitting fees have not yet been determined by DOE.
- Costs for transporting spent fuel from reactors to the MRS and from the MRS to the repository. DOE has stated that these costs are "more properly evaluated from a total system perspective" and are not included in the MRS facility's life-cycle cost estimates.
- Site acquisition costs. Although DOE has stated that these costs have not been estimated and could vary among the three sites, it believes "they would not significantly impact the life-cycle costs" of the facility.

Independent Cost Estimating Staff Assessment of MRS

In the December 1985 "Review Copy" of the MRS proposal, DOE estimated that an MRS would cost about \$2.9 billion (in 1985 dollars). DOE's Independent Cost Estimating (ICE) staff also assessed the costs to construct and operate the MRS in December 1985. Both of the proposed storage options, at each of the three potential sites, were studied. Although the ICE evaluation identified some differences in the way that the various construction components could be categorized, the net difference between the construction costs estimated by DOE's OCRWM and the ICE staff was within 5 percent on all of the proposed MRS options. The ICE staff's study also concluded that DOE may have underestimated the proposed operating costs of the preferred MRS option by 10 to 15 percent.

The ICE staff estimated that a larger number of personnel would be needed for an MRS (601 estimated by OCRWM vs. 656 estimated by the staff), as well as greater costs for waste canisters and facility utilities. On the basis of this analysis, DOE's ICE staff projected that over the period required to design, construct, operate, and decommission the MRS, a total of \$294 million (in constant 1985 dollars) more than DOE's estimate could be required for the program.

The ICE study reiterated that OCRWM has not included all the costs attributable to the construction and operation of an MRS. The study also listed items that have been excluded from OCRWM's cost estimate—including some items OCRWM acknowledged had been excluded—and indicated that several of these items could "be of substantial magnitude," which

could cause the total MRS to "... be considerably higher than currently shown in program estimates." These items are as follows:

- Land acquisition.
- State and local taxes (or grants in lieu thereof).
- State, local, and federal permit and license fees.
- Royalties on proprietary processes.
- Initial inventory of spare parts.
- Upgrading roads, railroads, and bridges for heavy transport.
- Annual impact assistance to local governments.
- Consultation and cooperation agreement with the state government.

DOE Estimates of MRS' Effects on System Costs

The costs of the total waste management system, including an MRS, are annually addressed in DOE's total system life cycle cost estimate. In the April 1986 cost study,¹ DOE estimated that including an MRS in the waste management system could increase system costs by \$1.6 billion to \$2.6 billion. Not included in this estimate was the cost of providing financial assistance to Tennessee. DOE stated that while the cost of integrating the MRS into the waste management system is estimated to be 5 to 11 percent higher than a system without an MRS, the cost of the facility is within the range of uncertainty for total system costs. The cost of constructing and operating an MRS would also be partially offset by (1) savings from more simplified facilities at the repository, (2) savings that would be realized by ratepayers because additional storage of spent fuel would not be required at reactor sites, and (3) other institutional benefits to the overall waste management system.

DOE's estimate of the cost of the waste management system is based on a study of scenarios of various types of rock and repository locations. The type of rock that exists in a repository can affect the cost of the canister that holds nuclear waste; the location of the repository can affect the cost of transporting waste from reactor sites to the MRS and from the MRS system to the repository. The assumptions for the waste management system included two repositories—the first beginning operation in 1998 and the second in 2008. The MRS was assumed to begin operation in 1996. On May 28, 1986, however, DOE announced that it had postponed site-specific work indefinitely on the second repository because of the progress in siting the first repository and the uncertainty of when a second repository might be needed. DOE now expects the MRS—if

¹Analysis of the Total System Life Cycle Cost for the Civilian Radioactive Waste Management Program, Department of Energy, April 1986.

approved—to begin operations in 1998 and the repository to be available in 2003. These estimates are based on spent fuel projections provided by the Energy Information Administration which assume that new nuclear capacity will be added to the system over time.

According to DOE, the April 1986 analysis is the first set of cost estimates for integrating an MRS into the total life-cycle cost for the entire waste management system; previous estimates had considered the MRS as a backup storage facility for nuclear wastes in case of a significant delay in the opening of a repository. Thus, according to DOE, the April 1986 analysis cannot be compared with previous life-cycle cost estimates. This analysis includes cost estimates for program management, environmental studies, regulatory compliance, training and testing, and institutional interactions. It does not include estimates for financial assistance to state and local governments or payments equal to taxes that would be paid to local units of governments affected by the facility.

In DOE's April 1986 analysis, the cost of the waste management system without an MRS ranges from \$23.6 billion to \$32.3 billion in constant 1985 dollars. If the cost of integrating the MRS into the system is included, the total estimated system cost increases to between \$26.2 billion and \$34 billion.

According to DOE's final proposal, the total system cost estimate—to be published later in 1987—will address the cost effects of the changes in the repository and MRS schedules. It will also incorporate changes in the data base for transportation system assumptions. The 1987 estimate will be based on the February 1986 MRS proposal's estimate for the total MRS facility cost with escalation factors included. According to DOE, the 1987 total system cost estimate will show that integrating the MRS into the system would increase total costs by about \$1.5 billion to \$1.6 billion, less than 5 percent of total system costs. The reduction in MRS' effect on total system costs—from \$1.6 billion to \$2.6 billion in the 1986 analysis to \$1.5 billion to \$1.6 billion in the most recent estimate—results from a revised assumption that less costly repository site-specific canisters would be used at the MRS, thus increasing cost efficiency in the transportation system.

Conclusions, Recommendations, and Agency Comments

DOE is proposing the construction of an MRS primarily for waste preparation and packaging rather than for long-term storage as envisioned by the Nuclear Waste Policy Act. While the MRS would be capable of storing spent fuel for long periods, most of the storage that would take place at the facility would be temporary until the spent fuel could be shipped to the repository. This difference in emphasis is one of the factors that needs to be considered in judging the merits of DOE's MRS proposal.

Regardless of the purpose of the MRS as proposed by DOE, we do not believe that DOE's proposal is sufficiently comprehensive for the Congress to make an informed decision on the cost of, need for, or consequences of integrating an MRS into the waste management system, or whether the benefits attributed to the MRS can be better achieved by other means. DOE has not presented sufficient data on how and to what extent the authorized waste management system could be improved—by means other than an MRS—to use as a basis for comparison with a system including an MRS. DOE's proposal presents advantages and disadvantages of various options for improving the waste management system and discusses how each option could individually affect the authorized system. DOE's proposal reaches no conclusions about the viability of individual options. DOE also does not examine how or to what extent combinations of some or all of these options might improve the authorized waste management system—and at what cost.

Before the Congress decides whether the MRS is needed or would be beneficial, and therefore, should be approved, more detailed information should be available regarding MRS' costs and the consequences for the waste program of not having an MRS. We believe that DOE should provide greater detail on how the authorized waste management system can be improved to provide benefits similar to an MRS. We believe that some or all of the improvements discussed in DOE's proposal—as well as those considered under the PRDA activities—warrant further evaluation with regard to the contribution they may make, either individually or collectively, to improving the authorized waste management system. We also believe that too many uncertainties regarding the costs and benefits of an MRS and potential alternatives currently exist to make a firm decision regarding the need for and relative value of an MRS. DOE should do more work to better define these factors to permit a more informed congressional decision on whether to include an MRS—at additional cost to electricity consumers—in the nuclear waste disposal program.

Conclusions

More Utility-Specific Information Is Needed to Support the MRS Proposal

DOE's proposal does not contain specific information on a reactor-by-reactor basis regarding (1) the utility industry's need for an MRS, (2) the extent to which companies would be willing or able to implement alternative options for improving the authorized waste management system in lieu of an MRS, or (3) how utility operations might be affected without the MRS. In addition, DOE has not determined if individual utilities have identified other alternatives not discussed by DOE that they believe are viable and may be preferable to an MRS.

We believe that DOE needs to collect more reliable information from utilities on the extent to which they are willing or able to introduce various options for improving the authorized system at their reactor sites in order to determine whether viable alternatives to an MRS could be implemented. DOE needs to obtain more thorough site-specific information from utilities on their willingness and ability to implement alternatives such as rod consolidation, dry storage, or upgraded rail access at their nuclear plants. We believe this type of information is important for the Congress to thoroughly evaluate DOE's proposal to integrate the MRS into the nuclear waste management system.

Additional Analysis of Transportation Improvements Is Needed

DOE has stated that the impacts and costs of the various alternatives for improving the transportation aspects of the authorized waste management system need to be better understood. DOE has not quantified (1) the effects of these options on the number of spent fuel shipments or the distance traveled by each shipment in the authorized system or (2) the costs of a system containing these alternatives relative to a system with an MRS. Further, DOE has not determined to what extent combining various transportation alternatives with other potential system improvement options—such as rod consolidation at the reactors—could improve the authorized system.

We believe that more thorough quantifications and comparisons of the various transportation options, such as truck shipments of spent fuel from reactors to rail access points or multi-cask shipments for trucks and trains, should be performed before making a judgment on the merits and disadvantages of the transportation aspects of a waste system including an MRS relative to the authorized system incorporating these improvements.

Results of Studies
Completed After DOE's
Proposal Should Be
Included in the Alternatives
Analysis

Some of the concepts reviewed in DOE's PRDA effort are similar to those improvements discussed in the MRS proposal. The final results of the PRDA studies were not incorporated into DOE's evaluation of options to improve the authorized waste management system. The final results of these studies—and DOE's evaluation of them—need to be incorporated into the evaluation of options to improve the authorized system before DOE can make a firm conclusion on the viability and merits of alternatives to the MRS.

We also believe that DOE's ongoing systems integration work in areas such as rod consolidation, on-site dry storage, various transportation options, and new cask designs may provide additional information on the viability and merits of options for improving the authorized waste management system. The results of this work should be provided to the Congress to assist in evaluating DOE's proposal.

Additional Information Is
Needed to Determine the
Cost of the MRS

According to DOE, it has not yet determined the costs attributable to several important elements of its MRS proposal. These elements include, for example, the costs associated with financial aid to affected communities and the state of Tennessee. DOE does not plan to determine these costs, however, until after the Congress has approved the proposal.

Before the Congress can make an informed decision on the MRS, we believe that DOE should determine the costs of the various elements that have been identified but not yet quantified by OCRWM and DOE's ICE staff. These include, but are not limited to, the cost of (1) aid to affected localities for mitigating the impacts of the MRS facility, (2) consultation and cooperation agreements with the state of Tennessee, (3) state and local taxes, and (4) state, local, and federal permit and license fees associated with the facility.

Matters for
Consideration by the
Congress

DOE has submitted its proposal to the Congress seeking authorization to construct and operate an MRS facility primarily for waste preparation and packaging rather than for long-term waste storage. In evaluating the proposal, the Congress needs to recognize that the MRS concepts embodied in the Nuclear Waste Policy Act and DOE's proposal are different.

Recommendations

To evaluate and decide on DOE's request for authorization of an MRS, the Congress will need sufficient information from DOE to permit it to balance the costs and benefits of the proposed MRS facility and to compare it with the best configuration of the waste management system authorized by the Nuclear Waste Policy Act. DOE's MRS proposal does not contain sufficient information to allow such an assessment. In order to assist the Congress in its determination of whether an MRS should be integrated into the nuclear waste management system, we recommend that the Secretary of Energy:

- Obtain reactor-specific information from utilities on (1) their need for an MRS and how it would affect their operations, (2) whether they are willing and able to implement alternatives for improving the authorized waste management system identified by DOE—such as rod consolidation, dry storage, and upgrading for rail transport—at reactor sites, (3) whether utilities have identified other potentially viable alternatives for the management of nuclear wastes that may be more beneficial than either the MRS or the alternatives identified by DOE.
- Identify the best configuration of the authorized waste management system that combines the most feasible alternatives for maximizing the effectiveness, efficiency, and safety of the system in lieu of an MRS and present the Congress with the benefits and costs of both systems. This analysis should include the final results of DOE's PRDA and ongoing systems integration studies.
- Determine the estimated costs of each program element which has been identified but not yet quantified.

DOE and State of Tennessee Comments and Our Response

We asked DOE and the state of Tennessee to comment on a draft of this report. Their formal comments are included as appendixes I and II, respectively. Specific editorial and technical comments have been incorporated into the report where appropriate. Major comments and concerns of both DOE and Tennessee officials are addressed in the following sections.

DOE Comments

In commenting on our report, DOE raised a number of concerns regarding our conclusions that DOE needs to provide the Congress with additional information in order to make an informed decision on the MRS.

Draft Report Title

DOE stated that the title of the draft report—"DOE's Proposal for a Monitored Retrievable Storage Facility Is Incomplete"—implied that the proposal does not meet the requirements of the Nuclear Waste Policy Act because it does not include what GAO believes to be a complete study of the need for and feasibility of an MRS.

In our discussions with DOE officials, we agreed to change the title in order to clarify the overall message of the report. The final report title reflects our conclusion that the Congress needs additional information, beyond what has been provided to date, in order to make an informed decision on whether to authorize an MRS.

Alternative to a System With an MRS

DOE strongly disagreed with the draft report's conclusion that more information on an "optimized no-MRS system" is needed for the Congress to make an informed decision on the MRS. DOE commented that we had not defined what we mean by an "optimized waste management system that does not include an MRS."

As reflected in the final report, we have omitted the term "optimized" system and clarified the type of information we believe the Congress needs as a basis for judging the merits of the MRS proposed by DOE. We believe that the Congress needs to be aware of the consequences of not approving an MRS as well as the implications of authorizing the facility. DOE provides an analysis of the implications of integrating an MRS into the waste system. However, the proposal does not demonstrate how and to what extent the waste system authorized by the act, which does not include an MRS, could be improved so as to maximize the efficient, effective, and safe management of nuclear wastes. The Congress needs information based on up-to-date data on the most effective and efficient configuration of the authorized waste management system as a basis for comparison with the system proposed by DOE.

DOE also stated that the advantages and disadvantages of a comprehensive array of potential waste system improvements were described in the MRS proposal documents. DOE stated that this analysis clearly indicates that the disadvantages of these options are significant and the potential gains from each potential improvement are limited.

As discussed in chapter 3, we agree that DOE described the advantages and disadvantages of a number of options for improving the waste system. We do not agree, however, that some of these individual options have been evaluated in sufficient depth to make a judgment on whether

the disadvantages of each outweighs its advantages. For example, DOE's evaluation of options for improving transportation, such as upgrading reactors to accommodate rail shipments and use of new cask designs, is not detailed enough to permit weighing the advantages against the disadvantages and determining a net effect. More important, the MRS proposal does not analyze the effects that various combinations of potential at reactor, transportation, and repository improvements would have on the authorized system as a whole, nor what the authorized system would cost with each of these variations. In this regard, we do not believe that the proposal presents an adequate supporting basis for DOE's "judgement" that no combination of improvements will provide benefits comparable to an MRS.

MRS Costs

DOE is concerned that we "misunderstood and incorrectly interpreted MRS costs." Therefore, we have clarified our discussion of MRS costs and effects on total system costs in response to DOE's concerns.

In responding to our recommendation that the Secretary of Energy should quantify all costs associated with the MRS, DOE explained why certain cost elements identified in the proposal and by DOE's ICE staff have not been quantified. DOE stated that costs of land acquisition from one federal agency to another, as in the case of the MRS, are not known in advance since circumstances for transfer "vary widely." Since DOE has identified proposed sites for an MRS and, therefore, the federal agencies that would be involved in the site acquisition, we believe that DOE should be able to define the specific circumstances of the site transfer sufficiently to provide a reasonable cost estimate.

DOE also stated that the overall cost impact of certain elements—such as royalties, initial inventory of spare parts, permit and license fees, and consultation and cooperation agreements—will not be significant and are included in the 25-percent contingency factor for costs of the MRS receiving and handling facility. We question DOE's assertion that the cost elements included in the 25-percent contingency factor will be insignificant since DOE's ICE staff indicated that some of these items "could be of substantial magnitude." We also question whether these costs are appropriately included in the "contingency" category which implies an adjustment for unanticipated costs rather than known but unquantified costs.

According to DOE's comments, costs for upgrading roads, railroads, and bridges for heavy transport are not appropriate because the MRS cost estimate includes costs for connecting the facility to highway and rail

lines. Beyond that, all shipments are assumed to proceed as commercial traffic. We believe, however, that, beyond connecting the facility to highway and rail lines, DOE might have to incur additional costs associated with upgrading roads and railroads leading to the facility if state and local authorities fail to do so and the operations of the MRS are, consequently, adversely affected.

DOE stated that specific amounts for state and local taxes (or payments in lieu of taxes) and annual impact assistance to local governments were not presented in the proposal to allow DOE "flexibility in the consultation and cooperation process" if the Congress approves the MRS. DOE maintains that "any costs estimated for these items volunteered by the Department at this time would be interpreted as a lower limit for purposes of beginning negotiations." According to DOE, these costs are considered to be a small percentage of the total system costs, "absent any Congressional direction to the contrary." Further, DOE believes that it is appropriate that some of these costs be determined by the Congress "as a matter of national policy and value of the MRS to the waste management system," as opposed to being estimated by DOE. In summary, according to DOE, "the Department believes it is appropriate for it to provide Congress an estimate of the 'hard' costs for MRS and to simply point out that any costs Congress determines to be proper" for consultation and cooperation agreements, state and local taxes, and impact assistance "will be above and beyond the 'hard' costs provided."

We disagree with DOE that the costs for such elements as payments to state and local governments for taxes and impact assistance may be relatively small. On the contrary, because they are the subject of negotiation, the costs of these elements could be significant. Because DOE's proposal does not provide some reasonable estimate for these elements the Congress is presented an incomplete picture of what the MRS may ultimately cost.

We continue to believe that it is DOE's responsibility to estimate all costs associated with an MRS so that the Congress will have a reasonable basis for weighing the benefits of the facility as described by DOE against its full costs. Without a complete cost estimate, it will be difficult for the Congress to make an informed decision on whether the MRS is worth the price that utilities and, in turn, ratepayers are being asked to pay. However, we also agree, in principle, that the Congress should have some flexibility to determine any payments that may be required beyond the strict costs of building and operating an MRS facility. In addition, we

acknowledge that DOE may need to maintain some flexibility in the negotiating process and may, therefore, wish not to identify specific estimates for state and local payments at this time. Therefore, in order to provide the Congress with as much information as possible on the potential effects of state and local payments on the overall cost of the MRS and, at the same time, provide DOE with the desired flexibility in this process, we believe DOE should provide estimates of the effects of a range of potential state and local payments on total system costs. By doing this, DOE would be providing the Congress with the type of information it will need to evaluate the acceptability of a range of future payments to state and local governments. This information would give the Congress some basis for determining acceptable limits for such payments.

State of Tennessee's
Comments

The state of Tennessee concurs fully with the conclusions and recommendations of our draft report. State officials recommended that we prepare a supplement to this report documenting changes made in the MRS proposal since December 1985. As indicated in chapter 1, we have reviewed DOE's final (March 1987) MRS proposal, identified differences from the "Review Copy" on which our draft report was based, and revised our final report where necessary to reflect the changes to the nuclear waste program contained in the Draft Mission Plan Amendment released in February 1987.

Comments From the Department of Energy



Department of Energy
Washington, DC 20585

May 1, 1987

Mr. J. Dexter Peach
Assistant Comptroller General
Resources, Community, and Economic Development
Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

The Department of Energy (DOE) appreciates the opportunity to review and comment on the General Accounting Office (GAO) Draft Report entitled, "Nuclear Waste: DOE's Proposal for a Monitored Retrievable Storage (MRS) Facility is Incomplete" (GAO/RCED-87-92).

The Department strongly disagrees with much of the information and many of the conclusions contained in the report, and as a result, does not concur in the GAO recommendations. Our specific comments and suggestions follow.

Much of the report is unfairly one-sided, key information is omitted, and the Department's position on a variety of topics is mischaracterized.

The GAO draft report focuses on two main criticisms of the needs analysis contained in the December 1985 review copy of the MRS Proposal:

1. That the Department has not developed an optimized no-MRS case for comparing the effects of the implementation of an integrated MRS facility into the waste management system. GAO concludes that "DOE's proposal does not, therefore, provide Congress with an adequate basis to make an informed decision on whether the MRS should be integrated into the nuclear waste management system" and that the "Department has not demonstrated that the MRS is needed to safely manage spent fuel or that the benefits attributed to the MRS could not be achieved through other means."
2. That the Department has not fully characterized the costs of adding an integrated MRS to the waste management system.

- 2 -

For the reasons discussed below, the Department considers the title of the GAO draft report to be misleading and strongly disagrees with the above criticisms.

The title of the GAO draft report states that the Department's MRS proposal is incomplete, implying that the proposal does not meet the requirements of the Nuclear Waste Policy Act of 1982 (NWPA). In fact, the analysis GAO considers to be incomplete, i.e., the need and feasibility study, is not even required by the NWPA to be a part of the proposal. Further, the NWPA does not even require an affirmative finding of need on the part of the Department as a prerequisite for submitting the proposal. The Department elected to include the study as part of the proposal for completeness and to help explain the precise role the Department believes the MRS can best serve.

The Department strongly disagrees that more information on an "optimized" no-MRS system is needed to provide Congress with an adequate basis for MRS decision-making.

Further optimization of alternative no-MRS system options will not produce any new data or insights of importance to the real issues involved here. The only alternative to performing packaging functions at either the repository or the MRS is to perform these functions at the reactor sites. These alternatives were qualitatively considered in the proposal documents, and it was shown that each activity would add significantly to reactor burdens. The real policy issue raised by GAO's conclusion is whether Congress wants the reactor operators to focus their efforts for the next 20 to 30 years on safe, reliable, and efficient generation of electricity -- the function for which the reactors were designed -- or whether Congress wants the reactor operators to assume new responsibilities for a range of high-level waste management activities that must inevitably divert some energy and attention from reactor operation.

The Congress finds in Section 111 of the NWPA that "a national problem has been created by the accumulation of spent nuclear fuel from nuclear reactors" and that the "Federal Government has the responsibility to provide for the permanent disposal." Placing additional burdens on the reactor operators would be inconsistent with the findings which serve as a basis for the NWPA.

- 3 -

The foreign experience further reinforces the Department's belief that more detailed study of alternatives that would further burden ongoing reactor activities is not warranted. For example, both West Germany and Sweden are minimizing the role of the operating reactors in spent fuel management and disposal, in order to allow the reactors to concentrate their efforts on the safe and efficient operation of the reactor facility. In reporting that the Department has not fully addressed the use of operating reactors in the waste management system, the GAO embraces direction in policy that the Congress did not incorporate into the NWPA.

The specific no-MRS system features that GAO believes should have been more thoroughly addressed include the institution of widespread reactor rod consolidation, expanding storage capabilities at reactor sites, the upgrading of all reactor sites to rail capability and using reactor sites to marshal multi-cask shipments. Additional options for improving the transportation system are also included, such as inter-modal (truck to rail) transfers, the multi-cask shipments for truck and rail, the use of extra large casks (both truck and rail), and the use of truck conveying techniques. These features are discussed below or in the specific comments that follow.

Reactors can perform rod consolidation, but at additional financial and operating costs and risks. Their experience to date with this technology has been to consolidate two assemblies into one square canister that will fit back into the original storage rack. This "reactor" canister will be open to permit water cooling (i.e., it will not be sealed); it will be exposed to water that may be contaminated; and it may or may not be compatible with repository packaging plans. In contrast, rods from as many as twelve Pressurized Water Reactor (PWR) or thirty Boiling Water Reactor (BWR) assemblies could be consolidated in round canisters at the MRS or the repository. The canisters would be sealed, free of surface contamination and specifically designed for the repository disposal package. Thus consolidation and packaging operations at reactor sites are not comparable to those same operations at a large dedicated packaging facility like the MRS (or the repository). In addition, the packaging functions at the MRS facility (or the repository), in contrast to reactor storage basins, would be designed, built, licensed and operated specifically for this purpose. Considering that several hundreds of thousands of assemblies will be consolidated and packaged, the DOE believes it is important that it be done with equipment and facilities dedicated to that objective, as opposed to its being an adjunct operation at over 100 different reactor sites not currently licensed for such a production operation.

- 4 -

GAO claims "DOE has not determined the extent to which utilities are willing or able to utilize various operational alternatives, in lieu of the MRS, to manage their growing spent fuel inventories." DOE is confident that utilities could manage these inventories as long as necessary. That is not an issue, and the MRS is not proposed with the primary objective of reducing the utility storage burden. Rather, reducing that burden is a very significant, but secondary, benefit associated with early implementation of the Federal disposal system that is permitted by the MRS and which makes the MRS all the more attractive.

GAO notes that the current DOE design for the system for transporting fuel from the reactors can be improved. This is true -- with or without the MRS. Almost all the transport system improvements suggested by GAO are improvements that DOE plans to incorporate as their merits and costs are further determined -- with or without an MRS. Their only effect on the MRS proposal is to potentially lessen, but not eliminate, some of the transportation system benefits offered by the MRS.

In any event, GAO has not defined what it means by an "optimized waste management system that does not include an MRS." For example with respect to what basis should the system be optimized? What performance criteria (and weighting factors for each) does GAO believe are appropriate? Since cost, technical or institutional improvements, albeit only small ones, can invariably be made to a complex system (especially for a system that is in a very conceptual stage), almost any system may be criticized for not being "optimized." Such criticism could be constructive if it identified considerations not already addressed by the Department that might result in major system improvements. The advantages and disadvantages of a comprehensive array of potential system improvements postulated by the Department and others were described in some detail in the need and feasibility analysis. A careful reading of that analysis clearly shows that the disadvantages of those options considered are significant, whereas the potential gains from each potential improvement are limited. It is the Department's judgment that neither a single improvement nor realistic combinations of various improvements will even remotely approximate the benefits to be gained from the MRS. In particular, the Department cannot conceive of how system development and early deployment benefits can be derived without an MRS. To postpone a decision on the MRS in an elusive, and perhaps never ending, search for an "optimized" no-MRS system would be wasteful and unproductive.

- 5 -

In response to the second point involving the Department's characterization of MRS costs, the GAO has misunderstood and incorrectly interpreted MRS costs in the reports it has generated on this subject.

Contrary to GAO's title heading "DOE Has Revised Its MRS Cost Estimate," the Department has not changed its estimate of the MRS facility costs, except to adjust for escalation, since the December 1985 review copy of the Proposal was printed (\$2902.4 million - 1985 dollars). The MRS facility costs were based on the conceptual design of the MRS that was completed in late 1985. Since the completion of the review copy of the Proposal, the Department printed a February 1986 final version of the Proposal (which it was prevented from submitting) and then updated Volumes I and III of that version for submission in March 1987.

What has changed are projections of the incremental costs for the integration of the MRS into the waste management system, taking into account how the MRS would affect overall repository, transportation and system development costs. Those costs are annually addressed by the Department in the Total System Life Cycle Cost (TSLCC) estimate.

The incremental costs, or the net impact, of the MRS on the total system costs are a very small difference between two very large numbers representing the costs of a system with and without an MRS. The preponderance of the costs in the large numbers presented in TSLCC estimates is associated with the repository program; these cost components are highly uncertain at this time for understandable reasons. In this regard, it is likely that the TSLCC estimate in succeeding years will fluctuate as the program evolves and as the design costing basis for other elements of the program becomes more detailed and comparable to the level of specificity contained in the MRS facility designs. GAO has erroneously attributed continuing, but justified, large uncertainties in total program costs to the MRS program and has used these uncertainties to question the MRS cost estimates.

The 1986 TSLCC estimate for the cost impact of MRS on the waste management system indicated that the incorporation of MRS would increase total system costs from about \$1.6 - \$2.6 billion. The 1987 TSLCC estimate, which will be formally published later this year, estimates the increase at \$1.5 - \$1.6 billion. The 1987 TSLCC estimate addresses the cost effects of the 5-year delay of the first repository along with the different operating conditions being proposed for the MRS in servicing the first

- 6 -

repository. In addition, the 1987 TSLCC analysis also addresses the new waste acceptance schedule presented in the Draft Amendment to the Mission Plan and incorporates all changes in the analytical data base regarding transportation system assumptions. Consistent with prior years, the 1987 TSLCC estimate continues to use the February 1986 Proposal's estimate for the total MRS facility cost with appropriate escalation factors. The 1987 TSLCC estimate of \$1.5 - \$1.6 billion represents less than 5% of the total system costs and will be further offset by savings in at-reactor storage costs, potentially up to \$1 billion, that result from the earlier acceptance rates permitted by a system with an MRS.

The reduction in the incremental cost impact of MRS on the waste management system from the 1986 TSLCC estimate to the 1987 estimate was brought about by an increase in the costs of certain repository surface facilities and by the use of repository waste canisters at the MRS that are less costly, resulting also in increased cost efficiency in the transportation system. Given the total costs of the waste management system, the new TSLCC results have not altered the Department's original conclusion regarding the total system cost impact of the inclusion of the MRS as presented in the Proposal -- that the incremental costs due to the inclusion of an MRS constitute a small percentage of the total system cost. To put these costs in perspective, the MRS incremental costs are within the uncertainty range of current cost estimates for a waste management system without an MRS facility.

Regarding the statement that the Department has not included all attributable costs to the construction and operation of MRS, the GAO draft report presented a list of unquantified costs that the Department originally identified and has responded to in the past:

1. Land acquisition costs;
2. Royalties on proprietary processes;
3. Initial inventory of spare parts;
4. State, local, and Federal permit and license fees;
5. Consultation and cooperation agreement with the State government;
6. Upgrading roads, railroads, and bridges for heavy transport;
7. State and local taxes (or payments in lieu thereof); and
8. Annual impact assistance to local governments.

- 7 -

Costs of land acquisition (Item 1) from one Federal Agency to another are not known in advance, since circumstances for transfer vary widely, if, indeed, costs would be directly incurred. The Department did, however, provide an estimate in the Proposal of the potential costs of acquiring the preferred site, based on average land costs in comparable areas. (The estimate for the land was \$2 million.) In identifying the items on the list presented above, the Department has consistently stated that the overall cost impact of items 2 through 4 will not be significant and is included by implication in the 25% contingency factor for costs of the MRS receiving and handling (R&H) building. Item 6 costs for upgrading roads, railroads and bridges for heavy transport are not appropriate since the transport of spent fuel to and from the MRS facility will be accomplished through commercial transport. The MRS cost estimate provided by the Department does include costs for connecting the facility to commercial highway and rail lines. Specific amounts for items 5, 7, and 8 were not addressed in the Proposal to allow the Department flexibility in the consultation and cooperation process that will be initiated if Congress approves the MRS Proposal. It should be noted that the Department did include a local estimate for item 7 in the proposal documents. (Such costs were identified to be as much as \$10 - \$15 million per year for the 10-year period preceding facility operation.) Any cost estimates for these items volunteered by the Department at this time would be interpreted as a lower limit for purposes of beginning negotiations. In any event, these costs are considered to be a small percentage of the total system costs, absent any Congressional direction to the contrary, and as such should not be a major factor in determining the need for MRS.

The Department further believes that it is appropriate that some of these costs be determined by Congress, as a matter of national policy and of the value of the MRS to the waste management system, as opposed to a DOE estimate. In summary, the Department believes it is appropriate for it to provide Congress an estimate of the "hard" costs for MRS and to simply point out that any costs Congress determines to be proper for items 5, 7, and 8, will be above and beyond the "hard" costs provided.

Although the GAO draft report presented a brief summary of the benefits that an MRS will bring to the system, it is clear from the presentation that the system development benefits have not been well understood by GAO staff. Inclusion of an MRS in the waste management system provides a stepwise approach to moving from the current state of experience to full scale operation of a disposal system including a repository. Those who emphasize a static comparison of already deployed MRS and no-MRS systems tend to overlook the importance of proceeding with an MRS as a step to a repository.

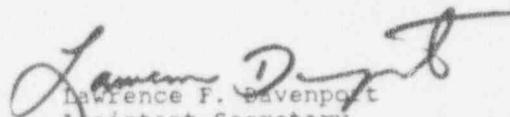
- 8 -

Whether or not there is an MRS in the waste management system, much in the way of resources and a large amount of human ingenuity will be dedicated during the next two decades to managing spent fuel before it is emplaced in a repository. If that effort were directed at performing spent fuel management operations at over 100 separate reactor sites, it would provide little learning experience that would be directly transferable to timely development and operation of a repository. If the effort were focused on the development and operation of an MRS, much of that experience would directly increase the likelihood of safe, timely and reliable operation of the system.

In summary, with no MRS in the waste management system, many of the first-of-a-kind technical and institutional challenges of high-level waste management and disposal will have to be faced at the first repository site. With the MRS in the system, many of the pertinent issues, except for the long term disposal issue, will have been addressed prior to the final development efforts for the first repository.

The Department appreciates the consideration shown by GAO personnel in meeting with us to discuss these concerns and hopes that these comments will be helpful to GAO in its preparation of the final report. Additional editorial comments have been provided to Mr. Dwayne Weigel.

Sincerely,


Lawrence F. Savenport
Assistant Secretary
Management and Administration

Comments From the State of Tennessee

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
CORDELL HULL BUILDING
NASHVILLE, TENNESSEE 37219-5402

JAMES E. WORD
COMMISSIONER

April 14, 1987

Mr. J. Dexter Peach
Assistant Comptroller General
United States General Accounting Office
Washington, DC 20548

Dear Mr. Peach:

The draft Government Accounting Office report DOE's Proposal for a Monitored Retrieval Storage Facility is Incomplete (GAO/RCED-87-92) has been carefully reviewed by my staff and other state officials. The state offers the following comments on the draft report.

- (1) The State of Tennessee concurs fully with the conclusion and recommendations of the draft report, as set forth in Chapter 5. We recommend that the GAO's assessment be provided to the Congress as expeditiously as possible.

State officials were not consulted by GAO investigators during the preparation of this report (page 17), nor were Tennessee's extensive technical review documents listed as sources of information by GAO. It is gratifying that GAO's findings (reached independently) reinforce Tennessee's earlier judgment of the December 1985 MRS proposal. The state's conclusions were expressed vigorously in comments delivered to the Department of Energy on February 5, 1986. (A copy is appended.)

- (2) The state strongly recommends that the Government Accounting Office prepare a supplement to this report, documenting changes made in the MRS proposal (now in Congress) since December 1985.

The draft GAO report is based on the December 1985 "Review Copy" of the MRS proposal, Environmental Assessment, and program plan. Like GAO, Tennessee was assured that the final proposal would be "essentially the same" as the "Review Copy." This is not the case.

Although our review of the revised proposal is not yet completed, it is evident that the March 30 version of the proposal is drastically different from the December 1985 version in several important respects. For example, the new proposal is predicated upon Congressional approval of the waste system implementation schedule set forth in the draft

Mr. J. Dexter Peach
Page 2
April 14, 1987

Mission Plan Amendment (released February 1987). A revised waste acceptance schedule is assumed, again based on the draft Mission Plan Amendment. While the estimated total system life cycle cost has increased by about \$4 billion, the cost of adding an MRS to the system has been reduced by \$1 billion. (The new cost estimates are not documented in the proposal.)

It would be helpful to Congress for the GAO to extend their assessment to these significant revisions, to examine the data/information supporting them, and to identify additional "matters for consideration by the Congress" implied by the proposed revision.

I appreciate the opportunity for Tennessee to review and comment on this important draft report.

Sincerely,


JAMES E. WORD

JEW/RHN/rc

cc: Mr. Jim Hall
Ms. Carol White

Major Contributors to This Report

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and Economic
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Washington, D.C.

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Vincent P. Price, Evaluator

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MONITORED RETRIEVABLE STORAGE (MRS)
FACILITY

MANAGEMENT REVIEW

PREPARED FOR

UNITED STATES DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

THE RALPH M. PARSONS COMPANY of DELAWARE
Westinghouse Electric Corporation
Golder Associates

MONITORED RETRIEVABLE STORAGE (MRS)
FACILITY

MANAGEMENT REVIEW

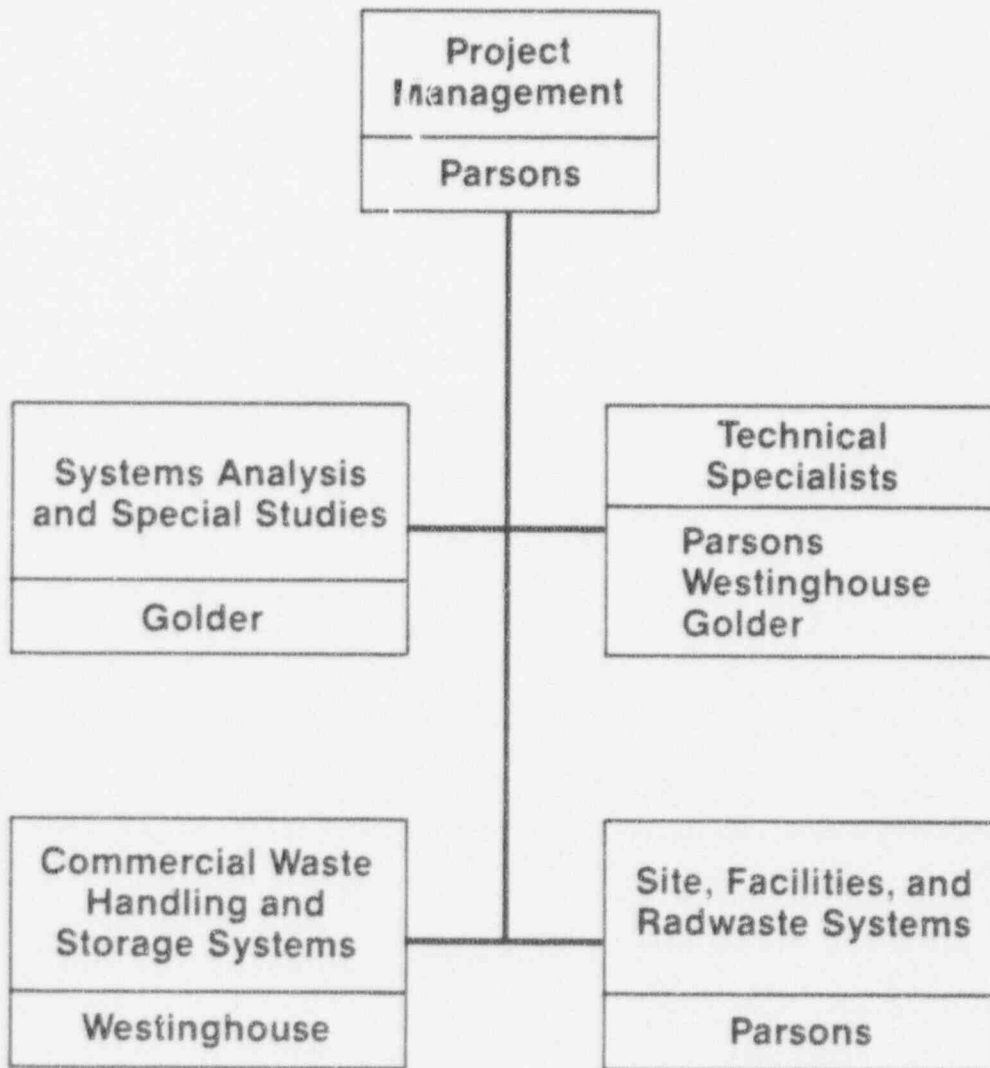
PREPARED FOR

UNITED STATES DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

THE RALPH M. PARSONS COMPANY of DELAWARE
Westinghouse Electric Corporation
Golder Associates

ORGANIZATION

A/E ORGANIZATION



A/E RESPONSIBILITIES

- | | |
|---|--------------|
| • Overall management | Parsons |
| • Systems analysis | Golder |
| • Geotechnical analysis | Golder |
| • SF HLW and RHTRU handling consolidation and packaging systems | Westinghouse |
| • Sealed storage cask and drywell systems | Westinghouse |
| • Improvements to land | Parsons |
| • Buildings and building systems | Parsons |
| • Onsite generated waste storage and treatment systems | Parsons |

CRITERIA

MRS FUNCTIONAL CRITERIA

- Site
- Configuration
- Operations
- Storage mode

MRS FUNCTIONAL CRITERIA

<u>Function</u>	<u>Criteria</u>
• Site	Primary: Clinch River Alternates: Oak Ridge or Hartsville
• Configuration	Licensed independent centralized waste preparation and temporary storage facility
• Operations	Receive, consolidate, and canister spent fuels Receive and overpack, if required, packaged HLW and RHTRU Repository overpack, if required Temporary storage of waste forms Concurrent 3,600 MTU/yr receipt and shipment 60% PWR/40% BWR 50 wt% rail/50 wt% truck
• Storage mode	1,000-MTU vault storage 14,000 storage cask/drywell

LICENSING

REGULATORY REQUIREMENTS

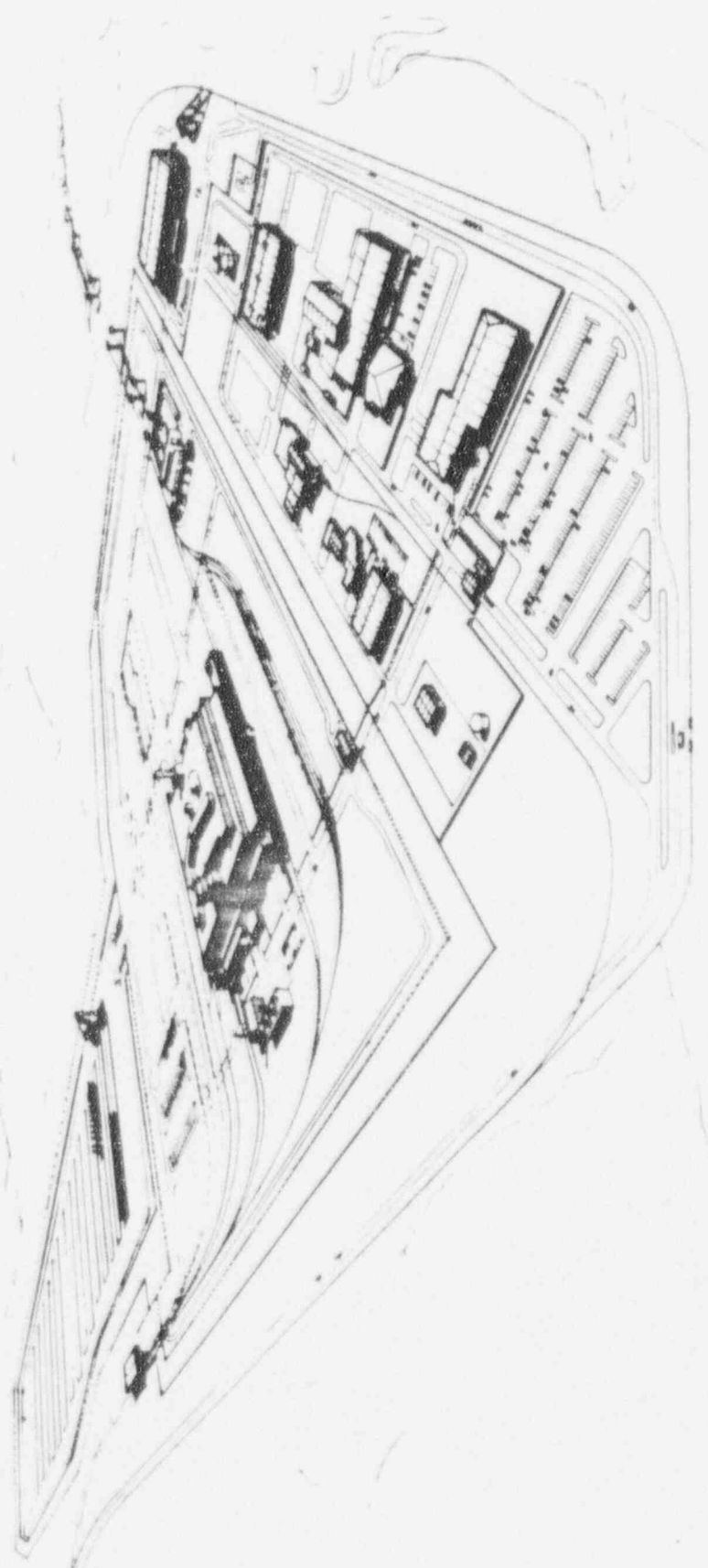
- 10 CFR 72 Basic Licensing Requirements
- 10 CFR 73 Physical Protection of Materials
(expanded by DOE 5632 Chapter III)
- 10 CFR 20 Exposure and Release Limits
(expanded by DOE 5480-1A and
DOE/EV 1830-T5)
- 10 CFR 70 Inventory Control
- 10 CFR 50 Quality Assurance
Appendix B (expanded by NQA-1)

SITE COMPARISONS

SITE COMPARISONS

<u>Item</u>	<u>Clinch River</u>	<u>Oak Ridge</u>	<u>Hartsville</u>
Size	303 acres (SSC)	322 acres (SSC)	317 acres (SSC)
	465 acres (Drywell)	429 acres (Drywell)	375 acres (Drywell)
Infrastructure	Railroad (4 mi)	Railroad (4 mi)	Railroad (7 mi)
	Highway (2 mi)	Highway (1 mi)	Highway (2 mi)
	Power supply (1 mi)	Power supply (1 mi)	Power supply (11 mi)
	Water supply (1 mi)	Water supply (3 mi)	Water supply (4 mi)
	Natural gas (2 mi)	Natural gas (1.5 mi)	Natural gas (1 mi)
Excavation	5½ MM CY (SSC)	5½ MM CY (SSC)	6½ MM CY (SSC)
	9 MM CY (Drywell)	7 MM CY (Drywell)	7 MM CY (Drywell)
Demolition/ relocation	None/powerlines	None/powerlines	Buildings/none
Seismic	0.25 G	0.25 G	0.20 G
Tornado	360 mph	360 mph	360 mph
Flood	Above flood plain	Above flood plain	Above flood plain

CLINCH RIVER



SUPPORT REQUIREMENTS

<u>Function</u>	<u>Facilities Provided</u>
• Administrative	Administration building
• Security	Security building and gatehouses
• Site maintenance	Site service building, vehicle maintenance building
• Utilities	Standby generator building, sewage treatment plant, fuel oil storage, water storage
• Emergency response	Fire station, heliport
• Industrial	Cask manufacturing facility

OAK RIDGE

5F, HLW & RHTRU
STORAGE FACILITY

LIMITED ACCESS AREA

3-STRAND BARBED
WIRE FENCE

PROTECTED AREA
EXIST POWER LINE
TO BE RELOCATED

RESTRICTED AREA

Hollow

McNew

RIDGE

VALLEY

RIDGE

ENERGY

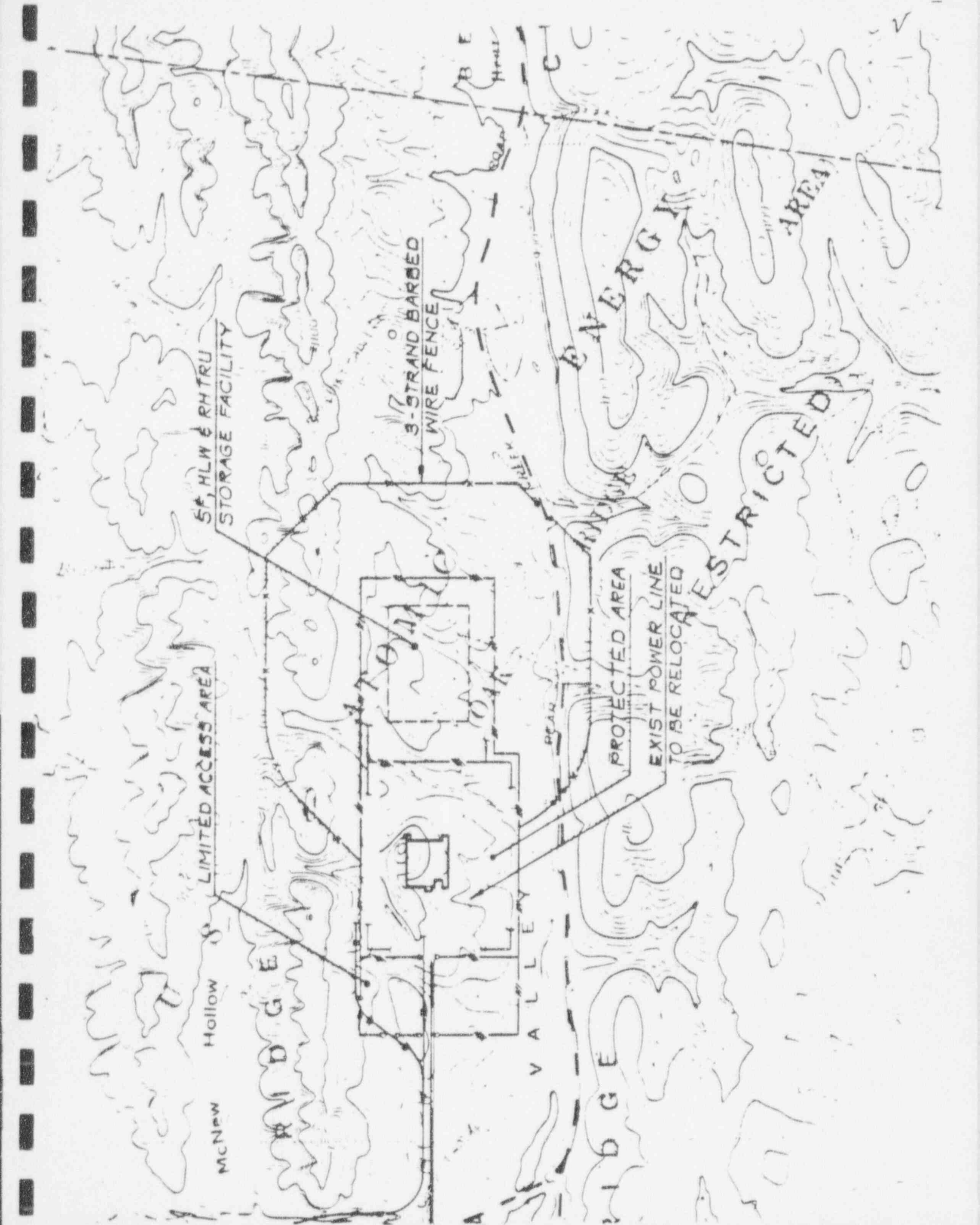
AREA

BE

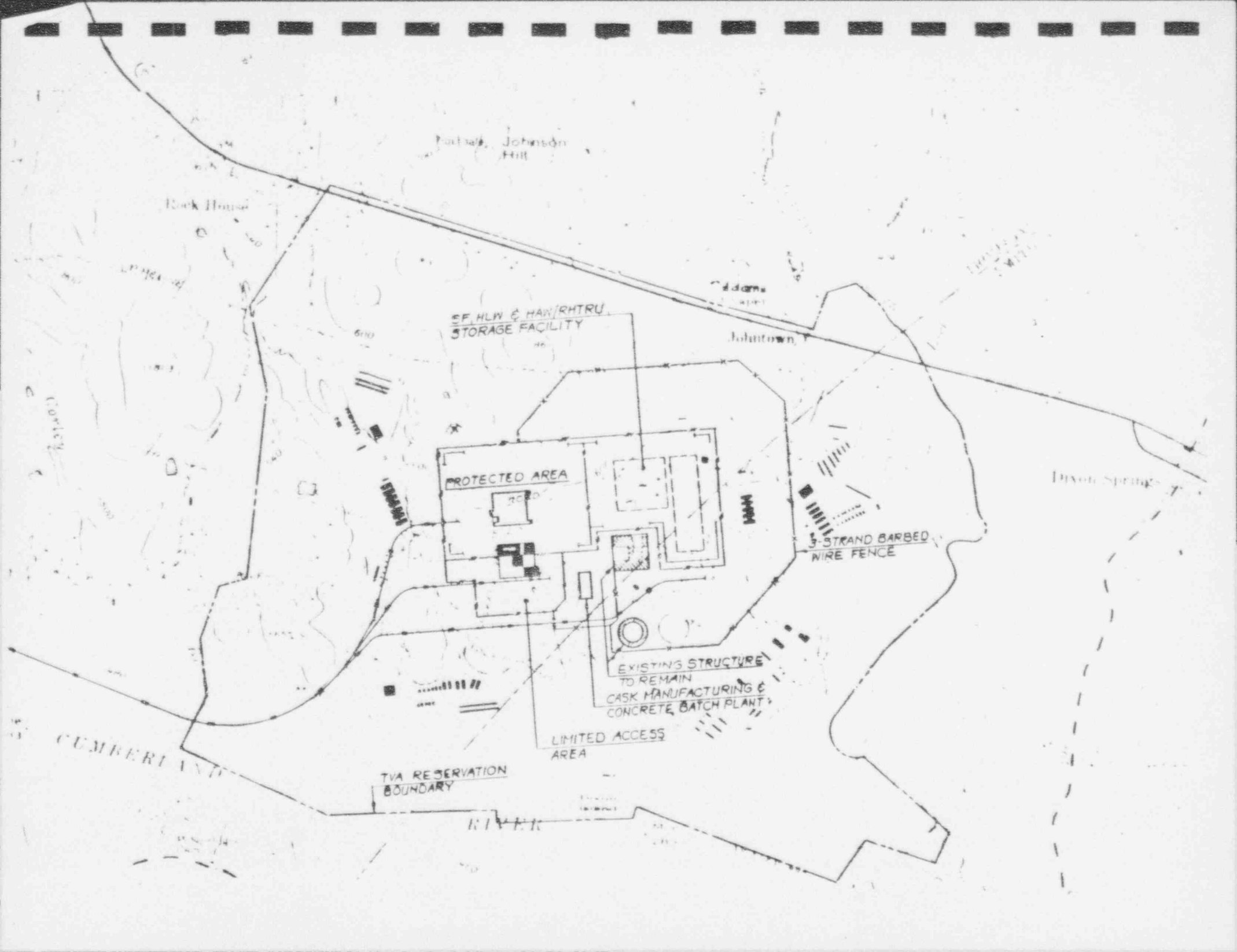
PEAR

A

2



HARTSVILLE



Johnstown

Rock House

SE, HLW & HAN/RHTRU
STORAGE FACILITY

Johnstown

PROTECTED AREA

DRAINAGE CANAL

3-STRAND BARBED
WIRE FENCE

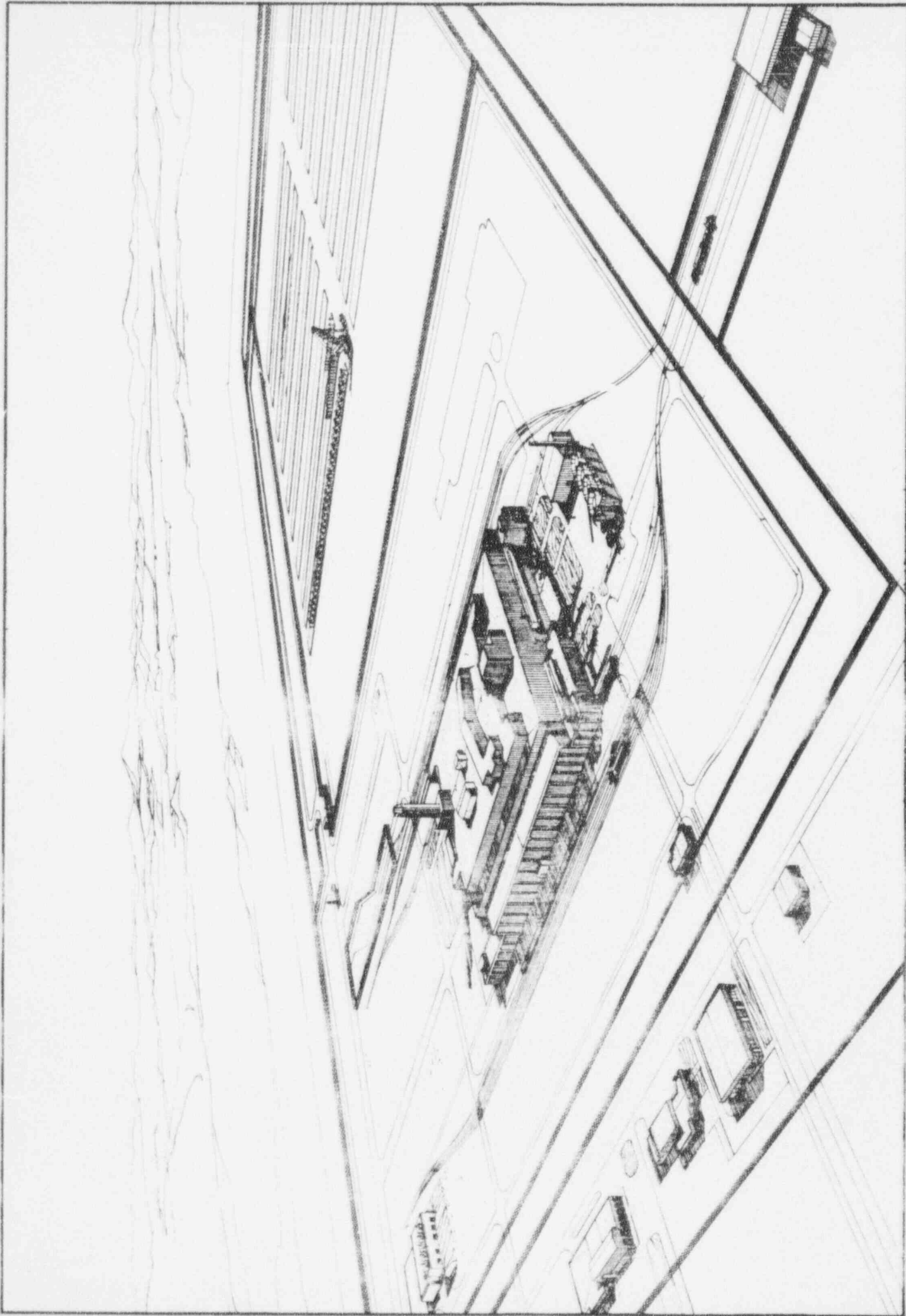
EXISTING STRUCTURE
TO REMAIN
CASK MANUFACTURING &
CONCRETE BATCH PLANT

LIMITED ACCESS
AREA

TVA RESERVATION
BOUNDARY

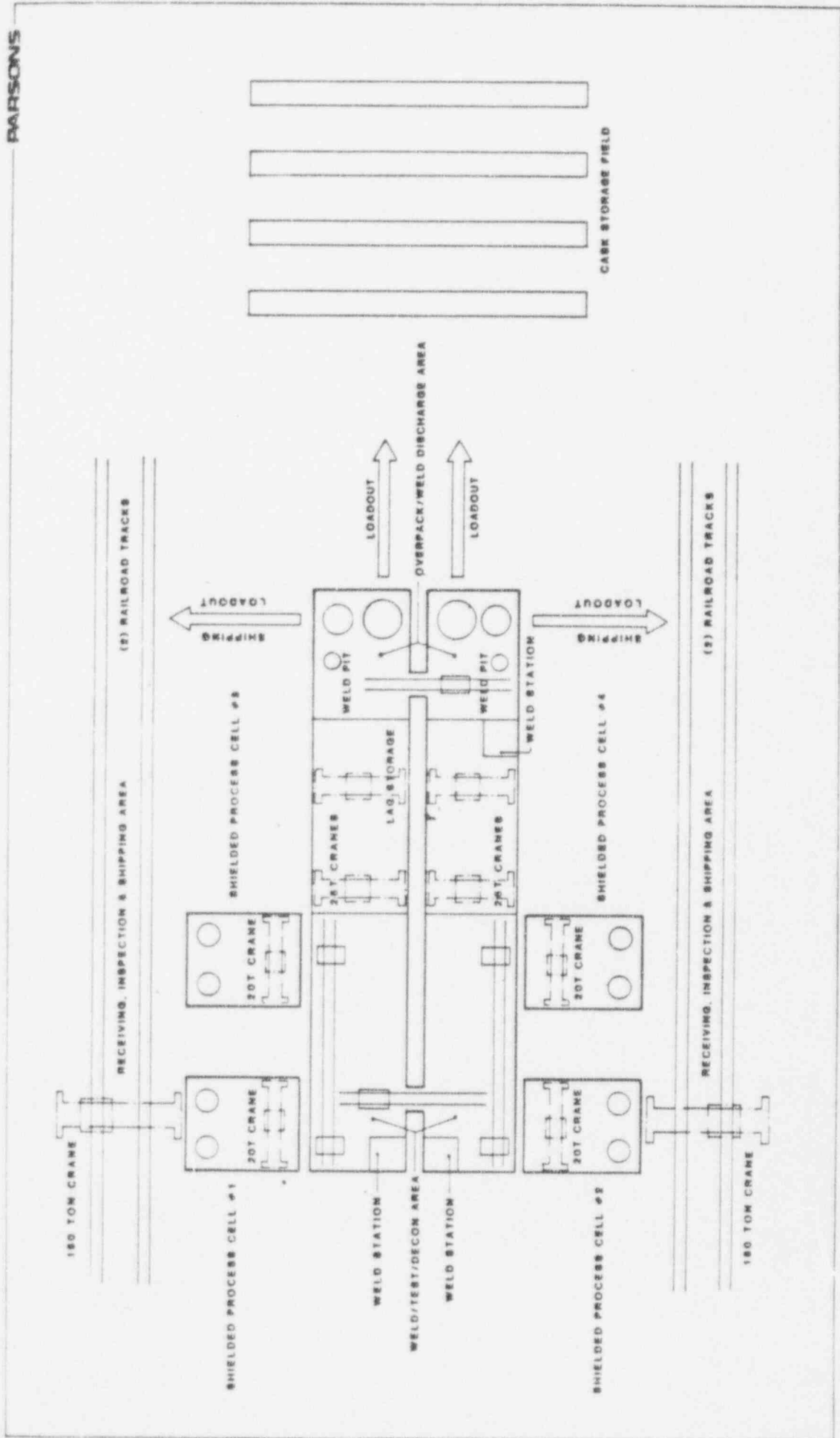
CUMBERLAND
RIVER

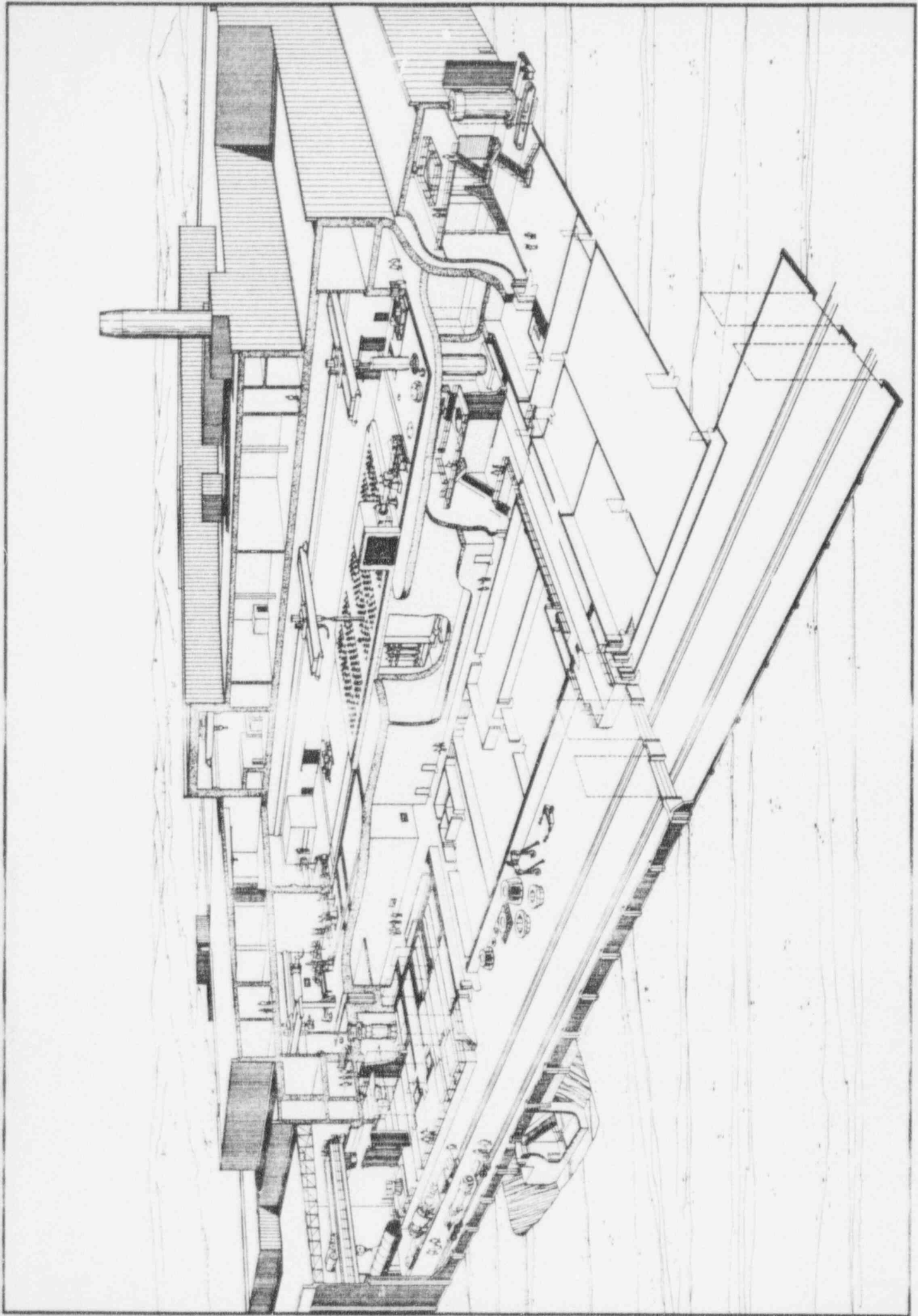
RECEIVING AND HANDLING BUILDING



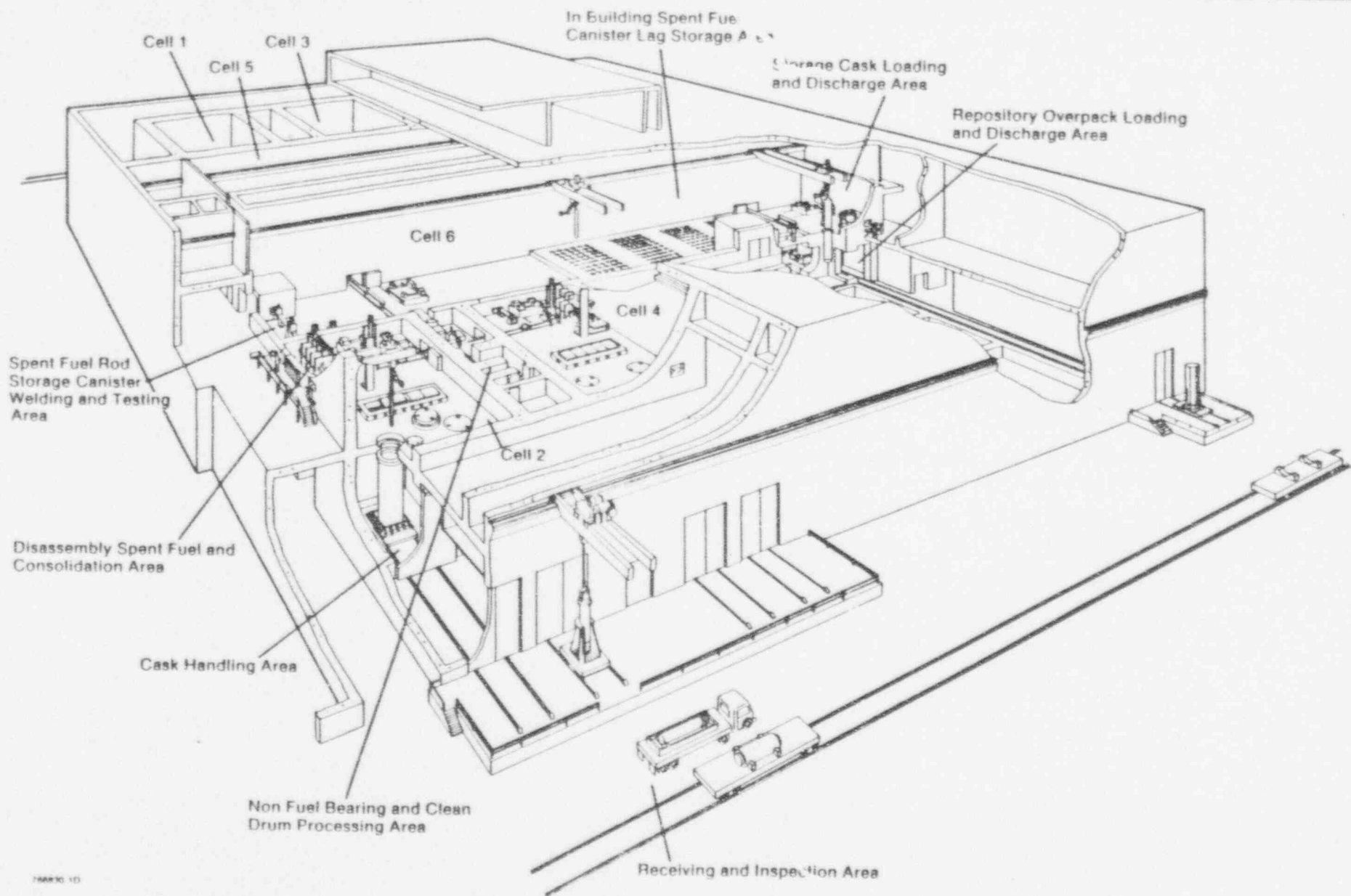
ARRANGEMENT

- Two rail/truck receiving and unloading areas
- Four shielded processing cells with dedicated cask-unloading areas
- Two HLW/RHTRU/repository overpack cells with four cask-loading/unloading areas
- Two canister welding stations
- Two repository overpack welding stations
- One canistered waste storage vault
- One high activity waste treatment area
- One low level waste treatment area
- HVAC equipment areas
- Electrical equipment areas
- Administration and personnel support areas

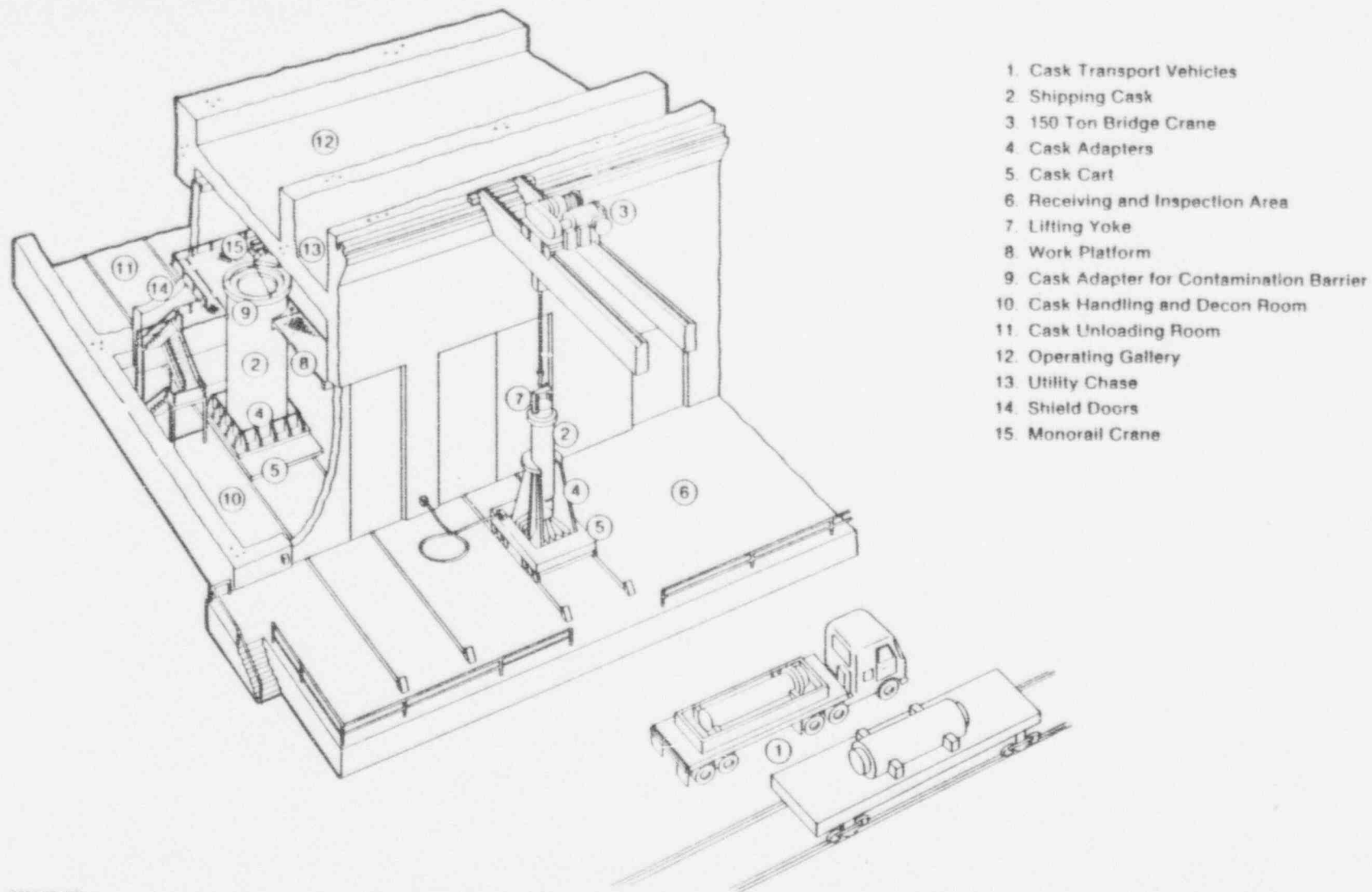




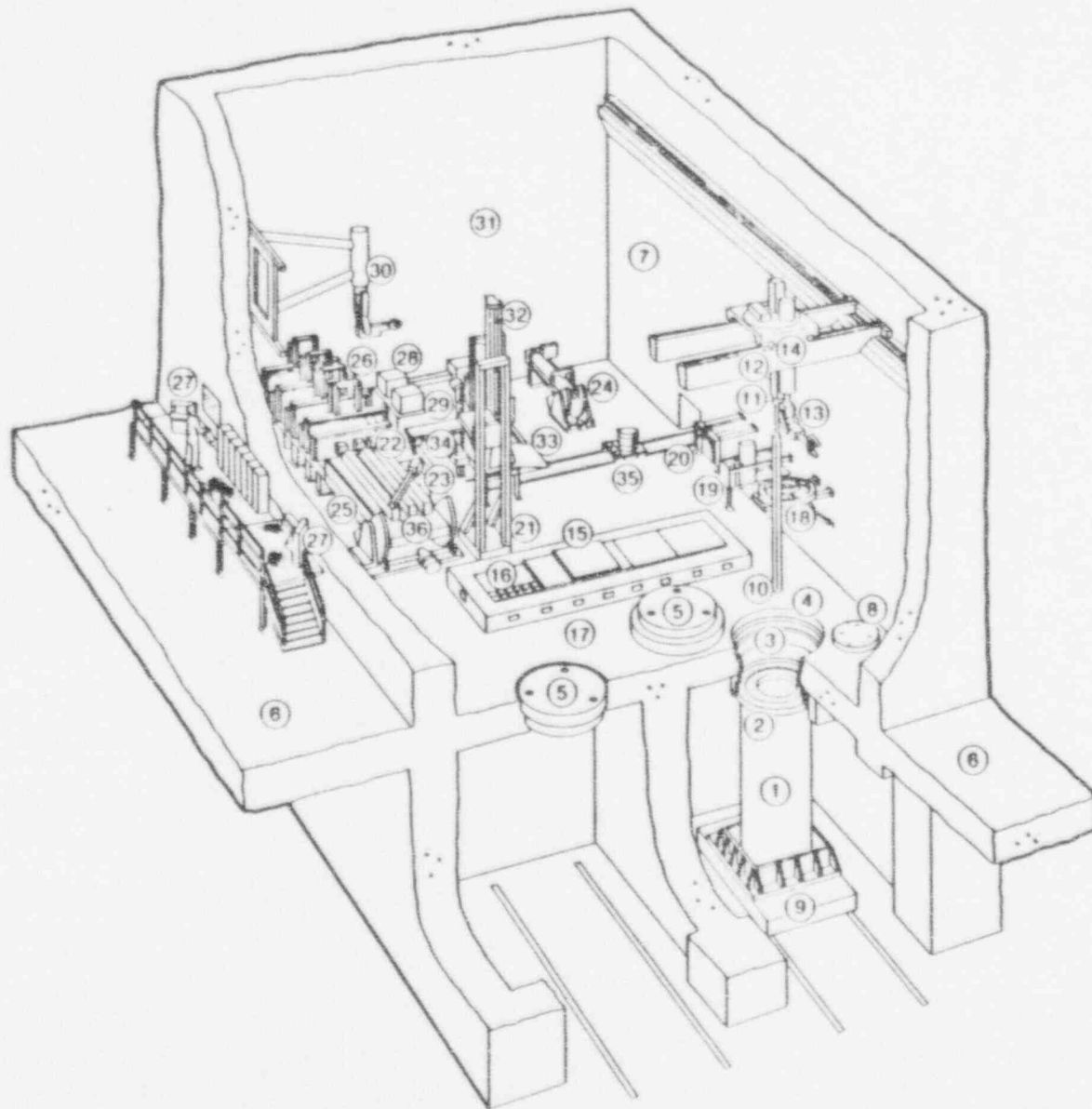
MONITORED RETRIEVABLE STORAGE FACILITY RECEIVING AND HANDLING BUILDING



Monitored Retrievable Storage Facility Receiving and Handling Building RECEIVING AND INSPECTION AREA

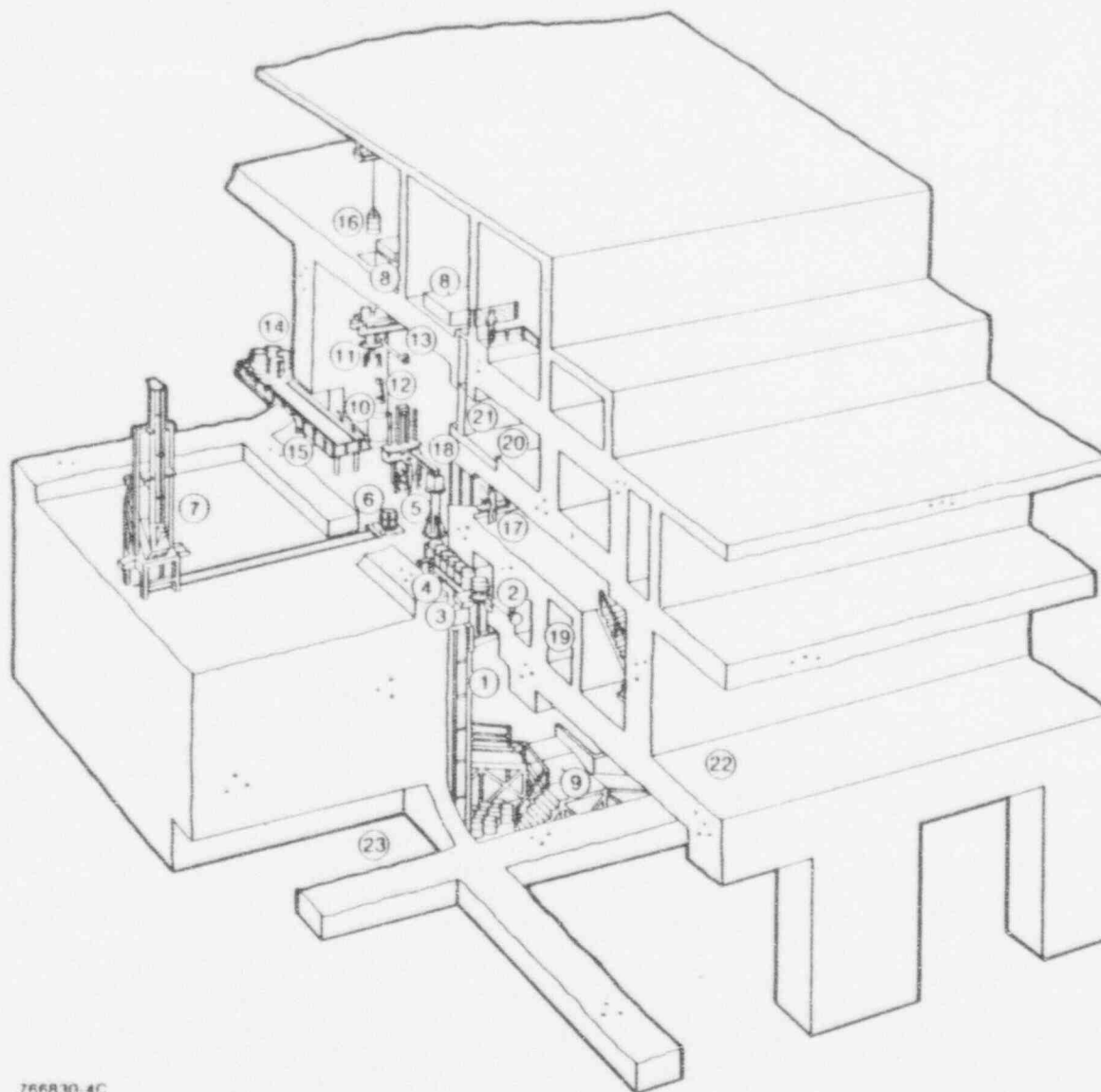


Monitored Retrievable Storage Facility Receiving and Handling Building SPENT FUEL DISASSEMBLY AND CONSOLIDATION AREA



- 1 Shipping Casks
- 2 Cask Adapter for Contamination Barrier
- 3 Contamination Barrier
- 4 Entry Port
- 5 Entry Port Shield Plugs
- 6 Operating Gallery
- 7 Shielded Process Cell #2
- 8 Shipping Cask Cover
- 9 Cask Cart
- 10 Spent Fuel Element
- 11 Spent Fuel Grapple
- 12 Power Mast
- 13 Manipulator
- 14 20 Ton Hot Cell Crane
- 15 Log Storage Covers
- 16 Log Storage
- 17 Log Storage Cooling Ducts
- 18 Port Grapple
- 19 Fuel Assembly and Pintle Grapples
- 20 Module Lifting Yokes
- 21 Laser Cutting System
- 22 Laser Cutting Head
- 23 Robotic (Auxiliary)
- 24 Intact Fuel Assembly Upender
- 25 Fuel Disassembly Station
- 26 Fuel Rod Consolidation Station
- 27 Process System Control Console
- 28 Maintenance Hatch Jacking Mechanism
- 29 Maintenance Hatch
- 30 Wall Mounted Manipulator
- 31 Shielded Process Cell Contamination Barrier
- 32 Secondary Waste Shredding System
- 33 Drum Lidding Station
- 34 Grid Infeed Chute
- 35 Drum/Filter Cart
- 36 Fuel Disassembly Module

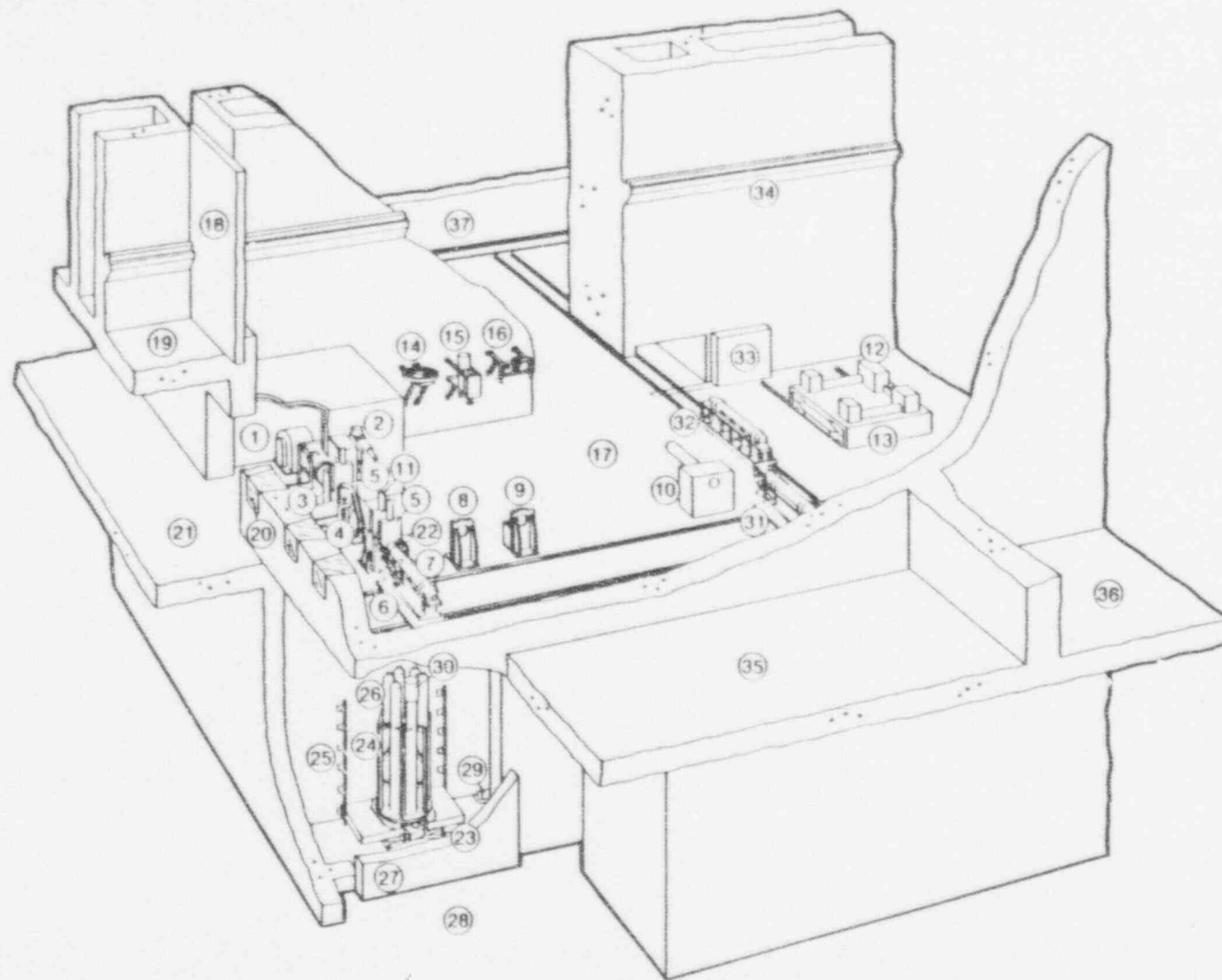
Monitored Retrievable Storage Facility Receiving and Handling Building SECONDARY WASTE PROCESSING AND DECON SYSTEM



1. Clean Drum Elevator
2. Drum Push Mechanism
3. Shield Valve
4. Drum Guidance System
5. Jib Crane w/Drum Grapple
6. Drum Transfer Cart
7. Secondary Waste Shredding System
8. Maintenance Hatch
9. Ramp
10. Drum Decontamination Station
11. Drum Grapple w/Decontam. Station Lid
12. Drum Swipe Arm
13. Overhead Crane w/Manipulator
14. Filled Drum Transfer Cart
15. Filled Drum Transfer Platform
16. HVAC Filter Drum
17. Secondary Waste Processing and Decon System Control Station
18. Observation Window
19. Airlock
20. Crane Maintenance Room
21. Crane Maintenance Shield Door
22. Operating Gallery
23. Clean Drum Storage

Monitored Retrievable Storage Facility Receiving and Handling Building

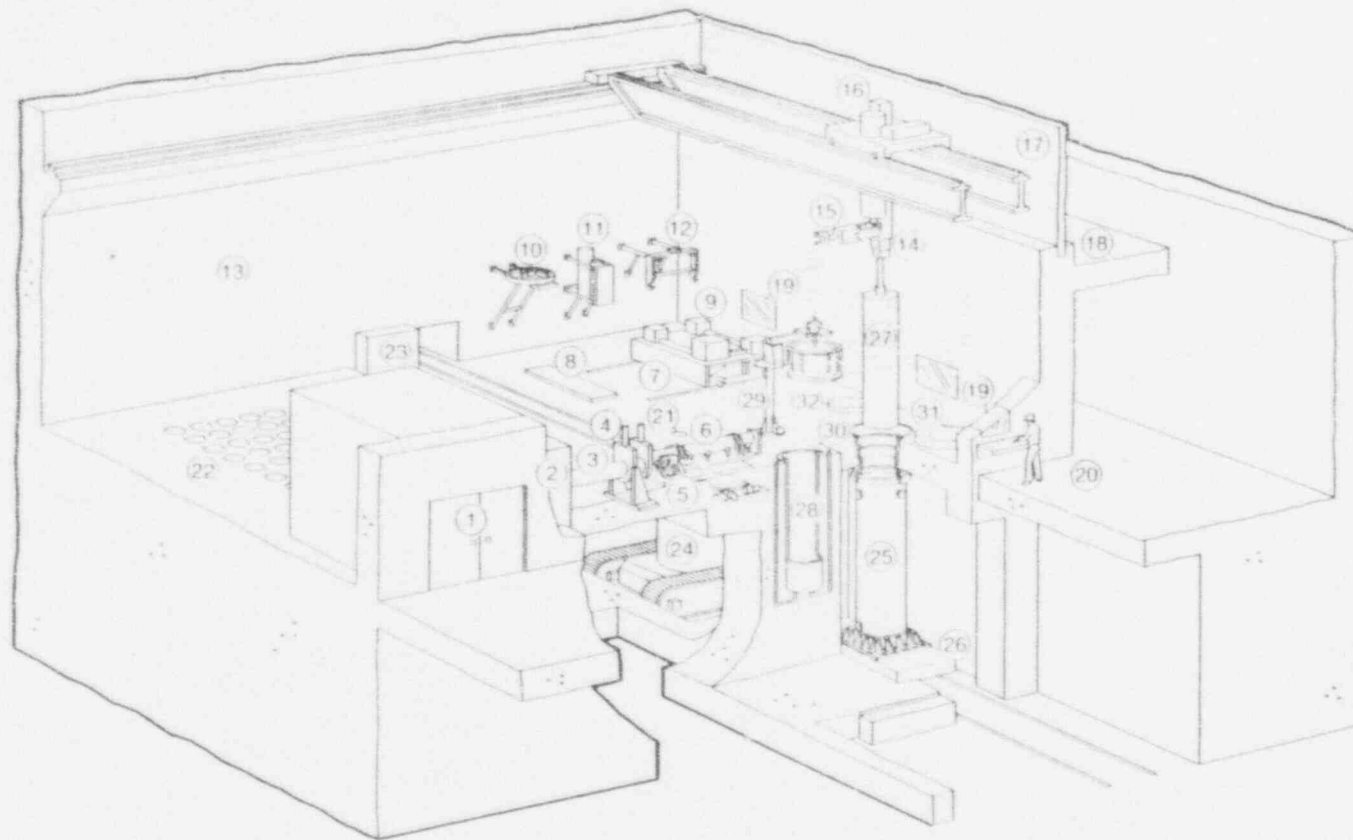
CANISTER LOADING AND WELDING AREA



1. Welding Power Generator/Equipment Room
2. Canister Lid Supply System
3. Canister Welding Station
4. Canister Decon/Helium Leak Test Chamber
5. Chamber Isolation Valves
6. Canister Upender No. 1
7. Storage Canister
8. Ultrasonic Test Station
9. Canister Cutting Station
10. Fuel Rod Bundle Push Rod System
11. Forge Press Restraint
12. Maintenance Hatch Jacking Mechanism
13. Maintenance Hatch
14. Plug Grapple
15. Pintle Grapple
16. Equipment Lifting Yoke
17. Shielded Canyon Cell #8
18. Maintenance Area Shield Door
19. Crane Maintenance Room
20. Observation Window
21. Operating Gallery
22. Clean Canister and Lid Supply Port
23. Carousel Lift Mechanism
24. Carousel Canister Rack
25. Guide Rail Lift Mechanism
26. Clean Canisters
27. Shield Door
28. Access Corridor
29. Lift Mechanism Hydraulic Pump System
30. Canister Lid Supply Support Tube
31. Canister Upender No. 2
32. Canister Pass-Thru Cart
33. Canister Pass-Thru Shield Door
34. 35 Ton Crane Rails
35. Shielded Process Cell #2
36. Decon Cell
37. Shielded Canyon Cell #5

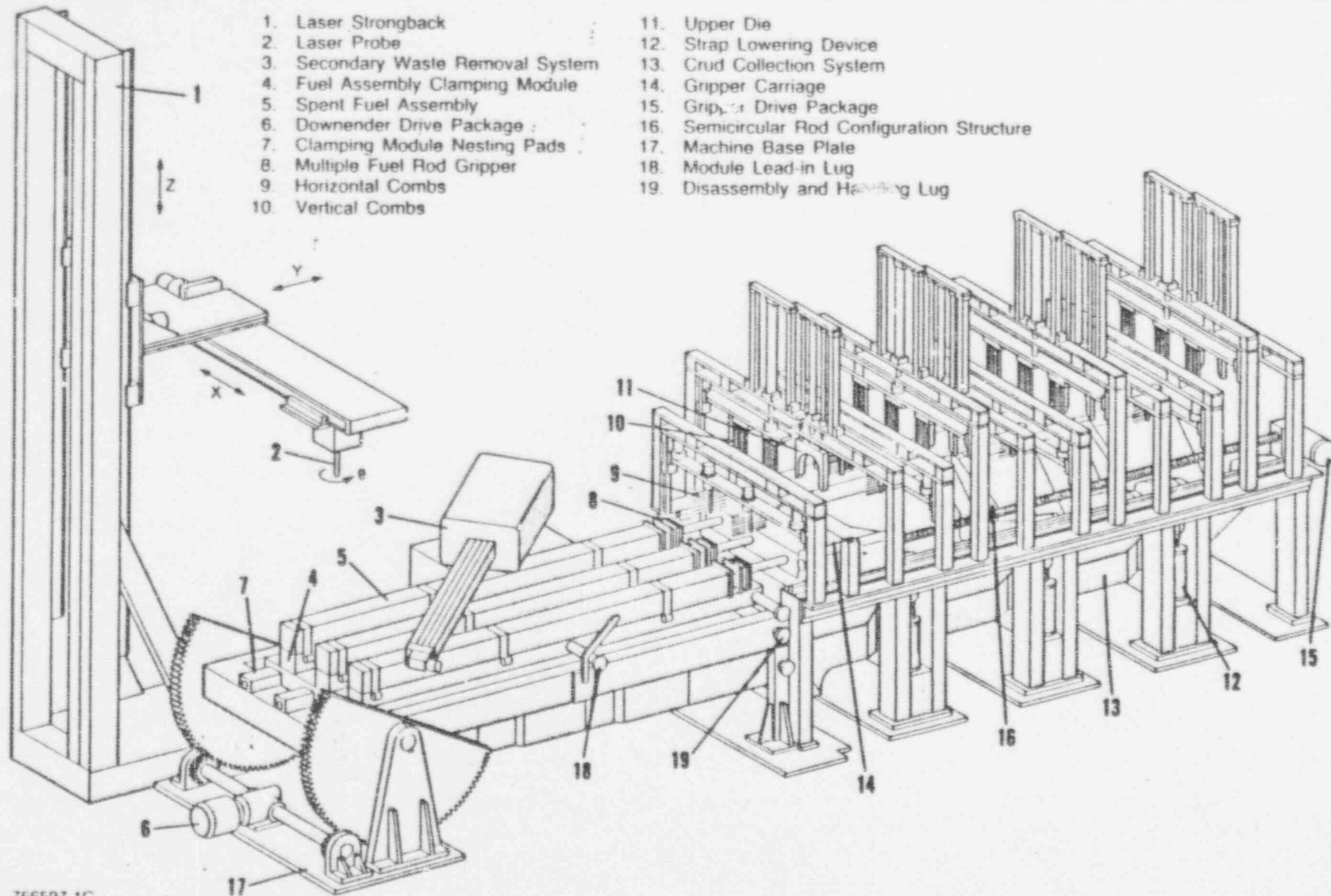
Monitored Retrievable Storage Facility Receiving and Handling Building

CANISTER OVERPACK AND REPOSITORY OVERPACK WELDING SYSTEM AND SHIPPING PORT



1. Welding Generator/Equipment Room
2. Canister Welding Station
3. Canister Decon/Helium Leak Test Chamber
4. Chamber Isolation Valves
5. Canister Upender
6. Storage Canister
7. Exit Port
8. Lag Storage Cover
9. Exit Port Jacking Mechanism
10. Plug Grapple
11. Pintle Grapple
12. Equipment Lifting Yoke
13. Shielded Canyon Cell #6
14. Power Mast
15. Manipulator
16. 35 Ton Cell Crane
17. Maintenance Area Shield Door
18. Crane Maintenance Room
19. Observation Window
20. Operating Gallery
21. Clean Canister and Lid Supply Port
22. Lag Storage Canyon Vault Area
23. Canister Pass-Thru Shield Door
24. Storage Cask and Transporter
25. Shipping Cask for Repository Overpack
26. Cask Cart
27. Repository Overpack
28. Repository Overpack Welding/Decon Pit
29. Repository Overpack Welding Head and Jib Support Structure
30. Repository Overpack Port
31. Repository Overpack Port Plug
32. Shipping Cask Inner Lid

SPENT FUEL CONSOLIDATION SYSTEM PWR SETUP



RECEIVING AND HANDLING BLDG.
PROCESS TIME VALUES

	1.0	2.0	3.0	4.0	5.0	6.0
	<u>Unload Cask From Vehicle</u>	<u>Process Cask</u>	<u>Unload Spent Fuel</u>	<u>Disassemble Consolidate Fuel Rods Load Canister</u>	<u>Seal Weld Canister Test Decon.</u>	<u>Unload Canisters</u>
Cell #1						
PWR Fuel Assy.						
Rail	2.5 hrs.	3.5 hrs.	2.25 hrs/can	3.85 hrs/can	1.9 hrs/can	1.5 hrs/can
Truck	2.0 hrs.	3.5 hrs.	6.0 hrs/can	3.85 hrs/can	1.9 hrs/can	1.5 hrs/can
Cell #2						
BWR Fuel Assy.						
Rail	2.5 hrs	3.5 hrs	4.2 hrs/can	7.25 hrs/can	1.9 hrs/can	1.5 hrs/can
Truck	2.0 hrs	3.5 hrs	7.7 hrs/can	7.25 hrs/can	1.9 hrs/can	1.5 hrs/can

NUMBER OF SPENT FUEL ASSEMBLIES
PROCESSED YEARLY

<u>Hot Cell</u>	<u>Transportation Mode</u>	<u>Controlling Rate</u>	<u>SF Assy Processed/yr (1)</u>	<u>Required Number (2)</u>
#1 PWR	*50% Rail, 50% Truck	**5.69 hrs	2302	2338
	All Rail	3.85 hrs	3403	2338
	All Truck	6.0 hrs	2184	2338
#2 BWR	50% Rail, 50% Truck	**7.63	4007	3870
	All Rail	7.25	4217	3870
	All Truck	7.7	3970	3870
#3 PWR BWR	Both Systems at 20% Capacity		436***	154
			794***	0

*Design Basis

**Weighted average based on 6:1 Truck to Rail Shipments

***Worst case All Trucks

(1) Process based on 50% operational efficiency

(2) Based on 60% PWR, 40% BWR

BUILDING SUPPORT SYSTEMS

- Remote high activity radwaste system
- Low level radwaste system
- Once-through multiple HEPA exhaust system
- Normal, standby, and UPS electrical systems
- Wet pipe, Halon, and dry chemical fire suppression systems
- Remote and contact equipment maintenance systems
- Analytical laboratory
- HP and personnel support systems

STORAGE FACILITIES

DECOMMISSIONING

DECOMMISSIONING

- Sealed storage cask Decon as required, seal, and store on site
- Drywell Decon as required, fill with sand, seal, and leave on site
- Receiving and handling building Decon equipment and building as required, remove all equipment off site, and seal building
- Support facilities Remove all support facilities