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Resources, Community, and
Economic Development Division

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August 15, 1986

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

The Honorable Edward J. Markey
Chairman, Subcommittee on Energy
Conservation and Power
Committee on Energy and Commerce
House of Representatives

As you requested in your March 18, 1985, letter and as agreed during the briefing we provided your staff on June 5, 1986, we have obtained information on the Department of Energy's (DOE) cost estimates for a monitored retrievable storage (MRS) facility. This fact sheet complements a similar document we provided to you on May 8, 1986 (GAO/RCED-86-104FS) which described, among other things, the purpose of an MRS, the advantages and disadvantages associated with the facility, and the state and local impacts of locating it in Tennessee.

In December 1985 DOE estimated that the MRS could add a net increase of between \$1.4 billion and \$2.0 billion to the cost of the total waste management system. In February 1986, after performing more comprehensive analyses of including an MRS in the waste management system, DOE revised its MRS cost estimate to a range of between \$1.6 billion and \$2.6 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; this staff has also estimated that the operating costs for the MRS may be underestimated by 10 to 15 percent.

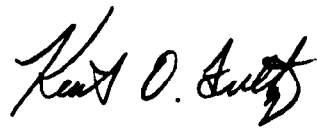
This fact sheet summarizes the information we have obtained to date regarding the MRS cost estimates developed by DOE. We will continue to evaluate DOE's plans for the MRS and, as agreed, we will provide a more comprehensive final report to you on the need for, benefits of, and alternatives to an MRS.

We obtained the information in this fact sheet from (1) documents developed by a DOE contractor to estimate the engineering and construction portion of the MRS, (2) the December 1985 "Review Copy" of DOE's MRS

proposal to the Congress, (3) discussions with DOE officials, (4) internal memorandums and cost evaluations, (5) portions of documents which DOE intended to provide to the Congress in February 1986 but, due to a court order, have not been submitted, (6) the fee adequacy report issued by DOE on March 27, 1986, and (7) DOE's April 1986 Analysis of the Total System Life Cycle Cost for the Civilian Radioactive Waste Management Program.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this fact sheet until 10 days from the date of this letter. At that time we will send copies to interested parties and make copies available to others upon request.

Please call me at (202) 275-1441 if you have any questions about the fact sheet.



Keith O. Fultz
Associate Director

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ABBREVIATIONS

DOE	Department of Energy
GAO	General Accounting Office
ICE	Independent Cost Estimating staff
mill	one-tenth of a cent
MRS	monitored retrievable storage
NRC	Nuclear Regulatory Commission
RCED	Resources, Community, and Economic Development Division

SECTION 1

THE DEVELOPMENT OF MRS COST ESTIMATES

The Nuclear Waste Policy Act of 1982 requires the Department of Energy (DOE) to develop a monitored retrievable storage (MRS) proposal that included at least three alternative sites and at least five alternative combinations of sites and facility designs. The three sites DOE identified 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 in the state of Tennessee on land owned and controlled by the federal government. DOE identified the former Clinch River Breeder Reactor location as the preferred site and aboveground sealed storage casks as the primary method for storing spent fuel.

The Department contracted with an engineering firm to prepare detailed cost estimates for the facility engineering and construction portion of the program. The cost projections that have been developed for the MRS program are a combination of estimated facility requirements for the three MRS locations and nine elements that DOE has determined are needed to implement the program.

CONTRACTOR COST ESTIMATES

DOE contracted with the Ralph M. Parsons Company to prepare cost estimates for the facility engineering, design, and construction portion of the MRS. The contractor's estimates, which were provided to DOE in September 1985, were based on the engineering work performed during the conceptual design phase of the MRS project. The estimates were developed by the types of functions and storage--aboveground sealed storage casks or inground field drywells--that would be performed at each of the three potential MRS locations. Figure 1.1 illustrates a proposed aboveground storage cask. These casks will be placed in rows on concrete pads located in the rear storage portion of the MRS facility, as illustrated in figure 1.2. Figure 1.3 illustrates the alternate drywell storage method, which extends about 20 feet into the ground.

Figure 1.1: Proposed Aboveground Storage Cask

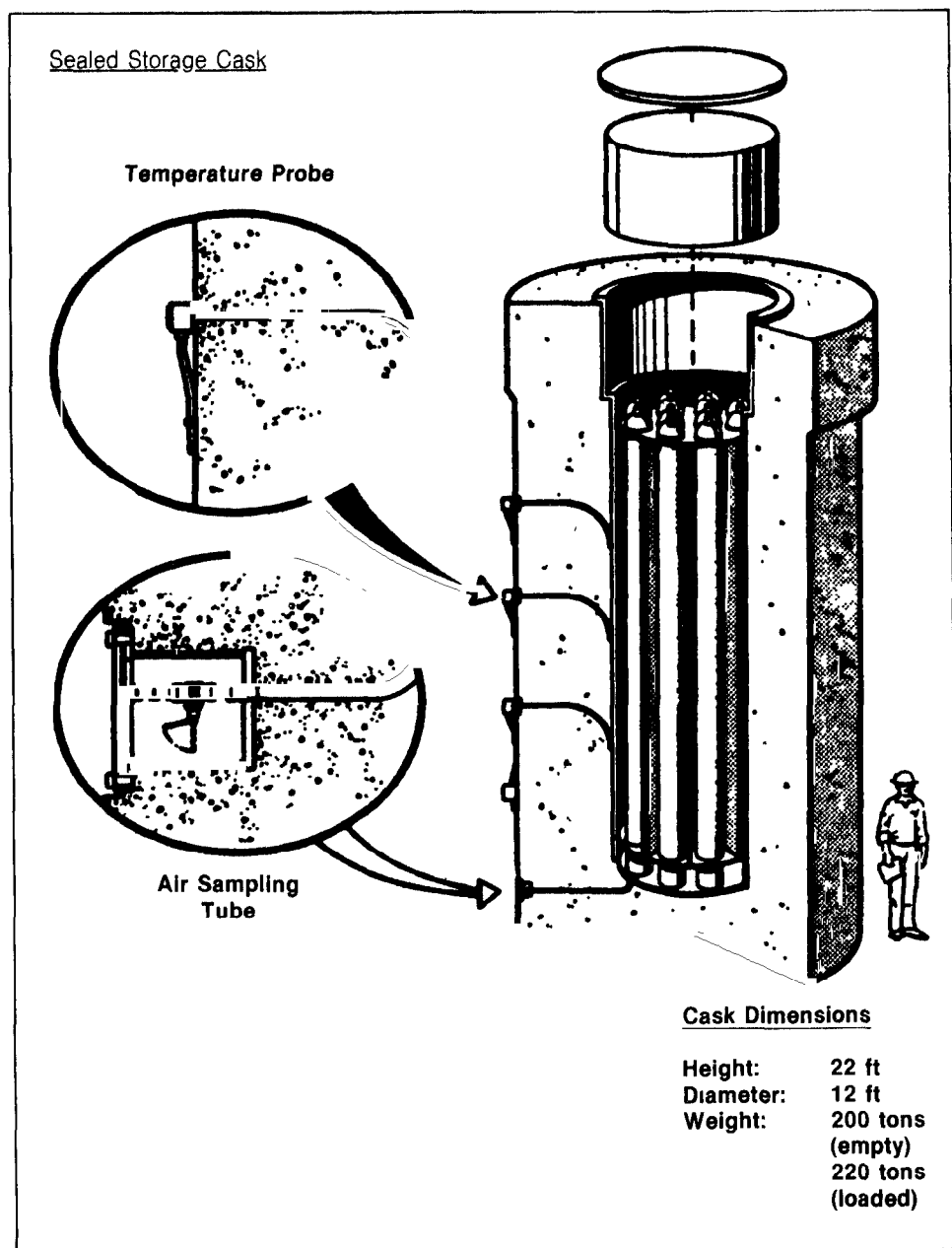


Figure 1.2: Proposed MRS Facility

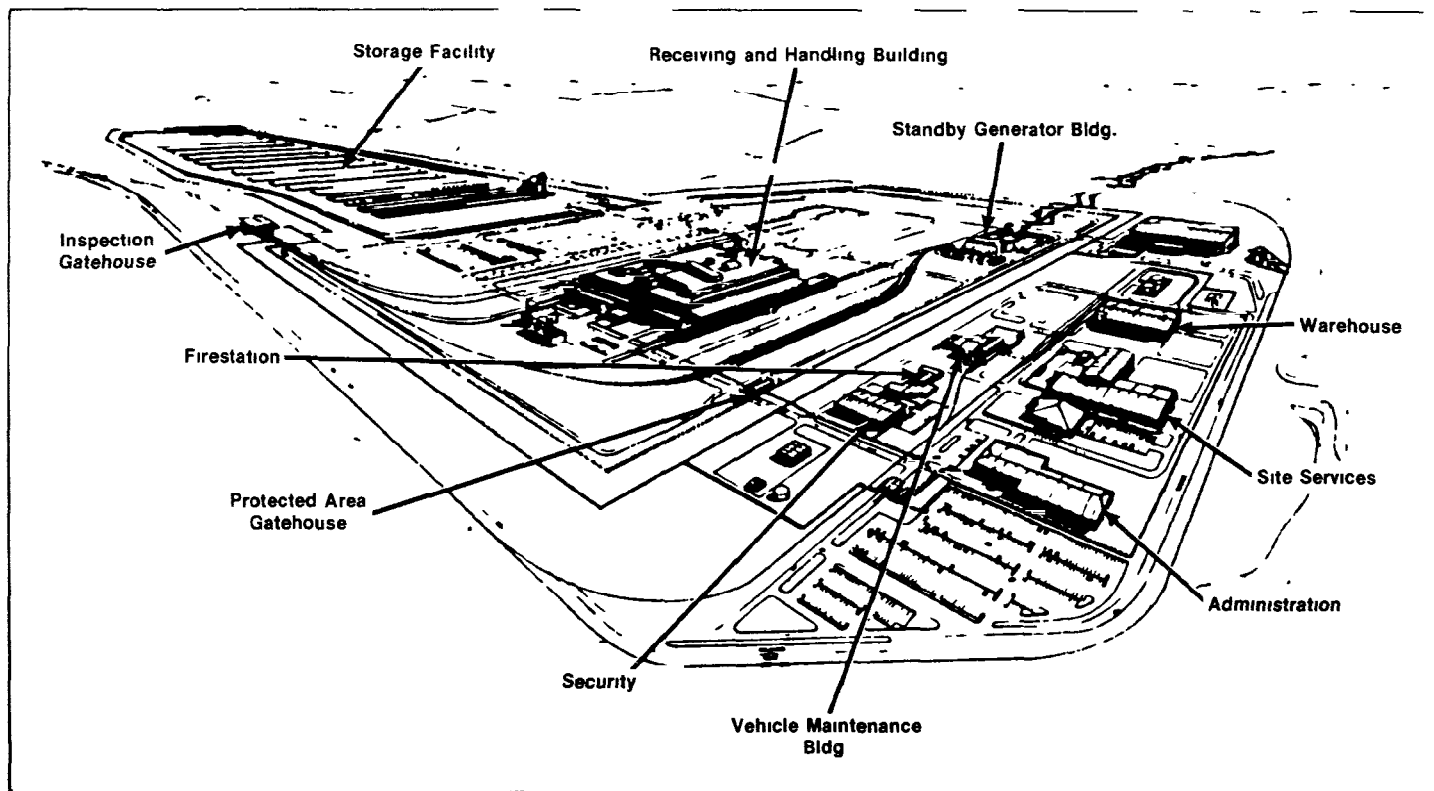
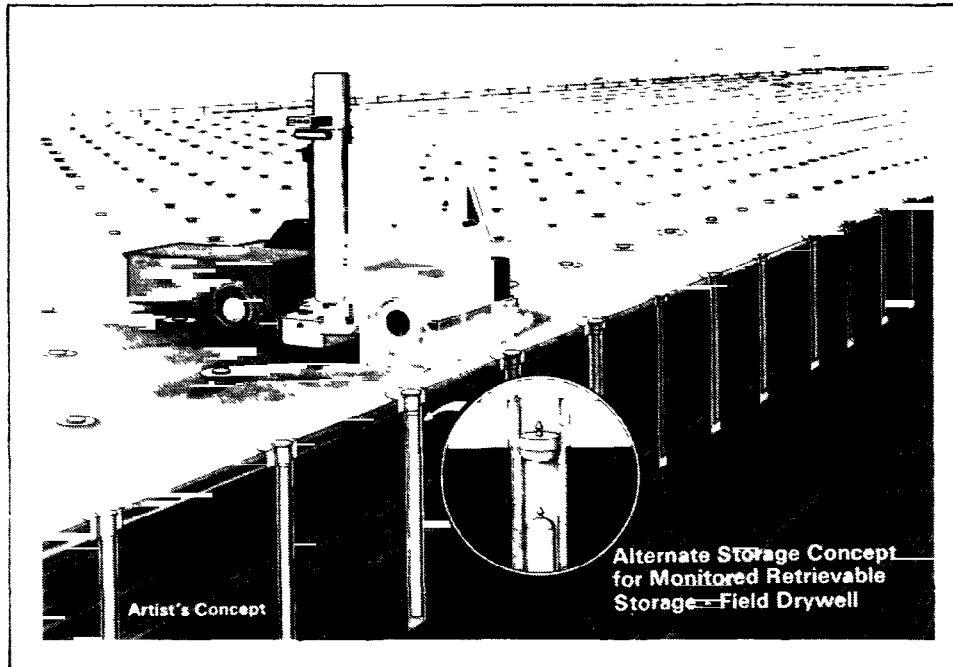


Figure 1.3: Alternative Inground Storage Cask



The following functional categories were included in the facility engineering and construction estimate for each location:

- facilities containing shielded areas to receive, handle, consolidate, and provide temporary storage for spent fuel;
- all the on-site improvements and support structures, such as maintenance and security buildings, warehouses, water treatment facilities, and fire stations;
- all on-site waste storage improvements and fencing required to transport, handle, and store 15,000 metric tons of spent fuel; and
- off-site improvements needed to integrate the MRS with existing infrastructures.

In developing its projections, the contractor stated that the cost estimates were associated with definitive engineering work, design verification, and other facility support functions, and did not include costs related to the following items:

- land acquisition and site testing;
- operating contractor management;
- cost escalation or unknown contingencies;
- DOE and Nuclear Regulatory Commission (NRC) costs;
- financial assistance to state and local governments;
- spare parts;
- premium pay, future labor rate changes, overtime, premiums for performance bonds; and
- sales taxes, royalties, permits, and licenses.

According to DOE program officials, these costs are not normally available at the conceptual stage of construction projects.

Table 1.1 summarizes the estimated facility costs the contractor provided to DOE for each proposed location and spent-fuel storage method.

Table 1.1: Summary of Engineering and Construction Costs for Each Proposed Location and Storage Method

<u>Location</u>	<u>Storage method</u>	<u>Project cost</u> (in millions)
Clinch River	Aboveground casks	\$701.4
	Inground drywells	796.4
Oak Ridge	Aboveground casks	690.2
	Inground drywells	781.9
Hartsville	Aboveground casks	708.4
	Inground drywells	772.8

DOE COST ESTIMATES

DOE used the contractor's estimates for the facility engineering and construction portion of the MRS as a basis for developing its cost projections for the facility. DOE 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.

DOE developed facility cost estimates for each of the six MRS alternatives. To estimate the cost of integrating the MRS into the waste management system, DOE used the preferred option for the MRS--a facility utilizing the aboveground cask storage method located in Clinch River, Tennessee. In addition to incurring the cost of designing and constructing the preferred MRS option, the facility will have an annual operating cost of about \$70 million and, according to DOE, will employ approximately 600 workers. DOE also estimated that about \$79 million will be required to decommission the MRS at the end of its 26-year service life.

The following summarizes the nine program elements and required activities that were used by DOE 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 is 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 1.2 summarizes, in constant 1985 dollars, the life-cycle cost estimates for the MRS; it also illustrates that the primary difference between these elements are the projections for construction and operation.

Table 1.2: Summary of DOE Cost Estimates for Each MRS Option^a

Cost Element	Location					
	Clinch River		Hartsville		Oak Ridge	
	Cask	Drywell	Cask	Drywell	Cask	Drywell
Environmental evaluations	\$ 5.3	\$ 5.3	\$ 5.3	\$ 5.3	\$ 5.3	\$ 5.3
Design	97.2	97.2	97.2	97.2	97.2	97.2
Regulatory compliance	25.7	25.7	25.7	25.7	25.7	25.7
CONSTRUCTION^b	646.4	741.4	653.4	717.8	635.2	726.9
Training and testing	62.0	62.0	62.0	62.0	62.0	62.0
OPERATION	1915.0	1718.0	1915.0	1718.0	1915.0	1718.0
Decommission	79.0	73.4	79.0	73.4	79.0	73.4
Institutional interaction	2.1	2.1	2.1	2.1	2.1	2.1
Program management	69.7	69.7	69.7	69.7	69.7	69.7
Total	<u>\$2902.4</u>	<u>\$2794.8</u>	<u>\$2909.4</u>	<u>\$2771.2</u>	<u>\$2891.2</u>	<u>\$2780.3</u>

^aAll estimates are in millions of constant 1985 dollars.

^bThese estimates vary from those developed by the contractor because DOE uses a different accounting method to aggregate the estimated costs.

DOE HAS IDENTIFIED OTHER COSTS THAT WERE NOT INCLUDED IN THE MRS ESTIMATE

In addition to the nine program elements listed in table 1.2, 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 December 1985 "Review Copy" of its MRS proposal to the Congress, sections 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. When approval 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 whether the federal entities 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.¹ 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 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.

¹The Nuclear Waste Fund was established by the Nuclear Waste Policy Act to ensure that the costs of a safe and environmentally acceptable program are fully funded. The fund is financed through fees collected from owners and generators of nuclear waste.

DOE BELIEVES THE MRS WILL
REDUCE OTHER COSTS FOR THE
NUCLEAR WASTE DISPOSAL SYSTEM

According to DOE, the cost to integrate the preferred MRS option into the total waste management system will be less than the \$2.9 billion cost for the preferred option (listed in table 1.2) because the MRS will provide benefits to the total waste management system. Such benefits would include decreased transportation costs throughout the entire system and a reduction of spent-fuel handling facilities at the repository, which will partially offset the cost of the facility. DOE concluded that if the effect of these benefits is considered, including the MRS in the waste management system would increase system costs from \$1.4 billion to \$2.0 billion. In its December 1985 "Review Copy" of the MRS proposal, DOE stated that the incremental MRS costs would add 5 to 8 percent to the total system costs. DOE also concluded that the cost of including an MRS in the waste management system is within the range of uncertainty for the estimated cost of a system without an MRS.

SECTION 2

DOE's INDEPENDENT COST ESTIMATING STAFF'S ASSESSMENT OF MRS

In December 1985 DOE's Independent Cost Estimating (ICE) staff assessed the costs to construct and operate the MRS. 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 costs estimated by DOE and the ICE staff was within 5 percent on all of the proposed MRS options. The 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 DOE vs. 656 estimated by the staff), as well as greater costs for waste canisters and facility utilities. On the basis of this analysis, the 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 DOE has not included all the costs attributable to the construction and operation of an MRS. The study listed items that had been excluded from DOE's cost estimate 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 of 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; and
- consultation and cooperation agreement with the state government.

The ICE evaluation also addressed whether current utility contributions would be adequate to cover the cost of the entire waste management system. The utility contribution is 1 mill (one-tenth of a cent) per kilowatt hour of electricity generated by nuclear power for waste disposal. Although previous examinations by this staff concluded that the revenues provided for the waste management program would cover more of a margin for error, with the adjustments attributable to the MRS and other factors, the December 1985 evaluation stated that the program "may barely be within the projected revenues" generated by the fees charged to utilities.

SECTION 3

THE COST IMPACT OF INCLUDING AN MRS IN THE WASTE MANAGEMENT SYSTEM HAS BEEN REVISED

DOE has been enjoined from submitting its proposal to the Congress. DOE has also revised its estimate of including the MRS in the waste management system. The revised estimate is based on an analysis of factors such as the location of the repository, the quantity of waste to be disposed, and the schedule of disposal operations. As a result of this analysis, DOE estimates the cost of integrating the MRS into the waste management system to range from \$1.6 billion to \$2.6 billion.

DOE ENJOINED FROM SUBMITTING THE MRS PROPOSAL TO THE CONGRESS

On August 20, 1985, the state of Tennessee filed a suit in the U.S. District Court located in Nashville, Tennessee, alleging that any DOE proposal to request authority from the Congress to construct an MRS facility in Tennessee would violate the Nuclear Waste Policy Act. Tennessee contended that, contrary to the act, DOE did not consult with the state before conducting a study of the suitability of the three Tennessee locations for an MRS facility. Tennessee also requested that the Secretary be enjoined from presenting any proposal to the Congress for an MRS facility in Tennessee until the requirements of the act have been fulfilled.

On February 5, 1986, the District Court concluded that DOE violated the act by failing to consult and cooperate with the governor and legislature of the state of Tennessee on the MRS siting process. DOE was prepared to submit its MRS proposal to the Congress in February 1986, but on February 7, 1986, DOE was permanently enjoined by the U.S. District Court from making any proposal that relies on siting studies developed before consultation and cooperation with Tennessee. As a result, DOE has not yet submitted its MRS proposal to the Congress.

In its February 1986 proposal, DOE estimated that the net incremental cost of the recommended DOE facility would range from \$1.6 billion to \$2.6 billion, not including avoided costs, financial assistance to Tennessee, and other intangible benefits attributable to the MRS. DOE stated that while the cost of integrating the MRS into the waste management system is estimated to be 5 percent to 11 percent higher than a system without an MRS, the cost of the facility is within the range of uncertainty for a total system without an MRS. 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.

TOTAL SYSTEM ANALYSIS PERFORMED

In April 1986 DOE estimated the cost of the total waste management system, including the preferred option for the MRS, based on a study of 32 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 to the repository. The assumptions for the waste management system included two repositories, with 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 as to when a second repository might be needed.

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 if there were 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 \$34.0 billion. The primary reasons for the revised estimates are costs required to develop and evaluate the system, increases in the cost of the repository, and decreases in spent fuel transportation costs.

SECTION 4

FEE ADEQUACY REPORT

The Nuclear Waste Policy Act requires the Secretary of Energy to annually review the fees established under the act to determine if they will provide sufficient revenues to cover the costs of the waste program. Four reports have been issued by DOE, with the most recent published on March 27, 1986. The March report includes, for the first time, an assessment that considers the impact of fees and costs associated with including defense high-level radioactive wastes in the waste management program. These wastes have been included in the program as a result of the President's April 30, 1985, decision to use a common repository for the permanent disposal of commercial and defense-related wastes.

To determine whether the current 1-mill-per-kilowatt-hour fee is adequate, DOE developed econometric models using a range of assumptions about the characteristics of the program. The principal assumptions included the following:

- projections of nuclear electricity growth;
- commercial spent fuel discharge through the year 2020;
- wastes produced by defense programs;
- the number of geologic repositories and their design capacity;
- operational startup dates for the repositories, and their receipt rates for spent fuel and defense-related waste;
- cooling time since discharge of spent fuel from the reactors; and
- the retrievability period at the repository for the wastes.

On the basis of these assumptions, DOE then categorized the estimated life-cycle costs for the program in the following ways:

- development and evaluation costs;
- waste transportation costs;
- costs to construct, operate, and decommission the repository;
- costs for an MRS; and

--costs for storing spent fuel at the reactor sites.

Although the report indicated that the current fee is adequate to offset total system life-cycle costs for the repositories and an MRS, it concluded that "Since the cost implications of these features are still being investigated, the conclusions in this report should be regarded as tentative." The report also acknowledged the possibility that the 1-mill-per-kilowatt-hour fee may have to be increased in the future by stating that "Fee revisions may be recommended within a few years, when more accurate program cost estimates will be developed as the program matures from its present conceptual design phase to the engineering design phase." In addition, the costs for activities such as institutional interaction have not been included in the fee adequacy report because DOE does not anticipate determining these costs until after the MRS has been approved by the Congress.

SECTION 5

SUMMARY OF FACTORS AFFECTING DOE'S COST ESTIMATES FOR THE MRS

In accordance with the Nuclear Waste Policy Act, DOE has developed a proposal for including an MRS facility in the system for managing commercial and defense-related nuclear wastes. DOE developed cost estimates for six MRS alternatives and used its preferred option--the use of sealed aboveground storage casks at a facility to be located in Clinch River, Tennessee--as the basis for its estimates for integrating an MRS into the waste system. The following is a summary of factors that affect the cost estimates that DOE has made for the MRS.

- The cost estimate provided by DOE's contractor was limited to design and construction and did not include costs required to acquire the land and to fund other aspects of operating the facility.
- In its December 1985 "Review Copy," DOE estimated the cost of integrating the preferred MRS option into the total waste management system to range from \$1.4 billion to \$2.0 billion. In February 1986 DOE revised its MRS cost estimate to a range of between \$1.6 billion and \$2.6 billion. DOE has stated that the cost of an MRS is within the range of uncertainty for a total system without an MRS.
- Some MRS-related costs have not been included or quantified by DOE in its estimate. These include, for example, the costs associated with financial aid to affected communities and the state of Tennessee. DOE has stated that these costs will not be known until after the MRS is approved by the Congress. According to DOE's ICE staff, several of the costs that have not been included in DOE's estimates could be substantial.
- According to DOE's fee adequacy report, the current fee is adequate to offset total system life-cycle costs. The report acknowledges, however, that the fees may have to be increased within a few years when the program matures and more accurate cost estimates can be developed.

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