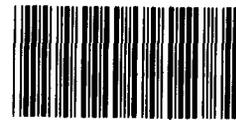


March 1992

NUCLEAR WASTE

Development of Casks for Transporting Spent Fuel Needs Modification



146243

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**Resources, Community, and
Economic Development Division**

B-231294

March 13, 1992

The Honorable Ernest F. Hollings
Chairman, Committee on Commerce,
Science, and Transportation
United States Senate

The Honorable Richard H. Bryan
United States Senate

You requested that we examine the Department of Energy's (DOE) efforts to implement transportation-related activities under the Nuclear Waste Policy Act of 1982 (P.L. 97-425 as amended). That act requires DOE to investigate Yucca Mountain, Nevada, as a potential site for the permanent disposal of nuclear waste in an underground repository and, if DOE finds that the site is suitable for that purpose, to construct a repository at the site.

DOE anticipates that it could begin operating a repository at Yucca Mountain by 2010. In the meantime, DOE wants to develop a facility for the monitored, retrievable storage of spent (used) nuclear fuel generated and stored at civilian nuclear power plants so that it can start removing these wastes from the utilities' nuclear plants in 1998. To help meet this goal, DOE is developing two types of high-capacity casks for shipping spent fuel by truck and by rail and/or barge. Although existing shipping casks have been used for many years, DOE believes that they are too small to efficiently transport spent fuel to a federal waste management facility. As agreed with your offices, this report addresses the pace and direction of DOE's program to develop the high-capacity casks.

Results in Brief

The pace and direction of DOE's cask development program are based on finding a willing host and suitable site for a Monitored Retrievable Storage (MRS) facility in time to develop and begin storing spent fuel in the facility in 1998. However, it is unlikely that the facility can be developed by then because of concern that such a facility might become a substitute for the permanent disposal of spent fuel in a repository.

Since 1988, the utility industry has recommended that DOE reassess the scope and timing of its cask development program and, at most, design a truck cask only. The industry's position is based on (1) uncertainty over the development of the MRS facility, (2) uncertainty over the length of time

needed before a repository will be completed, and (3) concerns about DOE's proposed casks and how the transportation system would interface with nuclear power plants. In addition to these issues, DOE is also concerned that the combined weight of a loaded truck cask and the tractor/trailer that would haul the cask could exceed weight limits for normal highway shipments.

DOE intends to resolve the cask-design issues raised by the utility industry during the final design of its truck and rail/barge casks because it is optimistic that it will be able to develop an MRS facility by about 1998. DOE points to recent applications by Indian tribes and county governments for grants to study the feasibility of hosting the MRS facility as support for its optimism.

Notwithstanding the grant applications, the potential obstacles to developing a facility by 1998 remain formidable. In our view, therefore, the issues raised by the utility industry and questions about the weight of the loaded truck cask make it prudent for DOE to reevaluate the pace and direction of the cask development program. This would allow DOE to conserve funds until there is a clear need to develop casks.

Background

The Nuclear Waste Policy Act of 1982 established a program within DOE directed toward the safe, permanent disposal of highly radioactive wastes (primarily spent fuel) generated by civilian nuclear power plants. Among other things, the act required DOE to develop, site, and construct one repository for the permanent disposal of spent fuel and to develop and submit to the Congress a proposal to site and construct one or more MRS facilities for the long-term storage of spent fuel. These wastes are generated and/or stored at 122 utility-owned nuclear power plants and other nuclear facilities. When the act was passed in 1982, it was expected that DOE would have a repository ready to dispose of nuclear wastes by 1998. Since then, DOE has extended its repository development schedule to 2010.

As amended in 1987, the act directed DOE to investigate a repository site at Yucca Mountain, Nevada, and authorized it to develop an MRS facility. In part to prevent the MRS facility from becoming a substitute for the repository, the facility may only be developed on a schedule linked to the repository's progress. For example, the Secretary of Energy may not select a site for an MRS facility until he has recommended a site for developing a repository to the President. Also, DOE may not construct an MRS facility

until the Nuclear Regulatory Commission (NRC) has granted a license for the repository's construction. The 1987 amendments also established the independent position of Nuclear Waste Negotiator. The negotiator is empowered to negotiate with the governor of a state or the governing body of an Indian tribe the terms and conditions under which a volunteer state or tribe would host a repository or an MRS facility at a technically qualified site.

In early 1990 DOE decided, after reviewing its cask design contractors' preliminary reports on five designs, to develop one type of truck cask and one type of rail/barge cask. The rail/barge cask is designed to carry up to 21 assemblies (groups of fuel rods) of spent fuel from pressurized water reactors and 52 assemblies of spent fuel from boiling water reactors.¹ A loaded rail/barge cask would weigh about 100 tons. DOE's contractor for the truck cask intends to make separate versions of the cask for up to four assemblies of pressurized-water-reactor spent fuel and up to nine assemblies of boiling-water-reactor spent fuel. When fully loaded, each of the two versions of the truck cask would weigh over 26 tons. Except for internal variations to accommodate the two types of fuel assemblies, the truck casks would be almost identical in design. DOE terminated one other cask design contract and limited further work on the other two cask designs to key technical issues.

According to DOE, several key "hold points" in cask design contracts provide convenient opportunities to review and evaluate the progress of the cask designs. In addition to the end of the preliminary design phase, the hold points go into effect at the end of final design, before DOE submits the designs to NRC for that agency's certification (approval) and before DOE orders long-lead items for fabricating prototypes of the casks. In 1992 DOE's contractors are expected to complete final designs of the selected truck and rail/barge casks, and DOE plans to submit the final cask designs to NRC for its approval.

DOE expects to receive NRC's approval of the cask designs and fabricate prototypes in 1995. By that time, DOE's estimates are that the cask development program, whose costs primarily include those incurred by cask design contractors, will have cost about \$54 million. Thereafter, according to DOE, it will cost \$1.3 million to \$1.5 million to fabricate each of the 32 to 54 truck casks and \$2 million to \$3 million to fabricate each of the 18 to 24 rail/barge casks. At these unit fabrication costs, the total cost

¹Pressurized and boiling water reactors are two types of reactors that are used, respectively, in about two-thirds and one-third of all domestic nuclear power plants.

of developing and producing DOE's fleet of truck and rail casks would range between \$132 million and \$207 million.

Utilities Believe DOE Should Reduce Scope of Cask Program

According to the transportation working group of the Edison Electric Institute (EEI), DOE's transportation program is of vital interest to the utility industry because the program is the only physical interface between utilities and the nuclear waste disposal program, transportation will be the most visible part of the nuclear waste disposal program to the largest number of people, and the development of the transportation program is being financed out of nuclear waste disposal fees paid to the federal government by the utilities who own and operate nuclear power plants.² Therefore, the utility industry, through EEI, has actively participated in the development of DOE's casks. EEI's nuclear waste review team has included individuals with substantial spent-fuel shipping experience.

In 1988 EEI concluded that DOE was moving too fast with the cask development program. The utility group reiterated this position in 1990 and also concluded that significant technical and operational issues had yet to be resolved. Furthermore, the utility group pointed out that, in view of DOE's extended repository schedule and uncertainty about the MRS facility, the spent-fuel storage conditions that DOE was designing its casks for might materially change by the time DOE is able to begin shipping utilities' spent fuel. For these reasons, EEI recommended that DOE reassess the appropriate scope and timing of its cask development program and, at most, proceed with final design of only the truck cask.

Cask Development Program Moving Too Fast

In an early 1988 letter to DOE, EEI concluded that DOE was proceeding with the cask development program more rapidly than was warranted and that, upon completion of the preliminary designs of the five casks then under development, DOE should restrict future cask development activities to one truck cask. In late-1990, after reviewing the DOE contractors' preliminary design reports for the five casks, EEI reiterated its earlier position before the Nuclear Waste Technical Review Board and DOE's transportation coordination group.³ Specifically, on the basis of unresolved technical and operational concerns, continued delay in the projected repository

²EEI is an association of investor-owned utilities whose members generate and distribute about three-quarters of the nation's electricity. The association's Transportation Working Group serves as the electric utility industry's primary contact with DOE for interactions on transportation issues.

³The 1987 amendments to the Nuclear Waste Policy Act created the Nuclear Waste Technical Review Board to evaluate the technical and scientific aspects of transporting and packaging spent nuclear fuel.

schedule, and uncertainty over the proposed MRS facility, EEI recommended that DOE make a fresh assessment of the appropriate scope and timing of the cask development program. Later, in February 1991, EEI provided DOE with specific comments on each of the five preliminary designs in case DOE redirects the cask development program at some future time.

In EEI's view, the only justification for continuing the cask development program, even on the modest basis it had recommended in 1988, was the potential for locating a site for an MRS facility through negotiations and bringing the facility into operation in 1998. EEI added, however, that nothing had happened since 1988 to cause it to reconsider its recommendation that DOE proceed with the final design of only one truck cask. If anything, the utility group said, subsequent events supported this recommendation more strongly. In its view, the possibility that an MRS facility could be operating as early as 1998 was not sufficient justification for developing a rail/barge cask at this time.

EEI concluded its analysis of DOE's preliminary cask designs by noting that, although it favors developing only one truck cask, a more difficult question is whether its technical concerns are so fundamental to DOE's cask-design program that they warrant stopping the program altogether. If its concerns are not likely to be resolved satisfactorily and there is no compelling need to move forward to keep pace with the remainder of the nuclear waste program, then DOE should terminate the cask development program, the utility group said. By doing so, DOE could address and resolve the utility industry's concerns before developing specific cask designs. Furthermore, if the Nuclear Waste Negotiator found a volunteer host for an MRS facility and the Congress removed the facility's links to the repository, then DOE could move forward with a new cask development program. In the utility group's opinion, it should not take more than 5 years to design truck and rail/barge casks, obtain NRC's certification, and fabricate truck and rail/barge casks, especially if DOE has spent several years gathering data and evaluating the operational and technical issues that must be addressed in cask designs.

Technical and Operational Concerns Need to Be Resolved

EEI reviewed each of the five preliminary design reports submitted by DOE's cask-design contractors. As a result of its review, in February 1991 the utility group identified for DOE several concerns that it considered important and generally applicable to DOE's cask development program.

EEI's principal concerns, which are discussed in appendix I, were the following:

- DOE's cask-design contractors did not have or were not effectively using the fuel and transportation cask-handling experience available within DOE, with its contractors, and within the electric utility industry. For example, estimated times for loading and unloading spent fuel in four of the preliminary design reports were excessively optimistic.
- Cask-design contractors may not have fully factored data on the interface between utilities' nuclear plants and DOE's transportation cask system into their preliminary cask designs. It is extremely important that DOE not proceed to final design on the rail/barge cask (which is much larger and heavier than the truck cask) until it has had an opportunity to factor the completed interface data into the design of this cask.
- For certain spent fuel from boiling water reactors, preliminary cask designs did not take into account all of the requirements of DOE's standard contract for accepting utilities' spent fuel or the practical needs of some utilities.
- The narrow spacing margins of different cask designs and the limiting conditions of NRC's regulations left little room for design changes in the final designs of casks. DOE needs more experience with the NRC process or with certifying cask designs. Going through the process on a truck cask design would provide this experience for subsequent use in obtaining certification of a rail/barge cask.

Changes in Spent Fuel Storage Conditions Could Affect Cask Program

The Nuclear Waste Policy Act states that owners and operators of civilian nuclear power plants are responsible for storing their spent fuel until the spent fuel is accepted by DOE. Utilities have traditionally stored spent fuel in water-filled storage pools constructed as part of their nuclear plants. However, by the year 2010—the earliest date that a repository might be operating—utilities are expected to exceed existing storage pool capacity by almost 14,000 metric tons.

DOE's transportation cask development program is based on the development of an MRS facility capable of beginning waste storage operations by about 1998 and eventually storing up to 15,000 metric tons of utilities' spent fuel. If DOE is unable to develop the facility, utilities would have to continue storing all of their spent fuel and, therefore, some utilities would have to expand storage capabilities at their nuclear power plants. Technologies for expanding on-site storage capacity—primarily

“dry” storage in metal and/or concrete containers outside of spent fuel storage pools—have been demonstrated and are in use.

According to EEI, more utilities will need to expand their on-site spent fuel storage capabilities in view of the uncertain status of an MRS facility and DOE’s extended schedule for developing a repository. Thus, if DOE does not begin accepting spent nuclear fuel for shipment until around 2010, a significantly larger percentage of the spent fuel in inventory at that time will be in dry storage than was anticipated when DOE began developing casks.

DOE is developing its casks under the assumption that they will be loaded with spent-fuel assemblies in utilities’ storage pools. In EEI’s view, this could necessitate removing fuel from dry storage and returning the fuel to spent fuel pools for cask loading, which would introduce significant inefficiencies into the fuel-loading process. According to EEI, DOE has acknowledged that spent fuel storage options chosen by utilities will have a major effect on its transportation program; however, DOE has not followed EEI’s suggestion that it halt further development of a rail/barge cask design that is based solely on the assumption of pool storage of spent fuel.

DOE officials told us that utilities prefer that DOE remove spent fuel from nuclear plant storage pools before shipping any spent fuel from dry storage. In DOE’s view, therefore, delays in accepting spent fuel could affect the mix of types of casks that DOE might use but would not eliminate the need to focus on early shipments from storage pools.

DOE Intends to Resolve Issues During Final Design Phase

In May 1991 DOE responded in writing to EEI’s comments on the five preliminary cask designs. In general, DOE stated that EEI had offered constructive suggestions that would be useful in resolving design and handling issues while DOE prepares the final designs of its casks. For example, DOE agreed that several of its contractors had included unrealistic estimates of cask-loading times in their preliminary design reports and also responded that it intends to redesign its casks to accommodate the practical needs of some utilities with certain spent fuel from boiling water reactors.

DOE did not propose a halt in developing either a truck or a rail/barge cask. According to DOE, its cask-design contractors have copies of all comments DOE received on the preliminary cask designs and will, to the extent

possible, address and resolve all comments while preparing the final designs of the casks. Finally, according to DOE transportation officials, the casks that DOE is developing will be needed to remove spent fuel from utilities' storage pools regardless of the amounts of spent fuel in dry storage and in storage pools.

Truck Cask System May Exceed Weight Limit

In addition to the technical and operational issues raised by EEI, DOE has recently become concerned that the combined weight of the truck cask and the tractor and trailer that would haul the cask might exceed the weight limit for highways.

DOE contracted with General Atomics to design legal-weight transporter systems for pressurized- and boiling-water-reactor spent fuel comprising a truck cask for each type of spent fuel and a trailer to haul the casks. A conventional tractor to pull the loaded trailer would make up the other element of the system. In designing the transporter systems, General Atomics allotted weight limits for each system element.⁴ According to the company, its preliminary cask design weights fall within the 80,000-pound gross-vehicle-weight limit established by the Federal-Aid Highway Amendments of 1974. DOE documents, however, show that factors not yet accounted for could cause the gross-vehicle weight to exceed the limit. For example, trip recorders, anti-lock brakes, satellite-tracking system components, snow and ice buildup, and state weighing-scale variances could, according to DOE, add over 2,000 pounds to the transporter system. In addition, DOE's contractor responsible for overseeing the design of the transporter systems has estimated that the tractor would weigh 800 to 900 pounds more than General Atomic's goal.

DOE is considering hardware and operational options to reduce total transporter system weight. For example, DOE may reduce the size of the tractor's engine block and sleeper compartment or eliminate the sleeper compartment altogether. If sleeper compartments are eliminated, DOE is considering (1) a "pony express" option, whereby replacement drivers could be staged along designated routes; (2) establishing safe havens along routes to permit drivers to rest; and (3) providing escort vehicles that contain sleeping units. At this time, DOE has not completed systems analysis or trade-off studies to determine the most cost-effective option, including modifying the cask design to reduce the weight of a loaded cask

⁴General Atomics allotted 54,000 pounds for a loaded cask, 9,000 pounds for the trailer, and 16,000 pounds for the tractor. In addition, the company allotted 1,000 pounds for margin if cask, trailer, and/or tractor targets were exceeded.

enough to bring the total weight of the transporter system under the limit for legal-weight vehicles.

According to DOE transportation officials, such studies are under way. The officials added that DOE might, as it firms up its plans for shipping spent fuel, decide to exercise one or more of the above options even if the transporter systems meet weight limitations. Such a decision might be made to accommodate the preferences of states through which the spent fuel would be shipped.

DOE Has Time to Resolve Issues Before Committing to Specific Cask Designs

The cask development program schedule is linked to DOE's goal of developing an MRS facility as early as 1998. The utility industry, however, believes that DOE is developing casks too quickly—particularly the large rail/barge cask—in view of uncertainty over the MRS facility and the extended schedule for operating a repository. In our view, it is unlikely that DOE will be able to develop an MRS facility by 1998 because states and Indian tribes are reluctant to host facilities for storing or disposing of highly radioactive wastes. Although several Indian tribes and county governments have recently applied to DOE for grants to study the feasibility of hosting an MRS facility, it is unlikely that this interest in the facility will lead to the development of a facility by 1998.

According to DOE, to accomplish its objective of having an MRS facility operational by 1998, the Nuclear Waste Negotiator must conclude an agreement with a host state or Indian tribe and obtain congressional approval of the agreement by the end of 1992. The negotiator believes that this is unlikely. We also recently concluded that DOE is unlikely to have an MRS facility operational by 1998.⁵

Furthermore, we pointed out that a major concern throughout the legislative history of the 1982 Nuclear Waste Act and the 1987 amendments was the possibility that an MRS facility would become a permanent storage site by removing the incentive for developing a repository for the permanent disposal of nuclear waste. Finally, public opposition has prevented siting an MRS facility and has hindered the siting and development of other waste facilities. For these reasons, we recommended that the Congress withhold any future funds requested by DOE for activities related to developing a site for an MRS facility until DOE

⁵Nuclear Waste: Operation of Monitored Retrievable Storage Facility Is Unlikely by 1998 (GAO/RCED-91-194, Sept. 24, 1991).

has demonstrated that a state or tribe has agreed, in principle, to host a facility at a specific site.

Without an MRS facility, DOE would not be able to begin removing spent fuel from civilian nuclear facilities until at least 2010, when it estimates that it could have a spent-fuel repository at Yucca Mountain. On the basis of DOE's current estimate of the time required to obtain NRC's approval of DOE's cask designs and fabricate prototype casks, DOE would need to seek NRC's approval by about 2005 in order to begin shipping spent fuel to a repository in 2010.

DOE is "highly optimistic" that a site for an MRS facility will be selected soon and that the facility will be developed in time for DOE to begin accepting spent fuel in 1998. The basis for DOE's optimism is recent applications from seven Indian tribes and county governments for grants to study the feasibility of hosting an MRS facility. In late 1991 the Mescalero Apache Tribe, New Mexico, and Grant County, North Dakota, obtained grants in the amount of \$100,000 and, as of January 7, 1992, DOE had received additional applications from four Indian tribes in Minnesota, Oklahoma, and Washington State, and a county in Wyoming.

Although these requests for feasibility grants demonstrate interest in an MRS facility, the potential for future negotiations remains uncertain, and development of a facility by 1998 remains unlikely. For example, following the receipt and use of initial grant funds, applicants may then obtain additional grants for further feasibility studies without making a commitment to host a facility. Negotiations would potentially follow, and any negotiated agreement would then have to be enacted into law by the Congress before DOE could begin developing the proposed facility. How long these steps would take is uncertain, as is whether the negotiated agreement would permit DOE to develop the facility as early as 1998.

At least two other factors could also complicate the negotiations. First, with respect to interest in an MRS facility by an Indian tribe, the Nuclear Waste Negotiator believes that he should negotiate and consult with both the governor and tribal leaders when a potential site is located on Indian lands. In the Negotiator's opinion, implementing a negotiated agreement without the support or permission of the affected state is uncertain. The grant application from the Mescalero Apache Tribe illustrates this issue. The tribe stated in its grant application that it would consider moving ahead with a formal application to host a facility if its feasibility assessment convinced it that an MRS facility would, among other things, be

temporary in nature. The Governor of New Mexico, however, "adamantly" opposes hosting an MRS facility in the state.

Second, when a potential site for an MRS facility or a repository is not on Indian lands, the Negotiator is only authorized to negotiate with the governor of a state or, under state law, a person or entity authorized to negotiate on behalf of the state. Therefore, the position of the state governor will be crucial to the potential that interest in an MRS facility expressed by a county or local government would evolve into successful negotiations on hosting a facility. For example, although the Governor of North Dakota did not oppose Grant County's application for a feasibility grant, in writing to the county, the Governor noted that there are no "temporary" nuclear waste storage sites in place. In addition, the Governor stated that, although some economic development and jobs would accompany an MRS facility, North Dakota is essentially a coal-, gas-, and oil-energy producing state. In the Governor's view, it is not up to North Dakota to facilitate a competitive industry in terms of any kind of financial support or encouragement.

Conclusions

The pace and direction of DOE's cask-system development program are based on the agency's conviction that an MRS facility can be developed in time to have a limited capability to receive and store spent fuel by 1998. For this reason, DOE intends to complete the final designs of a truck and a rail/barge cask in 1992. In contrast, EEI believes that uncertainty over the MRS facility and the current extended repository schedule gives DOE ample time to address and resolve important technical and operational issues before committing itself to specific cask designs. We agree that DOE is unlikely to achieve its objective of having a facility operating by 1998 and that, despite recent grant applications from potential host jurisdictions, the likelihood that a volunteer site will be found remains uncertain. In the absence of an MRS facility, DOE would not need a large-scale cask procurement program until about 2005.

Therefore, DOE has an opportunity in the next few years to reevaluate the course and direction of the cask development program while conserving funds until there is a clear need to develop casks. With additional time available, DOE can address whether the technical and operational issues that EEI has raised might affect cask designs.

Recommendations

We recommend that the Secretary of Energy limit funding for the cask-system development program to the amount necessary to complete final-design work planned for fiscal year 1992 on the casks currently being developed. The Secretary should, however, refrain from submitting the final design of any cask to NRC for certification at least until DOE has demonstrated that a state or tribe has agreed, in principle, to host an MRS facility at a specific site. In conjunction with this pause, the Secretary of Energy should

- factor into cask designs nuclear industry transportation experience, the final results of DOE's facility interface study, and the unique features of certain spent fuel from boiling water reactors;
- assess, in the absence of an MRS facility, the potential effects of utilities' actions to expand their on-site spent-fuel storage capacity on the cask systems development program; and
- determine whether the truck cask, in combination with its tractor and trailer, is too heavy and, if so, the most cost-effective approach to reducing the weight.

Our work was performed between January 1990 and September 1991 in accordance with generally accepted government auditing standards. (App. II provides a discussion of our objectives, scope, and methodology.)

As your offices requested, we did not obtain written agency comments on a draft of this report. However, we discussed the information in this report with DOE officials, who generally agreed with the information's accuracy. Their comments have been incorporated where appropriate.

As arranged with your offices, 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 of this report to the appropriate congressional committees, the Secretary of Energy, and the Director, Office of Management and Budget. Copies will also be made available to other interested parties.

This work was performed under the direction of Victor S. Rezendes, Director of Energy Issues, (202) 275-1441. Major contributors to this report are listed in appendix III.

A handwritten signature in black ink, appearing to read "J. Dexter Peach". The signature is written in a cursive style with a large initial "J" and a long, sweeping underline.

J. Dexter Peach
Assistant Comptroller General

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Abbreviations

DOE	Department of Energy
EI	Edison Electric Institute
GAO	General Accounting Office
MRS	Monitored Retrievable Storage
NRC	Nuclear Regulatory Commission
OCRWM	Office of Civilian Radioactive Waste Management

Edison Electric Institute's Concerns About Cask Development Program and DOE's Responses

In 1990 the Edison Electric Institute (EEI) reviewed the five preliminary designs for the casks then under development, and in February 1991 provided its comments to the Department of Energy (DOE). EEI found several technical and operational concerns that it considered both significant and generic to DOE's cask development effort. In May 1991 DOE responded to EEI's comments. In general, DOE stated that EEI had offered constructive suggestions that would be useful in resolving design and handling issues in the final design. Contractors had been provided with copies of all comments received by DOE on the preliminary designs and would address and resolve all issues identified, to the extent possible, during the final design phase.

DOE Had Not Factored Nuclear Industry Experience Into the Cask Program

One of EEI's concerns was that DOE's cask-design contractors did not have, or did not use effectively, the cask-handling experience that is available within DOE, among its contractors, and among the utilities that operate nuclear power plants. According to EEI, close to 5,000 civilian shipments of spent fuel have occurred in the United States, and DOE will eventually face many of the same operational problems that were experienced with these previous shipments. EEI's team that reviewed DOE's preliminary cask-design reports, which included individuals with experience in shipping spent fuel, identified many obvious operational concerns. For example, EEI concluded that estimated times for loading and unloading spent fuel in all but one of the preliminary design reports were "optimistic to the point of being unrealistic." As a result, EEI said DOE's cask-design data base appeared to be incomplete and using such data in preparing final cask designs would likely result in casks that could eventually require significant modifications.

EEI said that DOE must develop a mechanism for incorporating nuclear industry fuel-handling experience into its transportation cask development program as soon as possible so it can use this expertise for the timely resolution of current and future concerns with the program.

In response to EEI's statement, DOE said it had set up a process in which cask-design contractors would receive the benefit of the expertise that exists among DOE's nuclear contractors. According to DOE, the process ensures the full use of the cask-handling expertise that resides within the DOE contractor structure. DOE agreed with EEI's comments that estimated cask-loading times in several design reports were unrealistic. According to DOE, it has informed its contractors that more attention should be given to developing these estimates in the final design reports. Finally, DOE said it

would be interested in EEI's suggestions that DOE should consider adding cask-handling expertise within the utility industry to its review process.

Data on Nuclear Facility and Cask Interface Not Factored Into Designs

Another of EEI's concerns was that DOE's cask designers had not incorporated data from a study on the interface between nuclear facilities and DOE's transportation system that could aid them in designing a system that is compatible with utilities' nuclear facilities.

Since June 1989, DOE has been conducting a study on the constraints and complexities of moving spent fuel from the 122 civilian nuclear facilities at 76 sites. The Facility Interface Capability Assessment is designed to document on-site (within property boundaries of nuclear facilities) the constraints and capabilities of each nuclear facility to handle the conceptual designs of two types of truck casks and two types of rail/barge casks. According to DOE transportation officials, these conceptual designs were based on the preliminary designs of the five casks that DOE was developing early in the cask development program. The plant-by-plant assessments were based on the professional judgment and engineering experience of DOE's assessment contractor.

Preliminary assessment results show that current facility capabilities would not allow the handling of any of these casks at 50 of the 122 facilities. If potential administrative, licensing, and physical modifications were made to facility systems and equipment, however, all but 1 of the 122 facilities would be able to handle at least the conceptual design of a legal-weight truck cask, and 98 of the facilities would accommodate a 100-ton rail/barge cask. The scope of the report did not include analyses needed to determine if such potential changes are feasible and how much the changes would cost.

In January 1990 DOE selected the preliminary designs of one truck and one rail/barge cask for completion of final designs in 1992 even though the facility interface study had not been completed for use by its cask-design contractors. According to EEI, to the extent that cask designs require the use of ancillary equipment at particular sites, it is important to check the facility interface data to verify that the cask and ancillary equipment will still be compatible with the sites. In particular, in EEI's view, it is extremely important that DOE not proceed to the final design stage of a rail/barge cask until DOE has had an opportunity to factor the completed facility interface data into the cask design effort.

DOE responded that it had been closely monitoring the progress of the facility interface study and evaluating cask designs against the preliminary study data for incorporation into design guidance. Also, DOE said that it appeared that the cask development program had exceeded its original goal of meeting interface requirements for at least 80 percent of all nuclear facility sites. Because nuclear facilities vary in their specific capabilities to accommodate casks, DOE said that it expects to use special adaptive equipment in cask-handling operations. DOE expects the facility interface data to be valuable in its operational planning activities. DOE concluded by stating that it would continue to work with EEI and individual utilities, as appropriate, to ensure that DOE can service all nuclear facilities in a timely manner, consistent with its contractual responsibilities.

Cask Designs Did Not Address Contractual Requirements and Needs of Some Utilities

According to EEI, DOE's preliminary cask designs did not take into account all of the requirements of DOE's standard contract for accepting utilities' spent fuel or practical utility needs with regard to certain boiling-water-reactor spent fuel. The utility group pointed out that, among other provisions, the standard contract specifies the maximum physical dimensions for boiling-water-reactor spent fuel that must be met for the fuel to qualify for shipment by DOE as standard fuel. Among these dimensions is a maximum 6-inch-square cross section for a spent fuel assembly. EEI pointed out, however, that the relevant design dimensions for both the truck and the rail/barge casks were less than the 6-inch-dimension specified in the standard contract. In addition, EEI said that, as a practical matter, certain boiling-water-reactor spent fuel assemblies that have "channels" that carry cooling water attached to them will probably require an internal cask-design dimension of not less than a 5.9-inches square. Finally, the utility group said that, even though DOE had been aware of these discrepancies for over a year, the corrective action that DOE planned to take was still not clear.

According to DOE's estimates, at least 50 percent of boiling-water-reactor spent fuel assemblies have channels that carry cooling water attached to them that increase the dimensions of the assemblies. Recently, however, the Nuclear Regulatory Commission (NRC), which licenses and regulates civilian nuclear power plants, changed its regulations to prohibit the reuse of such channels. This means that eventually, each assembly awaiting disposal or storage by DOE will have a channel attached to it. Although DOE is attempting to increase cask capacity by developing its new casks, the physical attributes of these spent fuel assemblies will reduce the capacity of DOE's transportation casks by over 20 percent. This will occur because

the change in fuel assembly dimensions caused by the attached channels will decrease the number of fuel assemblies that can be loaded into transportation casks. For example, DOE estimates that the number of fuel assemblies that the rail/barge cask can carry will decrease from 52 to 40 assemblies—a decrease of about 23 percent.

DOE responded that its preliminary cask designs were being developed for transporting spent fuel assemblies, in several cases, without all nonfuel assembly hardware attached. On the basis of the utility group's suggestions, DOE said it now intends to transport boiling-water-reactor channels with the spent fuel and is taking steps to ensure that its cask design contractors factor this into their designs. DOE did not address the discrepancy between the standard fuel dimension specified in the standard contract and the related dimension in preliminary designs of both the truck and rail/barge cask.

Preliminary Designs Left Little Room for Design Changes

EEI also expressed concern about what it characterized as the narrow margin between DOE's preliminary cask designs and regulatory or design limits. In its view, the narrow margin leads to a minimal allowance for design changes through the final design of the casks. The utility group pointed out that calculated radiation dose rates in the preliminary designs were extremely close to the regulatory limits. This could, the group said, present a significant problem, considering that (1) cask designs are only at the preliminary design stage, (2) fuel with much higher burnup (used longer in the reactors and, therefore, more radioactive) than DOE initially anticipated would have to be shipped, and (3) verification of compliance with regulatory requirements for shipping operations through field measurements will introduce significant variations associated with the use of different equipment and personnel.

EEI concluded that the narrow margins allowed in the preliminary designs for changes due to regulatory requirements and unforeseen events demonstrated a naivete with respect to NRC's cask-certification process. In its view, DOE would obtain valuable experience by going through NRC's process for certifying cask designs in attempting to obtain NRC's certification of a truck cask design.

DOE noted that NRC properly imposes safety margins on the basis of uncertainty and it is DOE's intent to meet the regulatory agency's requirements and to rely on regulatory guidance and precedent to demonstrate compliance with all applicable rules and regulations. DOE also

**Appendix I
Edison Electric Institute's Concerns About
Cask Development Program and DOE's
Responses**

said it would provide sufficient technical backup to gain NRC's acceptance in those areas where DOE is introducing new or different approaches. In DOE's opinion, its cask contractors had provided sufficient design and regulatory margins in their preliminary designs. Furthermore, DOE anticipates that the calculated margins will increase when more rigorous final design analyses have been completed.

Objectives, Scope, and Methodology

The Chairman, Senate Committee on Commerce, Science, and Transportation, and Senator Richard H. Bryan, a member of that committee, asked us to review DOE's efforts to implement transportation-related activities under the Nuclear Waste Policy Act of 1982 (P.L. 97-425) as amended in 1987.

We reviewed the nuclear waste act, as amended in 1987, DOE's standard disposal contract, and NRC's regulations pertaining to the packaging and transportation of radioactive material (10 C.F.R. part 71). We also reviewed DOE's 1985 Mission Plan and subsequent draft amendments to the Mission Plan, its 1986 Transportation Business Plan, its 1990 Annual Capacity Report, and its 1991 draft acceptance priority-ranking report.

We interviewed Office of Civilian Radioactive Waste Management (OCRWM) staff to obtain information on the standard disposal contract, transportation-cask fleet projections, cask designs, cask development costs, and DOE's plans to provide transportation guidance to utilities. We also discussed NRC's cask-design certification process with staff of that agency. We supplemented all of these discussions by obtaining documentation, if available, to support the oral evidence provided.

In addition, we met with officials from the EEI to gain an understanding of the nuclear industry's perspective on DOE's transportation program. To obtain information on the cask development and production schedules of DOE's cask-design contractors, we contacted Babcock and Wilcox, General Atomics, Nuclear Assurance Company, and the Westinghouse Electric Corporation. To obtain information on at-reactor spent nuclear fuel storage capacity, we contacted four utilities whose DOE shipping priorities were high because of the age of their spent fuel—Commonwealth Edison Company, Northeast Utilities Service Company, Pacific Gas and Electric Company, and Southern California Edison Company.

We also attended meetings and conferences on spent-fuel transportation. For example, we attended an October 1990 and a September 1991 Nuclear Waste Technical Review Board panel hearing on transportation and systems as well as a December 1990 OCRWM Transportation Coordination Group meeting.

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Related GAO Products

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