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SPENT FUEL SHIPPING CASK HANDLING CAPABILITY ASSESSMENT OF 27 SELECTED LIGHT WATER REACTORS

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ABSTRACT

This report presents an assessment of the spent fuel shipping cask handling capabilities of those nuclear plants currently projected to lose full core reserve capability in their spent fuel storage basins in the near future. The purpose of this assessment is to determine which cask types, in the current fleet, each of the selected reactors can handle. This information will then be integrated into a subsequent report, a shipping cask supply-demand analysis, which contain the results of calculations of spent fuel shipping cask requirements. These projected requirements can then be compared with the existing shipping cask fleet availability.

The cask handling capability of a nuclear plant depends upon both external and internal conditions at the plant. The availability of a rail spur, the lifting capacity of the crane, the adequacy of clearances in the cask receiving, loading, and decontamination areas and similar factors can limit the types of casks that can be utilized at a particular plant. This report addresses the major facility capabilities used in assessing the types of spent fuel shipping casks that can be handled at each of the 27 selected nuclear plants approaching a critical storage situation. The results of this study cannot be considered to be final and are not intended to be used to force utilities to ship by a particular mode. In addition, many utilities have never shipped spent fuel. Readers are cautioned that the results of this study reflect the current situation at the selected plants and are based on operator perceptions and guidance from NRC related to the control of heavy loads at nuclear power plants. Thus, the cask handling capabilities essentially represent "snap-shots" in time and could be subject to change as plants further analyze their capabilities, even in the near-term.

A historical background description of the heavy-load control problem encountered by NRC licensees is included in this report. This problem is significant, of course, since it may limit the type of cask that can be used at each specific plant. An analysis of this problem may also show that operating limits must be established or that additional devices must be installed to assure compliance with the regulations. As the plans for a specific shipping

campaign are developed, detailed analyses of cask handling and cask support equipment have to be considered for nuclear plant compliance with guidelines and regulatory requirements.

From the spent fuel transportation viewpoint, identifying the type of cask(s) that can be handled at each facility is paramount. Once that determination is made, the cask-facility-interfacing requirements must be met. These requirements involve not only cask lifting yokes and redundancy but also factors such as special support equipment, in-plant clearances, and operating restrictions. Dry runs, checkout operations, and crew training can assure readiness for spent fuel transport operations and the establishment of reliable shipping schedules.

The results of this assessment indicate that 48% of the selected plants have rail access and 59% are judged to be candidates for overweight truck shipments (with 8 unknowns due to unavailability of verifiable data). Essentially all of the reactors can accommodate existing legal-weight truck casks.

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1.0 INTRODUCTION

This assessment of cask handling capabilities at nuclear power plants nearing their maximum onsite spent fuel storage capacity is both important and timely. The Commercial Spent Fuel Management (CSFM) Program, managed for the DOE by Pacific Northwest Laboratory (PNL), has the responsibility for implementing provisions of the Nuclear Waste Policy Act of 1982 (NWPA; P.L. 97-425) regarding research, development, and demonstration of concepts for storage of spent fuel. This report was prepared in support of the CSFM Program. It focuses on one aspect of the overall transportation system associated with these concepts: the spent fuel cask handling capabilities at 27 selected light water reactors (LWRs) associated with 14 utilities currently projected to lose full core reserve in their spent fuel storage basins in the near future. The purpose of this assessment is to identify which reactors can handle which types of casks.

DOE is currently formulating plans to ensure the availability of LWR spent fuel shipping casks when they are needed. All spent fuel shipments must use NRC-approved shipping casks of which there are only limited numbers. Thus, this assessment of commercial utility capabilities for handling these spent fuel transport casks is an integral step in the DOE plans associated with reactors that have near-future storage requirements.

Three types of commercial spent fuel shipping casks are available for transport--legal-weight truck (LWT), overweight truck (OWT), and rail casks. The three cask types can be used in mixed transport modes. Some of the reactors examined in this study have the capability to receive and handle all three types. Many reactors, however, are not equipped to handle the larger rail or OWT casks. If a large fraction of reactors that could ship their spent fuel are not capable of handling rail casks, transportation requirements could severely reduce the availability of the existing truck cask fleet for use in other shipping campaigns. Therefore, spent fuel cask handling capabilities can have an impact on shipping cask fleet requirements.

The results of this assessment are not intended to be used to force utilities to ship by a particular mode nor can the results be considered final. In addition, many utilities have never shipped spent fuel. The reader is thus cautioned that the results are based on current information that may change in coming years as utilities further analyze their capabilities.

The information obtained in this study will support a transportation logistics analysis (shipping schedules, cask availability, and cask requirements) currently being performed at PNL. The logistics and cask handling capability information will be used to evaluate the capability of the current cask fleet to effectively respond to needed spent fuel shipments, including shipments for Federal Interim Storage (FIS), intra-utility transshipments, cooperative demonstrations, dry storage tests and analyses, removal of fuel from West Valley, and other potential near-term planned movements of spent fuel.

The remainder of this report is divided into five sections and two appendices. Section 2.0 presents a summary of the results and conclusions from this study. The approach is discussed in Section 3.0. The cask handling capability assessment is presented in Section 4.0 and a discussion of observations and comments concerning this study is included in Section 5.0. Appendix A contains summary data of cask handling capabilities and limitations for each reactor plant utilized in the study. The number and types of existing commercial spent fuel shipping casks was determined through discussions with supplier companies. This information is included in Appendix B.

2.0 SUMMARY AND CONCLUSIONS

A significant increase in the transportation of irradiated fuel from commercial nuclear reactors is anticipated in the next several years. The greatest portion of this increase will be due to shipments to relieve spent fuel storage problems. An assessment of the cask handling capabilities of those reactors projected to have a potential need for shipping spent fuel is important for planning and scheduling those shipments. The purpose of this study is to identify which reactors can handle which types of casks. This assessment is the first phase of a two-phased spent fuel transportation analysis being performed at Pacific Northwest Laboratory for the Department of Energy (DOE). The overall purpose of the current studies is to evaluate the adequacy of the existing commercial shipping cask fleet to provide the expected demand for spent fuel transportation services.

The approach to this Phase 1 study involves an assessment of the spent fuel shipping cask handling capabilities at reactors that are projected to exceed their capacities for storing fuel in the near-term. The objective of this phase was to determine the shipping cask types that each of these reactors can currently receive and handle at their sites. This information will be used in Phase 2 as the basis for determining a preferred transport mode for each of these reactors. These preferred transport modes will then be used in an analysis of the supply and demand for spent fuel shipping casks. A range of spent fuel shipping cask fleet sizes and projected cask usage requirements through 1992 will then be developed in Phase 2. Separate shipping cask usage requirements will be developed for each transport mode. These requirements will then be compared with a range of potential cask availabilities to determine, on a mode-specific basis, if sufficient numbers of commercial spent fuel shipping casks are available.

The cask handling capabilities of the 27 selected LWRs examined in this study (i.e., Phase 1) are presented in Table 2.1. The results of this assessment indicates that 48% of the plants have rail access and 59% are considered to be candidates for overweight truck shipments. The cask handling capabilities of 8 plants could not be determined because of the unavailability of

TABLE 2.1. Summary of the Cask Handling Capabilities of the 27 Selected LWRs Examined in This Study

Docket No. 50-	Utility and Plant(s)	Cask Handling Capability[a] LWT	OWT	Rail
	Baltimore Gas and Electric Co.			
-317 & -318	• Calvert Cliffs 1 & 2 (Lusby, MD)	X	Unk[b]	
	Boston Edison Co.			
-293	• Pilgrim 1 (Plymouth, MA)	X	Unk	
	Carolina Power and Light			
-325 & -324	• Brunswick 1 & 2 (Southport, NC)	X	X	X
-261	• Robinson 2 (Hartsville, SC)	X	X	X
	Commonwealth Edison Company			
-454 & -455	• Byron 1 & 2 (Byron, IL)	X	X	X
-373 & -374	• LaSalle 1 & 2 (Seneca, IL)	X	X	X
	Consumers Power Co.			
-255	• Palisades (South Haven, MI)	X	Unk	
	Duke Power Co.			
-287	• Oconee 3 (Seneca, SC)	X	X	
	Florida Power and Light Co.			
-250 & -251	• Turkey Point 3 & 4 (Florida City, FL)	X	--[c]	
-355	• St. Lucie 1 (Hutchinson Island, FL)	X	--[c]	
	GPU Nuclear Corporation			
-219	• Oyster Creek (Forked River, NJ)	X	X	
	Northeast Utilities			
-245 & -336	• Millstone 1 & 2 (Waterford, CT)	X	X	X
	Northern States Power Company			
-263	• Monticello (Monticello, MN)	X	X	X
-282 & -306	• Prairie Island 1 & 2 (Red Wing, MN)	x	Unk	X
	Philadelphia Electric Company			
-277 & -278	• Peach Bottom 2 & 3 (Peach Bottom, PA)	X	Unk	
	Power Authority of the State of New York			
-333	• James A. Fitzpatrick (Scribs, NY)	X	X	X
	Rochester Gas and Electric Corporation			
-244	• Robert E. Ginna (Ontario, NY)	X	X	
	Virginia Electric and Power Company			
-280 & -281	• Surry 1 & 2 (Gravel Neck, VA)	X	X	

(a) LWT = Legal-weight truck; OWT = Overweight truck.
(b) Unk = Unknown due to unavailability of verifiable data at this time.
(c) The technical specifications currently limit the cask type to a single-element cask and the cask weight to a 25-ton limit.

verifiable data. The reader is cautioned that these results reflect the current situation at the selected plants and are based on plant operator perceptions and guidance from NRC related to the control of heavy loads at nuclear power plants. Some of the cask handling data were obtained from utility responses to the CSFM Program's spent fuel data collection activities and from follow-up telephone contacts with knowledgeable persons at the plants. Since many of the plants have never shipped spent fuel and many may not do so for many years, the plant operators in some cases are not certain as to their cask handling capabilities. These operators indicated that analyses must be performed to identify the type(s) of shipping cask(s) their plants can handle. Thus, the results are subject to change in future years as more and more utilities are faced with the need to ship spent fuel.

The existing commercial shipping cask fleet includes casks designed for three different transport modes; legal-weight truck (LWT), overweight truck (OWT), and rail. Essentially all reactors examined in this study are capable of receiving and handling LWT casks. However, some of the plants are not capable of receiving and handling the larger and heavier OWT and rail casks. Limitations on the capability to handle rail casks are due to either external plant conditions (e.g., lack of a rail spur) or internal plant conditions (e.g., a cask loading pool with inadequate clearance). This could cause an excess of demand for LWT casks over the supply represented by the existing fleet. Consequently, the adequacy of the existing spent fuel shipping cask fleet depends to a large extent upon the cask handling capabilities and limitations at these selected reactors.

The past experiences of the licensees in the handling and movement of spent fuel casks were also determined in this review. Ten of 14 utilities (71%), representing 15 reactors, have previously shipped spent fuel from at least some of their reactor plants. This type of experience is judged to be an important aspect of the plant-specific cask handling capabilities. In addition, it was determined that only 12 of 27 plants (44%) may be capable of intermodal spent fuel shipments via barge.

As previously mentioned, the guidance from NRC related to the control of heavy loads at nuclear power plants must be considered by licensees. It appears that future cask handling and movement operations will be directly tied to these guidelines. If a licensee does not meet the criteria established in NRC guidelines (NRC 1980) or, as a minimum, the interim criteria delineated in NUREG-0612, it is assumed that his cask handling capabilities could be questionable. For such licensees, any questions about their cask handling capabilities would probably have to be resolved before a spent fuel shipping campaign could commence. Appropriate technical specification changes, as necessary, would also have to be made. It is judged further that technical specification changes/amendments associated with complying with the required criteria at some future date would directly impact the final assessment of the licensee's cask handling capabilities at that time.

3.0 OBJECTIVES, APPROACH AND STUDY BASES

This section contains brief descriptions of the study objectives, approach, and bases. In regard to the bases, the results obtained in this study are specific to the major bases described herein and to the specific assumptions that are derived from them. Any assumptions made to facilitate the analysis undertaken are stated in the report.

3.1 STUDY OBJECTIVES

The objective of this study was to assess the spent fuel cask handling capabilities at selected commercial nuclear power plants that are currently projected to lose full core reserve capability in their spent fuel storage basins and could potentially be required to ship fuel offsite to avoid interruption of operations. The study was performed to provide input to DOE plans to assure that appropriate types and quantities of transportation equipment are available when needed. Some of the raw data for this study had been collected concurrently with the CSFM Program surveys of utility spent fuel storage data. However, cask handling data applicable to the needs of this study had not been tabulated in the past. Therefore, the bulk of the effort in this study was directed toward tabulating and performing quality assurance (QA) checks and verifications of the existing cask handling data. The QA checks included telephone contacts with utility representatives to verify and update past and current Utility Spent Fuel Data Verification Forms.[a]

As mentioned previously, the information obtained in this study will be integrated with transportation logistics data in a separate study to calculate shipping cask requirements. The overall phased-approach to both of these studies is illustrated in Figure 3.1. Further details concerning the overall approach used on both studies are briefly discussed below.

(a) The Utility Spent Fuel Data Verification Forms provide the basis for a comprehensive computerized data management system on LWR spent fuel storage requirements data. This system is operated by Pacific Northwest Laboratory (PNL) for the Department of Energy's Commercial Spent Fuel Management Program to provide rapid retrieval of any portions of the utility-supplied reactor and spent fuel data.

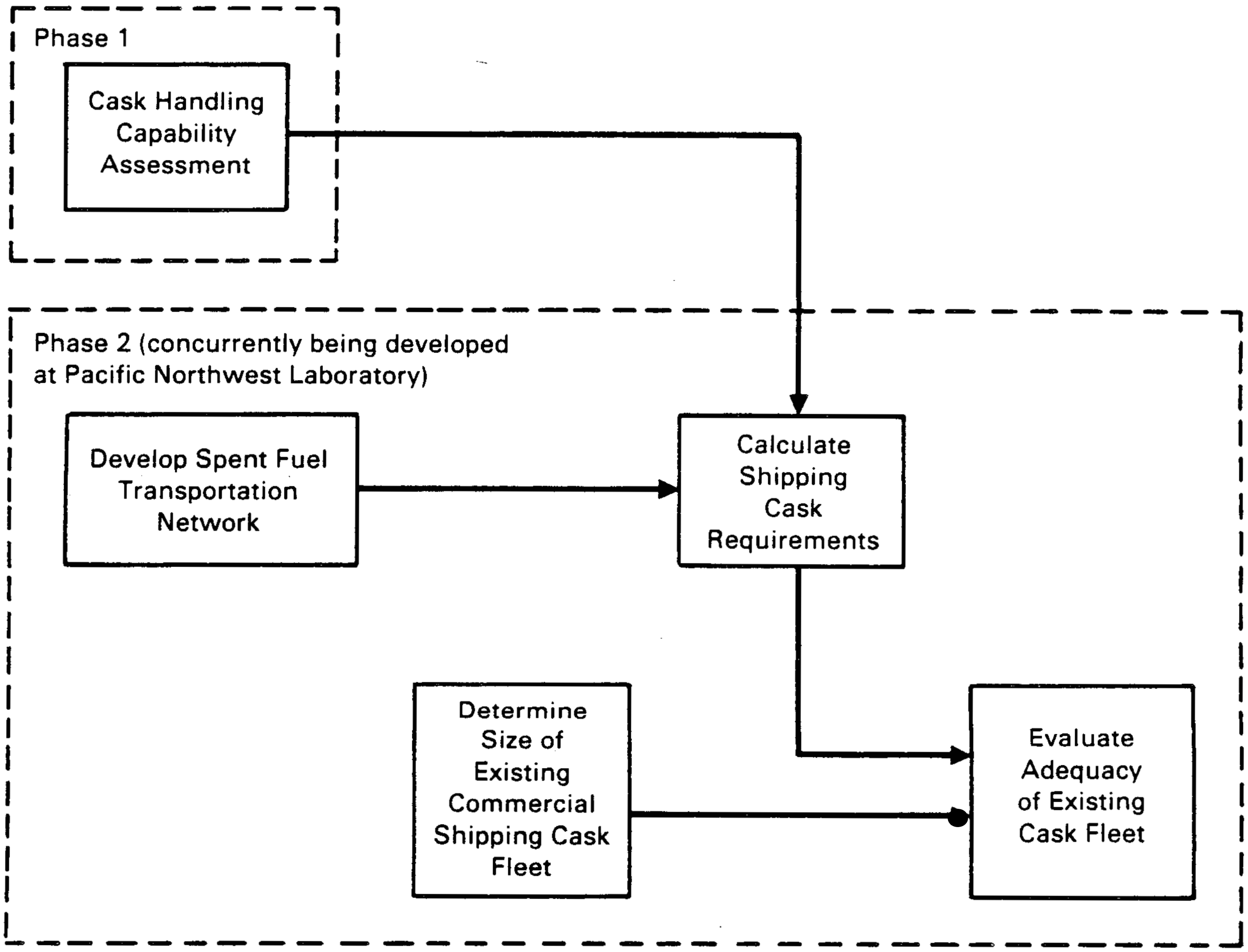

FIGURE 3.1. Illustration of Overall Phased-Approach Utilized in Support of the CSFM Program

This study--an evaluation of the spent fuel shipping cask handling capabilities at reactors that may have to ship spent fuel from their sites--constitutes the first phase as shown in Figure 3.1. The purpose of this phase was to determine which cask types in the current fleet can be handled by which reactors. The reactors for which this assessment is being performed include only the reactors that have potential near-term storage problems, as determined from DOE/RL-83-1 (DOE 1983). Shipments from these reactors represent the largest potential demand for spent fuel shipping casks over the next ten years.

3.2 STUDY APPROACH

The information used to determine the cask handling capabilities was derived by collection, verification, and analysis of data relevant to the facilities studied. The 1983 Utility Spent Fuel Data Verification Forms completed by nuclear utilities for the CSFM Program's spent fuel data base were used as a starting point. These forms contained a number of questions concerning cask handling capabilities at each plant. After these data were reviewed, the utilities were contacted by telephone to verify the data as well as reconcile missing or incomplete data. Some additional questions concerning their cask handling capabilities were also asked at this time. A list of the utilities contacted is presented in Section 3.3. Once all of the reactor-specific data was assembled, it was examined to determine the types of shipping casks that could be handled at each plant. Information in the open literature was also used.

Phase 2 (also shown in Figure 3.1) consists of a spent fuel shipping cask supply-demand analysis, which is concurrently being developed by Pacific Northwest Laboratory. The objective of this second phase is to determine if sufficient casks exist to provide the needed shipping services. This analysis will be comprised of two parts: 1) determination of the availability of the existing shipping cask fleet and 2) calculation of shipping cask requirements. Discussions with spent fuel cask supplier companies to accomplish Part 1 have been completed (see Appendix B for details). Information resulting from completion of Part 1 represents the "supply" of shipping casks. Due to future uncertainty in the availability of NRC-approved spent fuel shipping casks, two cask supply cases will be developed that represent lower and upper limits of cask availability. These data will then be compared with projected cask usage requirements to determine the adequacy of the existing fleet.

Results of Phase 1 (i.e., this study on the cask handling capability assessment at selected reactors) will be incorporated into the transportation network schemes developed in Phase 2 and will be used to assign a specific type of cask (i.e., LWT, OWT, or rail) to each shipment. For example, if the cask loading pool at a particular reactor is too small to accommodate a large rail cask, that reactor can only be considered to be capable of using legal- or over-weight truck shipping casks.

3.3 STUDY BASES

The major study bases of this cask handling capabilities assessment study are listed below.

- The study must yield realistic and up-to-date results based on 1) plant-specific responses provided by licensees via DOE's 1983 Utility Spent Fuel Data Verification Forms, 2) follow-up telephone contacts with utility representatives, and 3) applicable information contained in the open literature.
- The study is conducted within the framework of the existing regulations and regulatory guidance.
- The study evaluates only the current cask handling capabilities of the selected LWRs given in Table 3.1.

In addition, it should be recognized that to date, virtually all U.S. LWR spent fuel shipping has involved "wet" handling techniques, since all irradiated fuel is kept under water at the nuclear power plants. The term "wet cask handling" means that the cask is submerged in a pool of water while the fuel bundles are either loaded into the cask or removed from the cask prior to being placed into the underwater storage system (Lambert et al. 1981). The term does not describe the status of the cask cavity (i.e., water-filled or dry) while the cask is being transported or unloaded. The wet fuel handling procedure allows visual control of operations at all times. This feature is instrumental in producing a safe, efficient spent fuel loading/unloading sequence. All operating LWR reactors are designed to use wet cask handling techniques.

TABLE 3.1. Selected LWRs Utilized in This Study[a]

Docket No. 50-	Utility and Plant(s)	Net MWe	Type
	Baltimore Gas and Electric Co.		
-317	• Calvert Cliffs 1 (Lusby, Md)	825	PWR
-318	• Calvert Cliffs 2 (Lusby, Md)	825	PWR
	Boston Edison Co		
-293	• Pilgrim 1 (Plymouth, MA)	670	BWR

TABLE 3.1. (Contd)

Docket No. 50-	Utility and Plant(s)	Net MWe	Type
	Carolina Power and Light		
-325	• Brunswick 1 (Southport, NC)	790	BWR
-324	• Brunswick 2 (Southport, NC)	790	BWR
-261	• Robinson 2 (Hartsville, SC)	665	PWR
	Commonwealth Edison Company		
-454	• Byron 1 (Byron, IL)	1120	PWR
-455	• Byron 2 (Byron, IL)	1120	PWR
-373	• LaSalle 1 (Seneca, IL)	1080	BWR
-374	• LaSalle 2 (Seneca, IL)	1080	BWR
	Consumers Power Co.		
-255	• Palisades (South Haven, MI)	740	PWR
	Duke Power Co.		
-287	• Oconee 3 (Seneca, SC)	886	PWR
	Florida Power and Light Co.		
-250	• Turkey Point 3 (Florida City, FL)	646	PWR
-251	• Turkey Point 4 (Florida City, FL)	646	PWR
-335	• St. Lucie 1 (Hutchinson Island, FL)	890	PWR
	GPU Nuclear Corporation		
-219	• Oyster Creek (Forked River, NJ)	620	BWR
	Northeast Utilities		
-245	• Millstone 1 (Waterford, CT)	652	BWR
-336	• Millstone 2 (Waterford, CT)	864	PWR
	Northern States Power Company		
-263	• Monticello (Monticello, MN)	525	BWR
-282	• Prairie Island 1 (Red Wing, MN)	520	PWR
-306	• Prairie Island 2 (Red Wing, MN)	520	PWR
	Philadelphia Electric Company		
-277	• Peach Bottom 2 (Peach Bottom, PA)	1051	BWR
-278	• Peach Bottom 3 (Peach Bottom, PA)	1051	BWR
	Power Authority of the State of New York		
-333	• James A. FitzPatrick (Scribs, NY)	821	BWR
	Rochester Gas and Electric Corporation		
-244	• Robert E. Ginna (Ontario, NY)	470	PWR
	Virginia Electric and Power Company		
-280	• Surry 1 (Gravel Neck, VA)	775	PWR
-281	• Surry 2 (Gravel Neck, VA)	775	PWR

(a) Source: Spent Fuel Storage Requirements, DOE/RL-83-1, January 1983.

4.0 SPENT FUEL SHIPPING CASK HANDLING CAPABILITY ASSESSMENT

This section presents the results of a review of the current cask handling capabilities of 27 selected light water reactors (LWRs) associated with 14 utilities that are currently projected to lose full core reserve in their spent fuel storage basins in the near-term. As previously described in Section 3.0, the primary objective of the study was to assess the spent fuel cask handling capabilities at the 27 selected nuclear power plants. The subsequent plant-specific assessments focused primarily on onsite physical parameters (i.e., heavy load handling systems), and cask handling limitations. Lesser attention was given to administrative/procedural aspects and to offsite cask transportation concerns such as limitations imposed on access routes.

As mentioned previously, some of the raw data for this study had been collected concurrently with the CSFM Program surveys of utility spent fuel storage data. However, cask handling data applicable to the needs of this study had not been tabulated in the past. Therefore, the bulk of the effort in this study was directed toward tabulating and performing quality assurance (QA) checks and verifications of the existing cask handling data. The QA checks included telephone contacts with utility representatives to verify and update the data from past and current Utility Spent Fuel Data Verification Forms.

In nuclear power plants, heavy loads may be handled in several plant areas. If these loads were to drop in certain locations in the plant, they could affect spent fuel, fuel in the core, or the equipment that might be required to achieve safe shutdown and continue decay heat removal. If sufficient spent fuel or fuel in the core were damaged, and if the fuel was highly radioactive, the potential releases of radioactive material could result in offsite doses that exceed the limits established in 10 CFR Part 100. If the damaged equipment was associated with redundant safe shutdown paths, the capability to achieve safe shutdown might be defeated. Additionally, if a fuel of sufficient enrichment was dropped and the configuration was crushed, the normal boron concentrations that are maintained may not be sufficient to prevent criticality (NRC 1980).

The results of a licensee's analysis of the control of heavy loads, as delineated in NUREG-0554 (NRC 1979) and supplemented by the identified alternatives specified in NUREG-0612 (NRC 1980), can have a major impact on the cask handling capabilities at that reactor. Because of their relative importance to many of the assessments reviewed in this study, a brief historical summary of the guidelines used in these analyses is presented in Section 4.1. The results of the data review and the assessments of each reactor's spent fuel shipping cask handling capabilities are presented in Section 4.2.

4.1 HISTORICAL SUMMARY OF SELECTED GUIDELINES FOR THE CONTROL OF HEAVY LOADS BY NRC LICENSEES[a]

The control of heavy loads such as spent fuel casks must be accomplished in compliance with applicable regulations, guides, and standards. In this subsection, a brief summary is presented on the history of the control of heavy loads at commercial nuclear power plants. Regulations and guidelines for the control of heavy loads are dynamic; the Nuclear Regulatory Commission (NRC) policy relating to the control of heavy loads at LWRs, for example, has been evolving and changing in recent years. These changes have had and are having an impact on activities involving the movement and control of spent fuel casks by NRC licensees. In addition, as a result of requested regulatory analyses, some utilities have found that they must perform plant-specific modifications to their heavy-load handling systems, including their cask handling systems, and/or their operating procedures prior to use.

4.1.1 Historical Summary of the Guidelines for Analyses of Postulated Heavy Load Drops for NRC Licensees

Both the NRC and the nuclear power utilities are concerned about the potential consequences of a heavy load drop (e.g., a spent fuel cask) at commercial nuclear power plants. In earlier licensing reviews, the extent to which the potential for accidental load drops had been considered varied from plant to plant, with plants undergoing current licensing reviews receiving the

(a) The brief history discussed in this section is based on information contained in NUREG-0612 (NRC 1980), and NUREG-0828 (NRC 1983).

most thorough reviews. Some older plants have received little attention in this area. In recognition of this, Generic Technical Activity A-36 was established by the NRC in 1978 to systematically examine staff licensing criteria and the adequacy of measures then in effect at operating plants, and to recommend necessary changes to assure the safe handling of heavy loads once a plant becomes operational.

With the increased spent fuel storage capacities at many operating plants (primarily in the form of increased density of fuel storage within the pool), the potential for a given load causing damage to a large number of fuel assemblies has increased. Additionally, when offsite waste repositories are established, the handling of spent fuel casks over the spent fuel pools and near spent fuel assemblies will occur more frequently. Because of this, the need to complete Task A-36 expeditiously was identified in 1978 and culminated in January 1980 with publication of NUREG-0612, which contains guidelines for the control of heavy loads at nuclear power plants. The guidelines proposed in NUREG-0612 include definition of safe load paths, use of load handling procedures, training of crane operators, guidelines on slings and special lifting devices, periodic inspection and maintenance for the crane, as well as various alternatives that include the following:

- use of a single-failure-proof handling system,
- use of mechanical stops or electrical interlocks to keep heavy loads away from fuel or safe shutdown equipment,
- analyzing the consequences of postulated heavy load drops to show they are within acceptable limits.

Included in the resolution of Task A-36 was an evaluation of the existing criteria in Regulatory Guides and Standard Review Plans to determine the changes required to incorporate the guidelines developed in the task study that would be appropriate for new plants.

Certain of the alternative approaches suggested by the guidelines call for analyses of postulated load drops for a specific plant. These analyses may include an analysis of a spent fuel shipping cask drop or the drop of a reactor vessel head. In those cases where a licensee elected to perform a heavy load analysis and to subsequently implement actual physical changes to various reactor systems, changes to the plant's technical specifications also had to be considered.

In summary, guidelines developed in NUREG-0612 offer various alternatives to licensees to assure the safe handling of heavy loads. These "Recommended Guidelines" include general guidelines for all facilities to reduce the potential for the uncontrolled movement of a load or a load drop by calling for: the definition of safe load paths; development of load handling procedures, periodic inspection and testing of the crane; qualifications, training and specified conduct of the crane operator; and use of guidelines on rigging. The guidelines also define various acceptable alternative approaches for the containment building, refueling building and other safety-related areas. These alternatives may include using a single-failure-proof handling system, analyzing the effects of a load drop, or using procedures and interlocks to keep loads away from spent fuel and safe shutdown equipment.

The NRC subsequently recommended a program to review operating plants along the guidelines delineated in NUREG-0554 (NRC 1979) and NUREG-0612. This was initiated via two related generic letters directed to all licensees. The regulatory process that followed issuance of the generic letters is discussed briefly in the following subsection. As previously mentioned, the impact of the NUREG-0612 guidelines emerged as a major factor in licensees' planning for spent fuel shipments.

4.1.2 Additional Guidance on the Control of Heavy Loads via Generic Letter 81-07[a]

By Generic Letter 81-07 (NRC 1981) dated December 22, 1980, the NRC provided several recommendations to be implemented by licensees to ensure the safe handling of heavy loads. Generic Letter 81-07, dated February 3, 1981, regarding control of heavy loads provided further staff guidance on submittal of supplemental information.

Verification by the licensees that the risk associated with load-handling failures at their nuclear power plants is extremely low requires a systematic evaluation of all load-handling systems at each site. Not all of these evaluations have been completed. The following general information was provided to assist the licensees in their evaluation of risk associated with the control of heavy loads (NRC 1981).

Risk reduction can be demonstrated by either of two approaches:

- The likelihood of failure is made extremely low through enhanced handling-system design features (NUREG 0612, Section 5.1.6).
- The consequences of a failure can be shown to be acceptable (NUREG 0612, Section 5.1, Criteria I-IV).

Regardless of the approach selected, the seven general guidelines of NUREG 0612, Section 5.1.1., should be satisfied to provide maximum practical defense-in-depth. These guidelines are discussed in greater detail in Section 4.2.2 of this report.

(a) Generic letters are issued by the U.S. NRC Office of Nuclear Reactor Regulation, Division of Licensing. They are utilized to transmit information to, and obtain information from, reactor licensees, applicants, and/or equipment suppliers regarding matters of safety, safeguards, or environmental significance. Generic letters usually either 1) provide information thought to be important in assuring continued safe operation of facilities, or 2) request information on a specific schedule that would enable regulatory decisions to be made regarding the continued safe operation of facilities. They have been a significant means of communicating with licensees on a number of important issues, the resolutions of which have contributed to improved quality of design and operation.

A defense-in-depth approach was used to develop the NRC guidelines to ensure that all heavy load handling systems are designed and operated so that their probability of failures is appropriately small. Verification of the extent to which these general guidelines have been satisfied by licensees for their cask handling cranes form an important aspect in the overall assessments reviewed in this task. Details are provided in Section 4.2.

The complexities that could be faced by licensees in complying with the requirements of Generic Letter 81-07 (NRC 1981) are indicated by the following example taken from NUREG-0828 (NRC 1981):

> "By letters dated June 10, 1981, July 1, 1981, and September 23, 1981, the licensee responded to the generic letters. By letter dated July 2, 1982, the staff forwarded a draft Technical Evaluation Report (TER) on this issue to the licensee. The TER was prepared by Franklin Research Center (FRC) under contract to the staff. By letter dated January 28, 1983, the licensee responded to the TER and the responses are now under staff review. The review of control of heavy loads was divided into two phases by the staff. The first phase included the staff guidance dealing with administrative controls such as safe load paths and procedures. The TER dealt with the first-phase review. Phase two of the staff review includes staff guidance on hardware modifications to systems such as the containment crane. The information already provided by the licensee addresses both phases. Phase two of the staff's review of the licensee's plant has just begun and is being conducted by FRC under staff contract. As the licensee indicated, resolution of the administrative control aspects of this issue is nearly complete. However, as indicated in the submittal of June 1, 1983, the licensee anticipates that the staff may require hardware modifications to the containment crane, such as interlocks, to prevent crane travel over certain areas. The licensee indicated that several crane modifications, including interlocks, have been considered. None of the modifications were found to be cost effective. Accordingly, the licensee will submit an evaluation justifying this position in November 1983.
>
> The staff cannot draw conclusions on all possible modifications that might be identified in the second phase of the review. However, the crane must travel to all parts of the reactor deck and load area to perform various necessary tasks. Therefore, interlocks may be elaborate, and/or frequent overrides of the interlocks might occur (accompanied by elaborate plant procedures for overrides). Therefore, the staff believes that installation of travel interlocks on the containment crane may not significantly improve plant safety. A final determination cannot be made until the second phase of the review is completed."

No attempt is made to judge whether or not the elapsed time for review illustrated in the preceding example is typical. In the example case, however, it can be seen that the review process has not yet been completed after nearly three years. For those responsible for the planning and preparation phase of a spent fuel shipping campaign, cognizance of the complexities of the process for qualifying heavy load handling facilities is obviously an important consideration. Other considerations of interest to the planner are presented in Section 5.0 of this report.

In addition, it should be recognized that the criteria in NUREG-0612 also apply to applicants for operating licenses. Such applicants are expected to provide the information requested by Item 1 of Generic Letter 81-07 and to meet the same schedules of implementation as indicated in Item 2 of Generic Letter 81-07. Furthermore, Generic Letter 81-07 states:

> "Any item for which the implementation date is prior to the expected date of issuance of an operating license will be considered to be a prerequisite to obtaining that license."

4.2 RESULTS OF THE DATA REVIEW OF CASK HANDLING CAPABILITIES

In response to the DOE's 1983 Utility Spent Fuel Data Verification Forms (USFDVFs), licensees submitted various details related to cask load handling operations at their facilities. This information was to be provided by the licensees in the form of answers to plant-specific questions contained in the following sections of the USFDVFs:

- §3.0 Spent Fuel Storage Pool Characteristics
- §7.0 Spent Fuel Shipments (Past and Future)
- §8.0 Spent Fuel Shipping Cask Data

Many of the forms received did not provide sufficient information in these sections, thus necessitating follow-up telephone calls to utility representatives. The purpose of the telephone calls was both to verify the information received and to solicit additional information associated with cask handling capabilities. The cask handling capabilities of the 27 selected LWRs examined in this study are presented in Table 4.1. The results of this assessment

TABLE 4.1. Summary of the Cask Handling Capabilities of the 27 Selected LWRs Examined in This Study

Docket No. 50-	Utility and Plant(s)	Cask Handling Capability[a] LWT	OWT	Rail
	Baltimore Gas and Electric Co.			
-317 & -318	• Calvert Cliffs 1 & 2 (Lusby, Md)	X	Unk[b]	
	Boston Edison Co			
-293	• Pilgrim 1 (Plymouth, MA)	X	Unk	
	Carolina Power and Light			
-325 & -324	• Brunswick 1 & 2 (Southport, NC)	X	X	X
-261	• Robinson 2 (Hartsville, SC)	X	X	X
	Commonwealth Edison Company			
-454 & -455	• Byron 1 & 2 (Byron, IL)	X	X	X
-373 & -374	• LaSalle 1 & 2 (Seneca, IL)	X	X	X
	Consumers Power Co.			
-255	• Palisades (South Haven, MI)	X	Unk	
	Duke Power Co.			
-287	• Oconee 3 (Seneca, SC)	X	X	
	Florida Power and Light Co.			
-250 & -251	• Turkey Point 3 & 4 (Florida City, FL)	X	--[c]	
-335	• St. Lucie 1 (Hutchinson Island, FL)	X	--[c]	
	GPU Nuclear Corporation			
-219	• Oyster Creek (Forked River, NJ)	X	X	
	Northeast Utilities			
-245 & -336	• Millstone 1 & 2 (Waterford, CT)	X	X	X
	Northern States Power Company			
-263	• Monticello (Monticello, MN)	X	X	X
-282 & -306	• Prairie Island 1 & 2 (Red Wing, MN)	X	Unk	X
	Philadelphia Electric Company			
-277 & -278	• Peach Bottom 2 & 3 (Peach Bottom, PA)	X	Unk	
	Power Authority of the State of New York			
-333	• James A. FitzPatrick (Scribs, NY)	X	X	X
	Rochester Gas and Electric Corporation			
-244	• Robert E. Ginna (Ontario, NY)	X	X	
	Virginia Electric and Power Company			
-280 & -281	• Surry 1 & 2 (Gravel Neck, VA)	X	X	

(a) LWT = Legal Weight truck; OWT = Overweight truck.
(b) Unk = Unknown due to unavailability of verifiable data at this time.
(c) The technical specifications currently limit the cask type to a single-element cask and the cask weight to a 25-ton limit.

indicate that 48% of the plants have rail access and 59% are judged to be candidates for overweight truck shipments (with 8 unknowns due to unavailability of verifiable data).

Summaries of the plant-specific information collected during this task (from all sources) are presented in subsection 4.2.1. Assessments of the cask handling capabilities of the 27 selected reactors utilized in this study were based on this information and are discussed in subsection 4.2.2.

4.2.1 Summaries of Plant-Specific Information

Summaries of the plant-specific information associated with the cask handling capabilities of the 27 selected reactors are presented in matrix form in Table 4.2. In addition to the licensee data that were collected and verified, data were extracted from available Technical Evaluation Reports (TERs) on control of heavy loads developed for the NRC by the Franklin Research Center. A discussion of the assessment data shown in the matrix follows.

4.2.2 Cask Handling Capabilities Assessments

Assessments of the cask handling capabilities of the 27 selected LWRs are discussed in this subsection. These reviews focus primarily on onsite physical parameters.

The NRC has established seven general guidelines that must be followed to provide a defense-in-depth approach for the handling of heavy loads at nuclear reactor sites. These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

- Guideline 1 - Safe Load Paths
- Guideline 2 - Load Handling Procedures
- Guideline 3 - Crane Operator Training
- Guideline 4 - Special Lifting Devices
- Guideline 5 - Lifting Devices (Not Specially Designed)
- Guideline 6 - Cranes (Inspection, Testing, and maintenance)
- Guideline 7 - Crane Design.

TABLE 4.2. Heavy Load (Spent Fuel Shipping Cask) Handling Capability Assessments Matrix for 27 Selected LWRs Utilized in this Study

							NUREG-0612 Compliance Matrix(b,c)										Experience				Facility Handling Transport Feasibility(e)				
Docket No. 50-xxx	Utility and Plants	Net MWe	Type	Loses Fuel Core Reserve, Year(a)	Spent Fuel Cask Crane Weight or Capacity, Tons--Original Nameplate Rating	Spent Fuel Cask Weight Limit or Capacity Tons	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention	Licensee Substantially Does or Will Comply with NRC Measures for Interim Protection	Historical Spent Fuel Shipments	Cask Type Used(d)	Preferred Cask Type(h)	Current Spent Fuel Cask Status(d)	By Rail (• Means Nearest RR is Onsite)	By Overweight Truck (OWT)	By Barge	Limitations(e)	Shares a Common Storage Pool(f)
	Baltimore Gas and Electric Company																								
-317	• Calvert Cliffs 1 (Lusby, MD)	825	PWR	1993	150	(i)	C	--	P	--	--	--	--	--	--	Yes	Yes	"C" &	"D"	None	No	UNK	Yes	(i)	IPTC
-318	• Calvert Cliffs 2 (Lusby, MD)	825	PWR	1993	(h)	(i)	C	--	P	--	--	--	--	--	--	Yes	Yes	"D"	"D"	None	No	UNK	Yes	(i)	IPTC
	Boston Edison Company																								
-293	• Pilgrim 1 (Plymouth, MA)	670	BWR	1991	100												No	None	"N"	None	No	UNK	Yes	NK	SR
	Carolina Power and Light																								
-325	• Brunswick 1 (Southport, NC)	790	BWR	1991	125		C	C	--	C	--	--	--	C	--	Yes	Yes	"C","D"	"E"	Company	Yes•	Yes	No	(t)	No
-324	• Brunswick 2 (Southport, NC)	790	BWR	1990	125		C	C	--	C	--	--	--	C	--	Yes	Yes	& "E"	"E"	owns	Yes•	Yes	No	(t)	No
-261	• Robinson 2 (Hartsville, SC)	665	PWR	1990	125		--	--	C	--	--	C	C	--	--	Yes	Yes		"E"	one "E"	Yes•	Yes	No	(u)	SR
	Commonwealth Edison Company																								
-454	• Byron 1 (Byron, IL)	1120	PWR	1994	125												No	None	"N"	Leases	Yes•	Yes	No	NK	Yes
-455	• Byron 2 (Byron, IL)	1120	PWR	1994	(h)												No	None	"N"	two "Bs,"	Yes•	Yes	No	NK	Yes
-373	• LaSalle 1 (Seneca, IL)	1080	BWR	1990	125		C	C		I						Yes	No	None	"N"	owns one	Yes•	Yes	Yes	NK	IPTC
-374	• LaSalle 2 (Seneca, IL)	1080	BWR	1990	(h)		C	C		I						I	No	None	"N"	"G"	Yes•	Yes	Yes	NK	IPTC
	Consumers Power Company																								
-255	• Palisades (South Haven, MI)	740	PWR	1987	100	25	--	--	C	--	--	C	C	C	--	Yes	No	None	"C"	None	No(p)	UNK	Yes	(v)	SR
	Duke Power Company																								
-287	•Oconee 3 (Seneca, SC)	886	PWR	1987	100		--	C	C	--	--	C	C	C	--	Yes	Yes	"C"&"D"	"F"	Company owns	No	Yes	No	(w)	S
	Spent Fuel Cask(g)			--	--	29	C	C	--	C	C	--	--	--	--	--	--	--	--	two "A"s	--	--	--	--	--
	Florida Power and Light Company																								
-250	• Turkey Point 3 (Florida City, FL)	646	PWR	1986	105	25	R	C	--	--	--	--	--	R	--	Yes	Yes	"C"	(n)	None	No	(n)	UNK	NK	No
-251	• Turkey Point 4 (Florida City, FL)	646	PWR	1987	(h)	25	R	C	--	--	--	--	--	R	--	Yes	Yes	& "D"	(n)	None	No	(n)	UNK	NK	No
-335	• St. Lucie 1 (Hutchinson Island, FL)	890	PWR	1987	105	25											No	None	(o)	None	No	(o)	UNK	NK	No
	GPU Nuclear Corporation																								
-219	• Oyster Creek (Forked River, NJ)	620	BWR	1992	100		--	--	C	--	--	R	C	--	--	Yes	Yes	"C"(m)	"G"	None	No(q)	Yes	Yes	(x)	No
	Spent Fuel Cask(g)			--	--	30	C	C	--	R	--	--	--	C	--	Yes(k)	--	--	--	--	--	--	--	--	--
	Northeast Utilities																								
-245	• Millstone 1 (Waterford, CT)	652	BWR	1987	110		C	C	--	--	--	--	--	T	C	Yes	No	None	"N"	None	Yes•	Yes	UNK	(y)	No
-336	• Millstone 2 (Waterford, CT)	864	PWR	1993	100												Yes	"E"	"N"	None	Yes•	Yes	UNK	(z)	No
	Northern States Power Company																								
-263	• Monticello (Monticello, MN)	525	BWR	1990	85		C	R	--	R	--	--	--	C	--	Yes	Yes	"C"&"D"	"E"	None	Yes•	Yes	No	(aa)	SR
-282	• Prairie Island 1 (Red Wing, MN)	520	PWR	1992	125		--	--	C	--	--	C	C	C	--	Yes	No	None	"N"	None	Yes•	UNK	Yes	(bb)	Yes
-306	• Prairie Island 2 (Red Wing, MN)	520	PWR	1992	(h)		--	--	C	--	--	C	C	C	--	Yes	No	None	"N"	None	Yes•	UNK	Yes	(bb)	Yes
	Philadelphia Electric Company																								
-277	• Peach Bottom 2 (Peach Bottom, PA)	1051	BWR	1990	125		--	--	R	--	--	R	C	--	--	Yes	Yes	"D"	"N"	None	No(r)	UNK	No	(cc)	No
-278	• Peach Bottom 3 (Peach Bottom, PA)	1051	BWR	1990	125		--	--	R	--	--	R	C	--	--	Yes	No	None	"N"	None	No(r)	UNK	No	(cc)	No
	Spent Fuel Cask(g)			--	--	100	C	C	--	R	--	--	--	C	--	Yes(l)	--	--	--	--	--	--	--	--	--
	Power Authority of the State of New York																								
-333	• James A. FitzPatrick (Scriba, NY)	821	BWR	1991	125												No	None	"N"	None	Yes•(s)	Yes	Yes	NK	SR
	Rochester Gas and Electric Corp.																								
-244	• Robert E. Ginna (Ontario, NY)	470	PWR	1990	40	25(j)	--	--	C	--	--	R	C	C	--	Yes	Yes	"C"	LWT	None	No	Yes	No	NK	SR
	Virginia Electric and Power Company																								
-280	• Surry 1 (Gravel Neck, VA)	775	PWR	1987	125												Yes	"F"	"F"	Leases	No	Yes	Yes	(dd)	Yes
-281	• Surry 2 (Gravel Neck, VA)	775	PWR	1987	(h)												Yes	"F"	"F"	one "F"	No	Yes	Yes	(dd)	Yes

NOTE: The footnotes for this table are on the next page.

TABLE 4.2. Contd

(a) Source: Spent Fuel Storage Requirements, DOE/RL 83-1, 1983.
(b) The majority of this information was extracted from 1983 Technical Evaluation Reports (TERs) prepared by Franklin Research Center for the U.S. NRC. The TERs were conducted in accordance with criteria established by the NRC.
(c) The symbols shown have the following meanings:
   C = Licensee action is consistent with or complies NUREG-0612 Guidelines.
   R = The Licensee has proposed revisions or modifications which, when implemented, will result in load handling reliability consistent with NUREG-0612.
   -- = Not applicable.
   T = Licensee has proposed actions which are technically equivalent to the requirements of the NUREG-0612 Guidelines.
   P = Licensee information indicates partial compliance with NUREG-0612 Guideline.
   I = Insufficient information provided by the licensee (Jensen 1983).
(d) Symbols used to designate cask type follow:
   "A" = NAC-1
   "B" = NFS-4
   "C" = NAC-1/NFS-4
   "D" = NL1 1/2
   "E" = IF-300
   "F" = TN-8L
   "G" = TN-9
   LWT = Legal-Weight Truck
   "N" = No preference indicated at this time.
(e) UNK = unknown
   NK = none known
(f) Storage pool symbols are designated as follows:
   IPTC means two individual pools connected by a transfer canal.
   SR means a single reactor onsite.
   S means sharing is done with other reactor(s) onsite; however, unconnected pools require the use of casks for fuel transfers.
(g) The information contained in the Franklin Research Center TER for this reactor's spent fuel cask crane indicated two evaluations were conducted for compliance with NUREG-0612. The first evaluation was associated with general use of the crane at the indicated nameplate weight/capacity rating. The second evaluation concerned the specific use of the crane when handling a spent fuel cask with the weight limit given in the table.
(h) Shares a common crane with its sister unit.
(i) Currently limited by FSAR cask drop analysis to 25-ton class casks.
(j) An application for license amendment was submitted in early-1984 to increase this crane's heavy-load limit to 32 tons.
(k) Spent fuel cask operation will be governed by a new procedure each time with special lifting requirements applicable to that particular cask.
(l) The fuel cask yoke will be provided by the spent fuel cask supplier and will be evaluated for compliance with ASNI N14.6-1978 on a case-by-case basis.
(m) It is anticipated that a TN-9 cask will be utilized in the near future to return fuel to the reactor from the West Valley storage site.
(n) These Turkey Point units are limited by license to the use of single assembly casks with a 25-ton cask weight limit.
(o) The Technical Specifications for this reactor limit the cask type to a single-element cask and the cask weight to a 25-ton limit.
(p) The rail spur into the fuel handling building is covered with asphalt. Therefore, this unit is considered not to have rail access, although it could be renovated if the need arose.
(q) The railroad spur has been abandoned by the railroad and the tracks have been removed from the airlock and the site proper.
(r) The licensee states the railroad is currently not suitable for use.
(s) The railroad serving this site has not been used for some time (undefined).
(t) Reactor building airlock dimensions limit rail cask car length to 53 ft 8 in.
(u) In order to move the cask in and out of the fuel storage area, a roof panel and a wall panel must be removed. These panels must be in place during cask loading/unloading operations.
(v) Main SFP crane capacity has been administratively derated from 100 ton to 25 ton as a result of heavy object drop analysis. The auxiliary crane capacity is rated at 25 ton. Also, this 25 ton limit on main crane is the primary reason why the NAC-1 25 ton cask is preferred. It is estimated to take about 1-1/2 years to upgrade the crane. This is being deferred until a need is shown.
(w) The licensee judges the TN-8L cask to be the largest spent fuel cask that could be handled at this plant.
(x) The facility access doors must be closed during cask operations.
(y) Interlocking access doors must be closed during cask operations.
(z) The access doors must be closed during cask operations.
(aa) The access doors must be closed during cask operations, and a car puller is used to position the cask.
(bb) From March 1 through April 30, there are truck per axle weight restrictions because of road frost-heave concerns.
(cc) A car puller is used to move cask trailers in the fuel handling facility.
(dd) Units 1 and 2 have single access doors which must be closed during cask operations.

Criteria specified in these seven guidelines should be satisfied by all overhead handling systems and programs for handling heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems.

The licensee's verification of the extent to which the seven general guidelines have been satisfied for the plant's spent fuel cask handling crane(s) are contained in independent technical evaluations--the TERs. The available TERs were obtained and reviewed for the plants of interest to this study. They contained a point-by-point evaluation of the heavy load handling provisions of interest. Conclusions drawn as to the extent of the licensees' compliance are given in Table 4.2, together with other information of interest to plant assessments.

From the data shown in Table 4.2 it can be seen that 13 of 27 plants (48%) have rail access, and 16 of 27 plants (59%) are judged candidates for overweight truck shipments (with 8 unknowns). Only 12 of 27 plants (44%) may be capable of intermodal spent fuel shipments via barge. The past experiences of the licensees in the handling and movement of spent fuel casks were also determined in this review. Ten of 14 utilities (71%), representing 15 reactors, have previously made spent fuel shipments from at least some of their reactor plants. This experience with specific cask types is judged to be an important aspect of the plant-specific cask handling capabilities.

In summary, it appears that future cask handling and movement operations will be directly tied to the guidelines previously discussed in subsection 4.1. If a licensee does not meet these criteria (or, as a minimum, the interim criteria delineated in NUREG-0612, it is assumed that the plant's cask handling capabilities could be questionable. Licensees that do not meet the criteria would have to resolve outstanding questions and make appropriate technical specification changes/amendments before a spent fuel shipping campaign could commence. It is assumed further that technical specification changes/amendments required for compliance with these criteria at some future date would directly affect the final assessment of the licensee's cask handling capabilities.

4.2.3 Intermodal Spent Fuel Shipments via Barge

As previously mentioned, only 12 of 27 plants (44%) may be capable of intermodal spent fuel shipments via barge. None of the utility representatives contacted indicated that they are seriously considering this alternative at the present time. Only one representative indicated a study of this shipment mode had been done, while the remaining representatives indicated an in-depth study would be necessary. Thus, it is judged that more meaningful information could be obtained only by a comprehensive analysis of each reactor with the complete cooperation of the owner. Such analyses were beyond the scope of this study.

To date, barge transport has not been employed for commercial spent fuel shipments in the U.S. In general, the primary drawback to water shipment is the slow transit time. The obvious advantage of this shipment mode is the greater weight that can be transported. Compared to both rail and truck transport, weight limits for barge transportation are unrestrictive. Heavy haul[a] techniques between the reactor site and the barge landing can be simplified over what has been considered as conventional heavy hauling approaches. This is especially true if the barge landing is on the reactor site, since no commercial roads would be used. Consequently, the cost-effectiveness of the intermodal aspects at both the shipping and receiving ends of the transportation route may have to be determined. The licensee would probably be required to prepare a safety evaluation that would form the basis for concluding that the cask handling can be carried out in a safe manner. It is also reasonable to expect the safety evaluation to include the same level of defense-in-depth delineated in NUREG-0612, including retrieval plans should the barge sink. This latter consideration of course, may become an issue of public concern and debate in the current environmental climate.

(a) Heavy-haul is the transport of oversize and/or overweight objects by truck where special equipment is required.

Additional advanced preparations would be required at a reactor site prior to beginning a spent fuel shipping campaign utilizing barge transportation. Industry experience has shown that without exception both a site survey for interface compatibility and a dry run of cask operations are absolute necessities before making any attempt to handle fuel.

5.0 OBSERVATIONS AND COMMENTS

Because spent fuel shipping campaigns encompass activities that are relatively new to many utilities or because they are not frequent occurrences, substantial preparation is required. In addition, even after each campaign, operations should be reviewed to determine if improvements in cask handling efficiency can be made.

Problems associated with cask interfacing could probably be expected at almost every reactor facility that does not have previous spent fuel cask handling experience. For example, operations experience reported by Nuclear Assurance Corporation (NAC 1978) indicates that in many cases, the first entry of the cask into the plant resulted in the discovery of some unexpected problem or need. Therefore, licensees are encouraged to engage in dry runs and checkout operations designed to identify problems before they have an opportunity to interfere with a shipping campaign. The importance of dry runs is stressed by others as well. Kunita and Wallace (1978) advise that even if no problems or interferences are discovered, the hands-on training gained by plant personnel who will perform the cask-handling tasks during shipments is well worth the time spent on the dry run. Kunita and Wallace concluded that a significant learning curve exists for fuel handling activities.

In addition, some of the utilities are in various stages of assessing and/or implementing various plans designed to expand their spent fuel storage capacities. These plans may include 1) physical changes associated with the spent fuel storage pool itself, 2) studies of spent fuel rod consolidation, or 3) preparations for participation in government-sponsored rod consolidation or dry cask storage demonstration programs. Therefore, it should be recognized that the cask handling capabilities assessments presented previously in this report essentially represent "snap-shots" in time and could be subject to change as plants continue to analyze their capabilities. It should be further recognized that future spent fuel shipping campaigns requiring handling and movement of heavy loads, such as the currently available shipping casks, are inextricably tied to the guidelines previously discussed in Subsection 4.1. It appears that the full impact (i.e., incremental cost and time elements) associated with implementing many of these guidelines are yet to be felt by the industry.

This report examined one end of the cask handling transportation function at 27 selected reactors. These facilities will remain essentially unchanged, since the way they are designed and constructed leaves little room for modification or introduction of new concepts. The size of the invested capital, the relatively low priority of fuel transport, and the licensing risks associated with facility modification make it unlikely that these existing plants will undergo anything more than evolutionary-type changes. On the other hand, the spent fuel receiving and handling facilities, which are yet to be built, present an opportunity to implement new cask handling concepts.

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APPENDIX A

REACTOR SITE DATA FOR TWENTY-SEVEN SELECTED REACTORS

APPENDIX A

REACTOR SITE DATA FOR TWENTY-SEVEN SELECTED REACTORS

This appendix contains summary data of cask handling capabilities and limitations for each reactor plant utilized in this study. Data is also included regarding identification of the nearest railroad and navigable waterway for each site, where applicable. It should be recognized that the information applies to the site. Offsite transportation limitations are not explicitly included. In addition, where the feasibility of a specific transport mode is stated as unknown, it means exactly that. No judgment regarding eventual feasibility or infeasibility is implied, since, in most cases, the utility respondent indicated further study was required.

UTILITY: Baltimore Gas and Electric Company

PLANT NAME(S): Calvert Cliffs 1 & 2

NRC DOCKET NUMBER(S): 50-317 and 50-318

LOCATION: Lusby, Maryland

REACTOR TYPE: PWR and PWR, respectively

RATING:(a) 825 & 825 MWe, respectively

NEAREST R.R.: 40 miles
    Rail Spur on Site: No
    Rail Spur Extends into Cask Loading Bay:
Comments:

CASK HANDLING CAPABILITY:

    Share Pool:(b) Yes--B
    Preferred Cask: NLI-1/2; experienced with NAC-1/NFS-4 & NLI-1/2
    Cask Crane Capacity, tons: 150
    Crane Height, ft:(c) 35
    Pool Depth, ft:(d) 41
    Pool Width, ft:(d) 9
    Pool Length, ft:(d) 11
    Legal Truck: Yes
    Overweight Truck: Unknown
Comments: Calvert Cliffs 1 & 2 each had a cask well in their respective Spent Fuel Pools but used the cask well space in one during reracking. They judge to only need one cask well.

CASK HANDLING LIMITATIONS: Currently limited by FSAR cask drop analysis to 25-ton class casks.

NEAREST NAVIGABLE WATER: Chesapeake Bay
    Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
    B indicates pools connected by transfer canal.
    C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Boston Edison Company

PLANT NAME(S): Pilgrim 1

NRC DOCKET NUMBER(S): 50-293

LOCATION: Plymouth, Massachusetts

REACTOR TYPE: BWR

RATING:[(a)] 670 MWe

NEAREST R.R.: 10 miles
Rail Spur on Site: No
Rail Spur Extends into Cask Loading Bay:
Comments:

CASK HANDLING CAPABILITY:

Share Pool:[(b)] No
Preferred Cask: No preference indicated at this time
Cask Crane Capacity, tons: 100
Crane Height, ft:[(c)] 23
Pool Depth, ft:[(d)] 39
Pool Width, ft:[(d)] 7
Pool Length, ft:[(d)] 10
Legal Truck: Yes
Overweight Truck: Unknown
Comments:

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Cape Cod Bay
Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Carolina Power and Light Company

PLANT NAME(S): Brunswick 1 & 2

NRC DOCKET NUMBER(S): 50-325 & 50-324, respectively

LOCATION: Southport, North Carolina

REACTOR TYPE: BWR and BWR, respectively

RATING:[(a)] 790 & 790MWe, respectively

NEAREST R.R.: Seaboard Coastline, U.S. Government RR
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes, for each BWR.
Comments: For each BWR, the respective reactor building airlock dimensions limit rail cask car length to 53 ft 8 in.

CASK HANDLING CAPABILITY: The data given below is the same at each of the BWR plants.

Share Pool:[(b)] No
Preferred Cask: IF-300; experienced with NAC-1/NFS-4 & NLI-1/2
Cask Crane Capacity, tons: 125
Crane Height, ft:[(c)] 28.2
Pool Depth, ft:[(d)] 38.8
Pool Width, ft:[(d)] 10.3
Pool Length, ft:[(d)] 10.3
Legal Truck: Yes
Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Cape Fear River, Atlantic Ocean
Barge Access Feasibility: No
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Carolina Power and Light Company

PLANT NAME(S): Robinson 2

NRC DOCKET NUMBER(S): 50-261

LOCATION: Hartsville, South Carolina

REACTOR TYPE: PWR

RATING:[a] 665 MWe

NEAREST R.R.: Seaboard Coastline
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

Share Pool:[b] No
Preferred Cask: IF-300; experienced with the IF-300
Cask Crane Capacity, tons: 125
Crane Height, ft:[c] 37.0
Pool Depth, ft:[d] 40.7
Pool Width, ft:[d] 9.0
Pool Length, ft:[d] 9.0
Legal Truck: Yes
Overweight Truck: Yes

Comments: In order to move the cask in and out of the fuel storage area, a roof panel and a wall panel must be removed. These panels must be in place during cask loading/unloading operations.

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: None
Barge Access Feasibility: No
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Commonwealth Edison Company

PLANT NAME(S): Byron 1 & 2

NRC DOCKET NUMBER(S): 50-454 & 50-455

LOCATION: Byron, Illinois

REACTOR TYPE: PWR & PWR, respectively

RATING:[a] 1120 & 1120 MWe, respectively

NEAREST R.R.: Chicago and Northwestern Trans.
    Rail Spur on Site: Yes
    Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

    Share Pool:[b] Yes--A
    Preferred Cask: NFS-4
    Cask Crane Capacity, tons: 125
    Crane Height, ft:[c] Data Unavailable
    Pool Depth, ft:[d] 40
    Pool Width, ft:[d] Data Unavailable
    Pool Length, ft:[d] Data Unavailable
    Legal Truck: Yes
    Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Rock River
    Barge Access Feasibility: No
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
    B indicates pools connected by transfer canal.
    C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Commonwealth Edison Company

PLANT NAME(S): La Salle 1 & 2

NRC DOCKET NUMBER(S): 50-373 & 50-374

LOCATION: Seneca, Illinois

REACTOR TYPE: BWR and BWR, respectively

RATING:[(a)] 1080 & 1080 MWe, respectively

NEAREST R.R.: Atchison, Topeka, Santa Fe
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

Share Pool:[(b)] Yes--B
Preferred Cask: NAC-1/NFS-4
Cask Crane Capacity, tons: 125
Crane Height, ft:[(c)] 27
Pool Depth, ft:[(d)] 44
Pool Width, ft:[(d)] 10
Pool Length, ft:[(d)] 10
Legal Truck: Yes
Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Illinois River
Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Consumers Power Company

PLANT NAME(S): Palisades

NRC DOCKET NUMBER(S): 50-255

LOCATION: South Haven, Michigan

REACTOR TYPE: PWR

RATING:[a] 740 MWe

NEAREST R.R.: C&O
    Rail Spur on Site: No
    Rail Spur Extends into Cask Loading Bay:
Comments: The rail spur into the fuel handling building is covered with asphalt, therefore, this unit is considered not to have rail access, although it could be renovated if the need arose.

CASK HANDLING CAPABILITY:

    Share Pool:[b] No
    Preferred Cask: NAC-1
    Cask Crane Capacity, tons: 100
    Crane Height, ft:[c] 27.0
    Pool Depth, ft:[d] 40.6
    Pool Width, ft:[d] 3.7
    Pool Length, ft:[d] 3.7
    Legal Truck: Yes
    Overweight Truck: Unknown
Comments:

CASK HANDLING LIMITATIONS: Main SFP crane capacity has been administratively derated from 100 tons to 25 tons as a result of heavy object drop analysis. The 25 ton limit on main crane is the primary reason why the NAC-1 cask is preferred. It is estimated to take about 1-1/2 years to upgrade the crane. This is being deferred until a need is shown.

NEAREST NAVIGABLE WATER: Lake Michigan
    Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
    B indicates pools connected by transfer canal.
    C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Duke Power Company

PLANT NAME(S): Oconee 3

NRC DOCKET NUMBER(S): 50-287

LOCATION: Seneca, South Carolina

REACTOR TYPE: PWR

RATING:(a) 886 MWe

NEAREST R.R.: Southern (6 miles)
Rail Spur on Site: No
Rail Spur Extends into Cask Loading Bay:
Comments:

CASK HANDLING CAPABILITY:

Share Pool:(b) No
Preferred Cask: TN-8L; experienced with NAC-1/NFS-4 & NLI-1/2
Cask Crane Capacity, tons: 100
Crane Height, ft:(c) 23.8
Pool Depth, ft:(d) 44
Pool Width, ft:(d) 7.2
Pool Length, ft:(d) 8.9
Legal Truck: Yes
Overweight Truck: Yes
Comments: The licensee judges the TN-8L cask to be the largest spent fuel cask that could be handled at this plant.

CASK HANDLING LIMITATIONS: The spent fuel cask weight limit or capacity is currently limited to 29 tons.

NEAREST NAVIGABLE WATER: None
Barge Access Feasibility: No
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Florida Power and Light Company

PLANT NAME(S): Turkey Point 3 & 4

NRC DOCKET NUMBER(S): 50-250 and 50-251

LOCATION: Florida City, Florida

REACTOR TYPE: PWR & PWR, respectively

RATING:(a) 646 & 646 MWe, respectively

NEAREST R.R.: Florida East Coast RR
Rail Spur on Site: No
Rail Spur Extends into Cask Loading Bay:
Comments:

CASK HANDLING CAPABILITY: The data given below is the same at each of the PWR plants.

Share Pool:(b) No
Preferred Cask: Truck, single assembly; experienced with NAC-1/NFS-4 & NLI-1/2
Cask Crane Capacity, tons: 105
Crane Height, ft:(c) 9.4
Pool Depth, ft:(d) 40.4
Pool Width, ft:(d) 9.8
Pool Length, ft:(d) 10.1
Legal Truck: Yes
Overweight Truck: Unknown
Comments:

CASK HANDLING LIMITATIONS: These Turkey Point units are limited by license to the use of single assembly casks with a 25-ton cask weight limit.

NEAREST NAVIGABLE WATER: Biscayne Bay
Barge Access Feasibility: Unknown
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Florida Power and Light Company

PLANT NAME(S): St. Lucie 1

NRC DOCKET NUMBER(S): 50-335

LOCATION: Hutchinson Island, Florida

REACTOR TYPE: PWR

RATING:[a] 890 MWe

NEAREST R.R.:
- Rail Spur on Site: No
- Rail Spur Extends into Cask Loading Bay:

Comments:

CASK HANDLING CAPABILITY:

- Share Pool:[b] No
- Preferred Cask: Truck; single fuel assembly
- Cask Crane Capacity, tons: 105
- Crane Height, ft:[c] 46.0
- Pool Depth, ft:[d] 41.2
- Pool Width, ft:[d] 10.0
- Pool Length, ft:[d] 12.0
- Legal Truck: Yes
- Overweight Truck: Unknown

Comments:

CASK HANDLING LIMITATIONS: The spent fuel cask weight limit or capacity is currently limited to 25 tons.

NEAREST NAVIGABLE WATER: Intercoastal Waterway (Indian River)
- Barge Access Feasibility: Unknown

Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Jersey Central Power and Light Company

PLANT NAME(S): Oyster Creek

NRC DOCKET NUMBER(S): 50-219

LOCATION: Forked River, New Jersey

REACTOR TYPE: BWR

RATING:[a] 620 MWe

NEAREST R.R.:
Rail Spur on Site: No
Rail Spur Extends into Cask Loading Bay:
Comments: The railroad spur has been abandoned by the railroad and the tracks have been removed from the airlock and the site proper.

CASK HANDLING CAPABILITY:

Share Pool:[b] No
Preferred Cask: TN-9 & NAC-1/NFS-4; experienced with NAC-1/NFS-4
Cask Crane Capacity, tons: 100
Crane Height, ft:[c] 24.0
Pool Depth, ft:[d] 96.0
Pool Width, ft:[d] 27.0
Pool Length, ft:[d] 39.0
Legal Truck: Yes
Overweight Truck: Yes
Comments: The Spent Fuel Pool (SFP) has no cask "well." A 153 ft^2 area is set aside in the SFP for cask handling operations.

CASK HANDLING LIMITATIONS: The spent fuel cask weight limit or capacity is currently limited to 30 tons.

NEAREST NAVIGABLE WATER: Atlantic Ocean, Barnegat Bay
Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Northeast Utilities

PLANT NAME(S): Millstone 1

NRC DOCKET NUMBER(S): 50-245

LOCATION: Waterford, Connecticut

REACTOR TYPE: BWR

RATING:[(a)] 652 MWe

NEAREST R.R.: CONRAIL
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

Share Pool:[(b)] No
Preferred Cask: No preference indicated at this time
Cask Crane Capacity, tons: 110
Crane Height, ft:[(c)] 22
Pool Depth, ft:[(d)] 38.8
Pool Width, ft:[(d)] 30.5
Pool Length, ft:[(d)] 40.3
Legal Truck: Yes
Overweight Truck: Yes
Comments: The Spent Fuel Pool (SFP) has no cask "well." A 53 ft^2 area is set aside in the SFP for cask handling operations.

CASK HANDLING LIMITATIONS: Interlocking access doors must be closed during cask operations.

NEAREST NAVIGABLE WATER: Long Island Sound (Niantic Bay) onsite
Barge Access Feasibility: Unknown
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Northeast Utilities

PLANT NAME(S): Millstone 2

NRC DOCKET NUMBER(S): 50-336

LOCATION: Waterford, Connecticut

REACTOR TYPE: PWR

RATING:(a) 864 MWe

NEAREST R.R.: CONRAIL
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

Share Pool:(b) No
Preferred Cask: No preference indicated at this time
Cask Crane Capacity, tons: 100
Crane Height, ft:(c) 25
Pool Depth, ft:(d) 38.5
Pool Width, ft:(d) 9
Pool Length, ft:(d) 9
Legal Truck: Yes
Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS: The access doors must be closed during cask operations.

NEAREST NAVIGABLE WATER: Long Island Sound (onsite)
Barge Access Feasibility: Unknown
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Northern States Power Company

PLANT NAME(S): Monticello

NRC DOCKET NUMBER(S): 50-263

LOCATION: Monticello, Minnesota

REACTOR TYPE: BWR

RATING:[a] 525 MWe

NEAREST R.R.: Great Northern
  Rail Spur on Site: Yes
  Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

  Share Pool:[b] No
  Preferred Cask: IF-300; experienced with NAC-1/NAC-4 & NLI-1/2
  Cask Crane Capacity, tons: 85
  Crane Height, ft:[c] 24
  Pool Depth, ft:[d] 39.0
  Pool Width, ft:[d] 6.0
  Pool Length, ft:[d] 9.0
  Legal Truck: Yes
  Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS: The access doors must be closed during cask operations, and a car puller is used to position the cask.

NEAREST NAVIGABLE WATER: Mississippi River
  Barge Access Feasibility: No
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
  B indicates pools connected by transfer canal.
  C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Northern States Power Company

PLANT NAME(S): Prairie Island 1 & 2

NRC DOCKET NUMBER(S): 50-282 and 50-306

LOCATION: Red Wing, Minnesota

REACTOR TYPE: PWR and PWR, respectively

RATING:[(a)] 520 & 520 MWe, respectively

NEAREST R.R.: Chicago, Milwaukee, and St. Paul
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments:

CASK HANDLING CAPABILITY:

Share Pool:[(b)] Yes--A
Preferred Cask: No preference indicated at this time
Cask Crane Capacity, tons: 125
Crane Height, ft:[(c)] 36
Pool Depth, ft:[(d)] 41.5
Pool Width, ft:[(d)] 12
Pool Length, ft:[(d)] 13
Legal Truck: Yes
Overweight Truck: Unknown
Comments:

CASK HANDLING LIMITATIONS: From March 1 through April 30, there are truck per axle weight restrictions because of road frost-heave concerns.

NEAREST NAVIGABLE WATER: Mississippi River (dam downstream with locks)
Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Philadelphia Electric Company

PLANT NAME(S): Peach Bottom 2 & 3

NRC DOCKET NUMBER(S): 50-277 and 50-278

LOCATION: Peach Bottom, Pennsylvania

REACTOR TYPE: BWR & BWR, respectively

RATING:[(a)] 1051 & 1035 MWe, respectively

NEAREST R.R.:

Rail Spur on Site: No

Rail Spur Extends into Cask Loading Bay: No

Comments: The licensee states the railroad is currently <u>not</u> suitable for use.

CASK HANDLING CAPABILITY: The data given below is the same at each of the BWR plants.

Share Pool:[(b)] No

Preferred Cask: No preference indicated for either reactor at this time

Cask Crane Capacity, tons: 125

Crane Height, ft:[(c)] 32.0

Pool Depth, ft:[(d)] 39.0

Pool Width, ft:[(d)] 9.0

Pool Length, ft:[(d)] 9.0

Legal Truck: Yes

Overweight Truck: Unknown

Comments: At each reactor plant, a car puller is used to move cask trailers in the fuel handling facility.

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Susquehanna River

Barge Access Feasibility: Unknown

Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.

(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.

(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.

(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Power Authority of State of New York

PLANT NAME(S): Fitzpatrick

NRC DOCKET NUMBER(S): 50-333

LOCATION: Scribs, New York

REACTOR TYPE: BWR

RATING:[a] 821 MWe

NEAREST R.R.: CONRAIL
Rail Spur on Site: Yes
Rail Spur Extends into Cask Loading Bay: Yes
Comments: The railroad serving this site has not been used for some time (undefined).

CASK HANDLING CAPABILITY:

Share Pool:[b] No
Preferred Cask: No preference indicated at this time
Cask Crane Capacity, tons: 125
Crane Height, ft:[c] 40
Pool Depth, ft:[d] 39
Pool Width, ft:[d] 12
Pool Length, ft:[d] 14
Legal Truck: Yes
Overweight Truck: Yes
Comments:

CASK HANDLING LIMITATIONS:

NEAREST NAVIGABLE WATER: Lake Ontario
Barge Access Feasibility: Yes
Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Rochester Gas and Electric Corp.

PLANT NAME(S): Ginna

NRC DOCKET NUMBER(S): 50-244

LOCATION: Ontario, New York

REACTOR TYPE: PWR

RATING:(a) 470 MWe

NEAREST R.R.: CONRAIL

Rail Spur on Site: No

Rail Spur Extends into Cask Loading Bay: No

Comments:

CASK HANDLING CAPABILITY:

Share Pool:(b) No

Preferred Cask: NLI-1/2; experienced with NAC-1/NFS-4

Cask Crane Capacity, tons: 40

Crane Height, ft:(c) Data unavailable

Pool Depth, ft:(d) 40

Pool Width, ft:(d) 22.3

Pool Length, ft:(d) 43.0

Legal Truck: Yes

Overweight Truck: Yes

Comments: Within the spent fuel pool area, a 153 ft^2 area is set aside for cask handling operations.

CASK HANDLING LIMITATIONS: The spent fuel cask weight limit or capacity is currently limited to 25 tons.

NEAREST NAVIGABLE WATER: Lake Ontario

Barge Access Feasibility: No, too expensive

Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.

(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.

(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.

(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

UTILITY: Virginia Electric Power Company

PLANT NAME(S): Surry 1 & 2

NRC DOCKET NUMBER(S): 50-280 and 50-281

LOCATION: Gravel Neck, Virginia

REACTOR TYPE: PWR and PWR, respectively

RATING:[(a)] 775 & 775 MWe, respectively

NEAREST R.R.: CSX
- Rail Spur on Site: No
- Rail Spur Extends into Cask Loading Bay: No

Comments:

CASK HANDLING CAPABILITY:

- Share Pool:[(b)] Yes--A
- Preferred Cask: TN-8L; experienced with TN-8L
- Cask Crane Capacity, tons: 125
- Crane Height, ft:[(c)] 29.0
- Pool Depth, ft:[(d)] 40.5
- Pool Width, ft:[(d)] 12.0
- Pool Length, ft:[(d)] 21.3
- Legal Truck: Yes
- Overweight Truck: Yes

Comments:

CASK HANDLING LIMITATIONS: Units 1 and 2 have single access doors which must be closed during cask operations.

NEAREST NAVIGABLE WATER: James River
- Barge Access Feasibility: Yes

Comments:

(a) Spent Fuel Storage Requirements, DOE/RL-83-1, 1983.
(b) A indicates common pool shared by two reactors.
B indicates pools connected by transfer canal.
C indicates pools connected by cask transfer.
(c) The distance from the operating deck to the bottom of the crane hook at its uppermost position.
(d) Refers to the respective usable dimension (i.e., length, width, or depth) of the cask loading well.

APPENDIX B

EXISTING COMMERCIAL SHIPPING CASK FLEET

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EXISTING COMMERCIAL SHIPPING CASK FLEET

This appendix presents the total numbers of the various LWT, OWT, and rail shipping casks that have been fabricated and the number that are currently available and/or certified by the NRC. Summaries of the cask types and availability information are discussed in the following subsections for each supplier.

B.1 EXISTING COMMERCIAL SHIPPING CASK TYPES

The existing fleet can be separated into three types of casks; legal-weight truck (LWT), overweight truck (OWT) and rail casks. LWT casks are those which can be transported at a gross vehicle weight (GVW)[a] less than 36,400 kg (80,000 lb). OWT casks are defined as casks that must be shipped at a GVW in excess of this weight. Except for requiring special overweight permits for each state a shipment passes through, OWT truck casks operate in much the same manner as LWT shipments (e.g., prenotification of state officials, safeguards, and security requirements). Rail casks are more massive than the truck versions and are generally designed for rail service only. However, provisions can be made for a special short-distance, heavy-haul transfer of a rail cask by truck to a rail siding where the cask can be loaded onto a railcar. This type of transfer has not been performed in this country for spent fuel shipments.

B.2 EXISTING COMMERCIAL SHIPPING CASK SUPPLIER COMPANIES

The number of existing commercial spent fuel shipping casks was determined through discussions with supplier companies. The companies currently providing spent fuel transportation casks are:

(a) Gross vehicle weight includes the weight of the tractor, trailer cask, cargo, and ancillary equipment.

- Nuclear Assurance Corp. (NAC)
- Transnuclear, Inc. (TN)
- General Electric Company (GE)

B.2.1 Nuclear Assurance Corp. (NAC)

NAC supplies a variety of legal-weight truck and rail shipping casks. Their truck cask fleet includes the NFS-4, NAC-1 (same design as the NFS-4), and NLI-1/2 shipping casks. The rail cask supplied by NAC is the NLI-10/24 model. The total number of completely fabricated casks and some of their important features are presented in Table B.1.

NAC either owns or possesses long term leases on all of their equipment listed in the table. All seven of the NAC-1 and NFS-4 casks were temporarily suspended from use by the NRC in 1979. Two of the NAC-1 casks (one owned by NAC and one owned by a utility) were declared not licensed pending resubmittal of their Safety Analysis Report for Packaging (SARP). These casks were modified slightly by the addition of some copper patches during the

TABLE B.1. Existing Commercial LWR Spent Fuel Shipping Cask Fleet

Designation	Primary Transport Mode[a]	Capacity PWR/BWR Assemblies	Number of Casks Completed	Number Currently Certified
NAC-1	LWT	1/2	5[b]	0
NFS-4	LWT	1/2	2	0
NLI-1/2	LWT	1/2	5	5
NLI-10/24	Rail	10/24	2[c]	0
TN-8L	OWT	3/0	2	2
TN-9	OWT	0/7	2[d]	2
IF-300	Rail	7/18	4[e]	4

(a) LWT = Legal weight truck and OWT = overweight truck.
(b) Includes two casks that are owned by a utility company and are not available for lease from NAC.
(c) There are no internal baskets for these casks; therefore, they can not be used until new baskets are fabricated.
(d) Includes one TN-9 cask owned by a utility company.
(e) Includes one IF-300 cask owned by a utility company.

manufacturing process and the NRC had not reviewed and approved the modification. As a result, these two casks can not be used until NRC has reviewed and approved updated SARP's.

The remaining NAC-1 and NFS-4 shipping casks cannot be used for spent fuel shipments because of an agreement between the NRC and NAC. NAC has agreed not to use these casks because the NRC believes there is a potential for buckling of the internal cavity that could cause the lead shielding to change position. This could cause the radiation shielding to lose effectiveness at some locations on the casks. Subsequent inspections of the casks showed no evidence of buckling or loss of ovality. However, because NRC believes there is potential for this type of fault, they have asked NAC not to use these casks for spent fuel shipments pending further analyses. According to NAC, all of the NAC-1 and NFS-4 shipping casks will ultimately be recertified.

NAC possesses long-term lease agreements for the NLI-10/24 rail casks and the NLI-1/2 legal-weight truck casks. These casks were previously supplied by NL Industries Inc., who leased the casks to NAC in 1980. All 5 of the NLI-1/2 casks are certified and operational. Both completed NLI-10/24 casks are not available because of a lack of internal baskets. New baskets would have to be fabricated for these casks. If new baskets are fabricated using the original design approved by the NRC, little difficulty is expected in reactivating the casks. However, if the new baskets are designed differently, analysis and testing of the new design will be required. Submission of the safety analysis of a new basket design and subsequent review and approval by the NRC is also required. These casks are currently considered to be unavailable.

B.2.2 Transnuclear, Inc.

Transnuclear, Inc. (TN) supplies the TN-8L and TN-9 overweight truck shipping casks. The TN-8L is designed to transport 3 PWR assemblies; the TN-9 has a design capacity of 7 BWR assemblies. As shown on Table B.1, there are currently 2 TN-8Ls and 2 TN-9s in this country. One of the TN-9 casks has been sold to Commonwealth Edison but is assumed to be available for use by TN if it is not being used by the utility. The other three casks are owned by TN and are certified and operational.

B.2.3 General Electric Co.

General Electric Co. (G.E.) supplies the IF-300 rail shipping system. Currently there are four completed IF-300 casks. One is owned by a utility and three are owned by G.E. as shown in Table B.1. All of these casks are currently operating only with dry internal cavities at reduced thermal capacities. Consequently, only long-cooled fuel may be shipped in the IF-300 as a full load. This reduces some of the flexibility for using these casks. However, since most of the fuel expected to be shipped in the near future is relatively old, this limitation is not anticipated to restrict the use of the cask in most instances.

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