

DOCUMENT RESUME

07099 - [B2&27657]

Before Licensing Floating Nuclear Powerplants, Many Answers Are Needed. EMD-78-36; B-127945. September 13, 1978. 33 pp. + 2 appendices (7 pp.).

Report to the Congress; by Elmer B. Staats, Comptroller General.

Issue Area: Energy: Making Nuclear Fission a Substantial Energy Source (1608).

Contact: Energy and Minerals Div.

Budget Function: Natural Resources, Environment, and Energy: Energy (305).

Organization Concerned: Nuclear Regulatory Commission; Atomic Energy Commission.

Congressional Relevance: Senate Committee on Energy and Natural Resources; Congress.

Authority: Atomic Energy Act. National Environmental Policy Act of 1974. 49 C.F.R. 170. 46 C.F.R. 146.

The predecessor to the Nuclear Regulatory Commission (NRC) received an application in 1973 to manufacture eight standardized floating nuclear powerplants near Jacksonville, Florida, and received a separate application in 1974 to station two of the eight plants off the New Jersey coast. Because the floating plants will be built at a location other than where they will be operated, the NRC has issued new regulations requiring a license for the manufacture of the plants. Approximately \$300 million has been spent by the applicants on activities related to the applications, and the first application is more than 3 years behind its original licensing schedule. Findings/Conclusions: The NRC staff has made several management decisions that have complicated and contributed to the 3-year delay in its review of the application to manufacture floating nuclear powerplants. Factors inhibiting the licensing review process include: preparation of a generic environmental statement which adds little to the licensing process, NRC's failure to evaluate siting possibilities in a timely manner, and NRC's failure to evaluate a reactor core melt in a timely manner. The following questions concerning floating nuclear powerplants remain: Is more information needed on the risks of a core-melt accident? Will the site meet requirements for a floating nuclear plant? Does the weight of the plant represent a problem? Have methods been developed for handling and recovery of nuclear fuel and radioactive waste? Has a method been developed for decommissioning the floating plant? and Will a floating plant minimize the environmental effect of powerplant operation? Recommendations: Before concluding its review of the manufacturing license, the Chairman, NRC, should: establish an acceptable level of risk for a core-melt accident on a floating nuclear plant, identify those changes which must be made to the design to achieve that level of risk, and require that weight parameters be developed for the safe operation of the

powerplant. Before concluding its review of a license to operate the plants, the Chairman should: identify specific methods of handling the loading and offloading of radioactive material; require specific procedures for mitigating the consequences of a core-melt accident; require that a specific decommissioning plan be prepared for the floating plant and the breakwater, including a funding mechanism to assure that the facility owner pays the costs of decommissioning; and reanalyze the effect of the powerplant on tourism. (BRS)

7657

BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Before Licensing Floating Nuclear Powerplants, Many Answers Are Needed

By mounting a conventional nuclear powerplant on a floating barge it may be possible to site a powerplant in estuaries, on the shore, or in the ocean where it would be protected by a breakwater.

The uniqueness of floating nuclear powerplants, which are planned to begin operation by the late 1980s, requires that special attention be paid to the safety and environmental aspects of their operation.

The Nuclear Regulatory Commission has been conducting a licensing review of floating nuclear powerplants since 1973. Although the review is continuing, the Commission has not yet resolved in sufficient detail salient safety and environmental issues which various parties have raised during the licensing review.



EMD-78-36

SEPTEMBER 13, 1978



COMPTROLLER GENERAL OF THE UNITED STATES

WASHINGTON, D.C. 20548

B-127945

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the Nuclear Regulatory Commission's process for evaluating the safety and environmental impact of floating nuclear powerplants.

This review was prompted by interest expressed initially by Congressman Hughes, and subsequently by the other members of the New Jersey Delegation, about the floating nuclear plants.

We are sending a copy of this report to the Chairman, Nuclear Regulatory Commission.

A handwritten signature in black ink, reading "James R. Stacks".

Comptroller General
of the United States

D I G E S T

The floating nuclear powerplant is a relatively new and unique concept. Standardized nuclear powerplants mounted on barges could be stationed in the ocean near, but off, the shore and protected by a breakwater. Floating powerplants could be situated also on the shore and in estuaries. (See p. 1.)

Under current plans and projections floating plants could be operating in the late 1980s and more than 40 plants could be in place by the year 2000. Deployment in such numbers magnifies the need to find answers to important environmental and safety-related issues in the Nuclear Regulatory Commission licensing review process. This review of floating plants was continuing at the time GAO performed its work.

The former Atomic Energy Commission received an application in 1973 to manufacture eight standardized floating nuclear powerplants close to Jacksonville, Florida, and a separate application in 1974 to station two of the eight plants off the New Jersey coast. While the Nuclear Regulatory Commission has been continuing the licensing review of the first application, it has suspended the licensing review of the other because of an announced 3-year delay in the delivery of the first plant. The first floating nuclear plant is now scheduled to be in operation by mid-1988; the second, 2 years later.

Approximately \$300 million has been spent or committed by the applicants on activities related to the two applications. (See pp. 2 to 4.) The Nuclear Regulatory Commission has made several management decisions that have complicated its licensing review of the floating nuclear plants and have contributed to a 3-year delay in the licensing process. This process is unnecessarily fragmented

and confusing to the parties participating in the various proceedings preliminary to the granting of the licenses. Specifically, the Commission has

- prepared a generic environmental statement that provides little assurance about the feasibility of the floating nuclear power-plant concept (see pp. 9 to 10);
- not evaluated a number of matters on a timely basis (see pp. 11 to 14); and
- not resolved a number of salient safety and environmental issues which various parties have raised during the licensing process (see pp. 15 to 27).

The most significant unresolved issue is a core-melt accident. If a reactor's nuclear core should overheat, hot molten nuclear fuel could breach the containment structure and the barge and contaminate the surrounding waters. The Commission says the probability of a core-melt accident is very low.

In a recently issued study, the Commission found that the risks of a core-melt accident on a floating barge are 6 to 30 times greater than the risks of such an accident on a land-based plant. Nonetheless, the Commission has not yet established an acceptable level of risk for a core-melt accident on a floating nuclear plant nor identified the changes that must be made to the floating plant to achieve that level of risk. (See pp. 16 to 17.)

The Commission is now comparing the site off the coast of New Jersey with prescribed operating conditions for the floating plant to assure compatibility. Where they are not compatible, the design of the floating plant or the operating conditions may be changed to accommodate the New Jersey site. In such instances, the Commission may need to reopen the safety hearings to consider the impact of the changes on the safe operation of the floating nuclear plant. (See pp. 17 to 18.)

Additionally, the Commission has not yet resolved other safety, environmental, and related issues, including

- methods for mitigating the consequences of a core-melt accident (see pp. 16 to 17);
- possible problems with the anticipated weight of the floating plant (see pp. 18 to 20);
- procedures for transportation and handling of nuclear fuel and radioactive waste (see pp. 20 to 21);
- plans for decommissioning the floating plant and breakwater (see pp. 21 to 23); and
- analysis of the effect of tourism from the siting of floating plants (see pp. 23 to 25).

RECOMMENDATIONS

Because of the unique and critical nature of a nuclear powerplant operating in a water environment, answers to important safety and environmental issues must be resolved in the licensing process.

Before concluding its review of the manufacturing license to construct eight standardized nuclear powerplants, the Chairman, Nuclear Regulatory Commission, should

- establish an acceptable level of risk for a core-melt accident on a floating nuclear plant;
- identify those changes which must be made to the design of the floating nuclear plant to achieve that level of risk; and
- require that weight parameters be developed for the safe operation of the floating plant and insure that these parameters are met.

Before concluding its review of a license to operate the two floating plants off the New Jersey coast, the Chairman should

- identify specific methods for handling the loading and offloading of radioactive material and the recovery of such material in case of an accident;
- require specific procedures be developed for mitigating the consequences of a core-melt accident;
- require that a specific decommissioning plan be prepared for the floating plant and the breakwater, including a funding mechanism to assure that the facility owner pays the costs of decommissioning; and
- reanalyze the effect on tourism.

The State of New Jersey has ownership of the Outer Continental Shelf for a distance of 3 miles from its shore. If the licensing review starts again, the Chairman should determine as early as possible whether New Jersey is willing to provide a grant for the siting of two floating powerplants off its coast. It may be necessary to establish a milestone date in the licensing review process by which time the applicant should have obtained the grant. Otherwise, the Chairman should once again suspend the licensing review.

AGENCY COMMENTS ON
THE DRAFT REPORT

The Commission said, in its judgment, the report does not present an accurate, complete, and current overview of the Commission's policies and reviews related to the licensing of floating nuclear powerplants. GAO recognizes that the licensing review process is ongoing and that the Commission might sufficiently evaluate the safety and environmental issues contained in this report. However, the purpose of GAO's work was to evaluate what the Commission has done up to a certain point in time.

C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Formulation of the concept	1
	Filing of applications	2
	Funding of activities	2
2	OBSERVATIONS ON THE LICENSING REVIEW PROCESS	5
	Scope of the licensing review process	5
	Status of the licensing review process	8
	Factors inhibiting the licensing review process	8
	Licensing future plants	14
	Deploying floating nuclear plants in volume	15
3	UNRESOLVED QUESTIONS	16
	Is more information needed on the risks of a core-melt accident on a floating nuclear plant?	16
	Will the Atlantic Generating Sta- tion site meet the requirements for a floating nuclear plant?	17
	Does the weight of the floating nuclear plant represent a problem?	18
	Have methods been developed for handling and recovery of nuclear fuel and radioactive waste from a floating nuclear plant?	20
	Has a method been developed for decommissioning the floating plant and breakwater?	21
	Will a floating nuclear plant have an adverse effect on tourism?	23
	Will a floating nuclear plant mini- mize the environmental effect of powerplant operation?	25
	Will the State of New Jersey provide a grant for use of the Atlantic Generating Station site?	26

		<u>Page</u>
4	CONCLUSIONS, OBSERVATIONS, RECOMMENDATIONS, AND AGENCY COMMENTS	
	Recommendations	28
	Agency comments	29
		30
5	SCOPE OF REVIEW	33
APPENDIX		
I	Letter dated August 2, 1978, from the Executive Director for Operations, Nuclear Regulatory Commission	34
II	Principal officials responsible for administering activities discussed in this report	40

ABBREVIATIONS

GAO	General Accounting Office
NRC	Nuclear Regulatory Commission

CHAPTER 1

INTRODUCTION

Floating nuclear powerplants have emerged as a new and unique concept that is expected to be operational by the late 1980s. By mounting a conventional nuclear powerplant on a floating barge, it may be possible to site powerplants in the ocean, on the shore, or in estuaries. This technology is expected to permit nuclear power sources to be placed in areas lacking suitable land sites.

In January 1973 the predecessor agency to the Nuclear Regulatory Commission (NRC) ^{1/} received an application to manufacture eight standardized Floating nuclear powerplants. In March 1974 NRC received a separate application to site two of the eight plants off the New Jersey coast--called the Atlantic Generating Station site. The first application is currently pending licensing review and approval, referred to as the licensing review process, while the application to site two of the eight plants has been indefinitely suspended because of an announced 3-year delay in the delivery of the first plant. The first floating nuclear plant is scheduled to begin operation in 1988.

FORMULATION OF THE CONCEPT

In 1969 Public Service Electric and Gas Company, New Jersey's largest utility company, was exploring ideas to solve an immediate concern--lack of large land tracts needed for nuclear powerplant operations. After concluding that there were no areas onshore or along the Delaware River, the utility decided that siting off the coast was not only feasible but would best suit New Jersey's needs. The idea of creating a floating nuclear powerplant was also viewed as a way to make nuclear powerplants safer from earthquakes. Further it was believed that the floating plant would reduce population exposures and assure the adequacy of cooling water.

The utility invited and received bids from three nuclear manufacturing companies to build the floating plants. The concept of a floating plant was structured around building a conventional nuclear powerplant on top of a barge and floating it to a desired coastline location. The plants would then

^{1/}The Nuclear Regulatory Commission was established on January 19, 1975. Before then, nuclear regulation was the responsibility of the Atomic Energy Commission.

be moored within a manmade breakwater for stability as well as for protection against storms, and collision from ships. Electricity would be transmitted to land by cables buried beneath the ocean floor. 1/

FILING OF APPLICATIONS

In late 1972 Public Service Electric and Gas Company signed a contract with Offshore Power Systems 2/ to purchase two floating nuclear plants. Several months later the company exercised an option to buy two additional units.

After studying the utility market, Offshore Power Systems applied to NRC in January 1973 for a license to manufacture eight standardized floating plants at Blount Island, a site close to Jacksonville, Florida. The license application requested up to 14 years for manufacturing eight plants. Because no nuclear materials would be stored or used at the manufacturing facility, NRC has decided that Offshore Power Systems does not need to obtain an NRC license to build the facility.

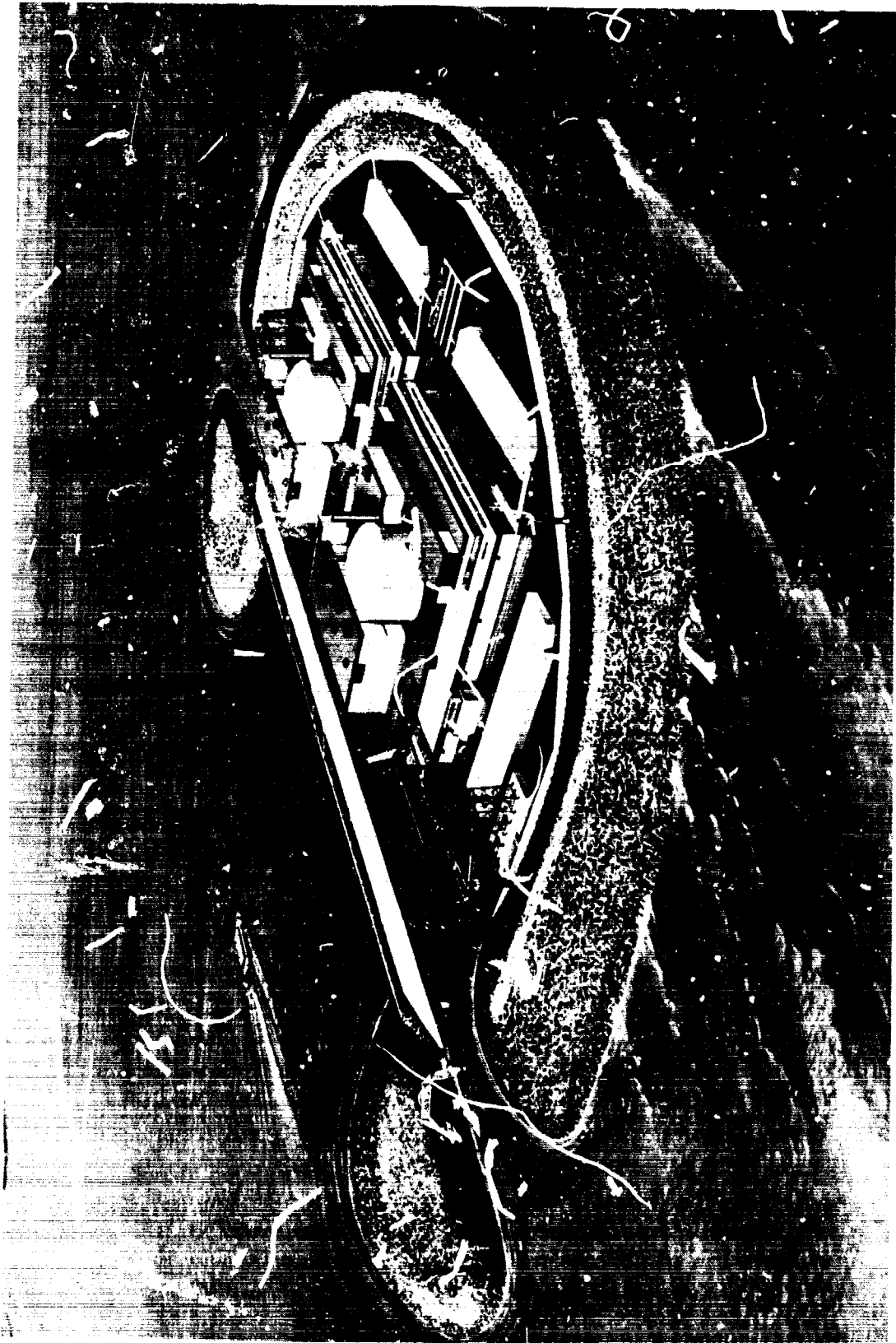
In March 1974 the Public Service Electric and Gas Company submitted its application to NRC to construct the Atlantic Generating Station which includes two floating plants 2.8 miles off the coast of New Jersey and about 11 miles northeast of Atlantic City. The first floating plant is now scheduled to begin operation in mid-1988 and the second plant 2 years later. Ownership will consist of the Public Service Electric and Gas Company, the Atlantic City Electric Company, and the New Jersey Central Power Company who will own 80 percent, 10 percent, and 10 percent respectively, of the plants. The third and fourth plants are expected to begin operations in 1993 and 1995, respectively, but no application has been submitted to NRC for them nor has a site been announced for their location.

FUNDING OF ACTIVITIES

Since 1972 Offshore Power Systems has spent or committed approximately \$100 million for dredging, construction, and

1/See page 3 for an artist's concept on two floating plants.

2/An enterprise established by Westinghouse Electric Corporation and Tenneco Power Systems, Incorporated, just for this purpose. Tenneco Power Systems later terminated its involvement in the project, leaving Westinghouse as sole owner of Offshore Power Systems.



FURNISHED BY OFFSHORE POWER SYSTEMS, INC.

FIGURE 1. ARTIST'S CONCEPT OF TWO FLOATING NUCLEAR POWERPLANTS.

material purchases at the Blount Island manufacturing facility. Another \$140 million is needed to complete the facility, according to Offshore Power Systems estimates.

In addition, Public Service Electric and Gas Company estimates it has paid \$172 million to Offshore Power Systems for the purchase of long lead-time items to build the floating plants. Also, it estimates that \$50 million to \$60 million has been spent on work at the Atlantic Generating Station site, including site development, consultants' fees, and reports to NRC. Officials of the company said about \$15 million to \$20 million is usually spent in licensing a conventional land-based nuclear plant. The difference in cost, according to these officials, can be attributed to the time it has taken to license the floating nuclear plant plus the uniqueness of the concept itself.

- - - -

Because the floating nuclear plant will involve operating a reactor in a relatively new environment, it is important, for health and safety reasons, that due consideration is given to all relevant issues in the NRC licensing review process. The following chapters highlight our observations on this ongoing review process and the more important safety and environmental issues which are yet to be resolved.

CHAPTER 2

OBSERVATIONS ON THE LICENSING REVIEW PROCESS

The NRC licensing review process is intended to provide a systematic approach for evaluating safety and environmental matters which relate to the construction and operation of a nuclear powerplant. The process includes a comprehensive review by the NRC staff and the Advisory Committee on Reactor Safeguards¹ as well as public hearings before the Atomic Safety and Licensing Board². As of May 1978, the NRC staff was continuing its licensing review of the Offshore Power Systems manufacturing license application, whereas the Atomic Safety and Licensing Board has been holding public hearings. This application is more than 3 years behind its original licensing schedule.

SCOPE OF THE LICENSING REVIEW PROCESS

The NRC licensing review process for the proposed floating nuclear powerplants differs from the process for licensing land-based nuclear plants in one important respect. Because the floating plants will be built at a location other than where they will be operated, NRC has issued new regulations requiring a license for the manufacture of the plants--called a manufacturing license.

The regulations stipulate, in part, that a license will be issued only after NRC finds that the manufacturer has sufficiently described the proposed design of the plants and the site conditions under which the plants can operate. If granted, the manufacturing license will specify the number of plants authorized to be manufactured and the latest date for the completion of the manufacture of all such plants. (See chart on page 6 which depicts the uniqueness of the floating plant licensing process and presents the status of the more important licensing steps.)

¹ Consisting of a maximum of 15 members, it is an independent committee established by the Congress and statutorily required to conduct a safety review of each nuclear powerplant application.

² An independent Board comprising one lawyer, acting as chairman, and two technically qualified persons. Members are selected from a panel of full- and part-time panel members appointed by the NRC Commissioners.

**COMPARISON OF THE LICENSING REVIEW PROCESS FOR CUSTOM
LAND-BASED NUCLEAR PLANTS AND FLOATING NUCLEAR PLANTS**

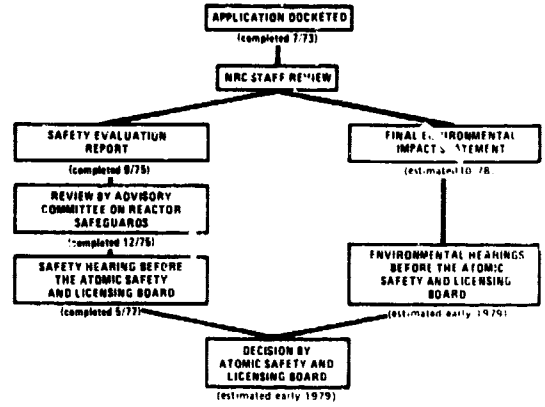
**THE LICENSING REVIEW PROCESS FOR
CUSTOM LAND-BASED NUCLEAR PLANTS**

**THE LICENSING REVIEW PROCESS FOR
FLOATING NUCLEAR PLANTS**

MANUFACTURING LICENSE

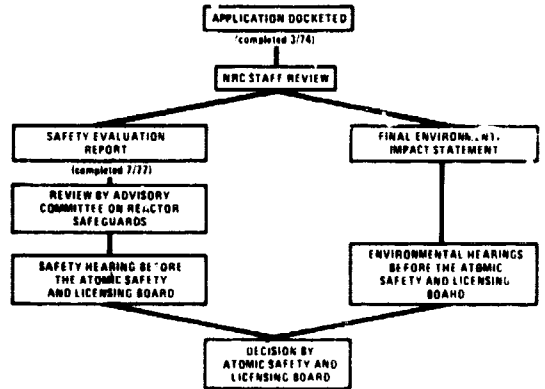
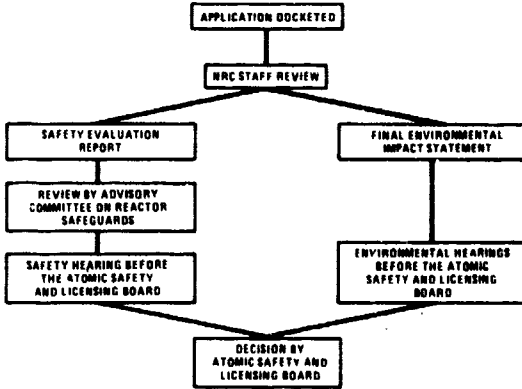
MANUFACTURING LICENSE - OFFSHORE POWER SYSTEM

NONE



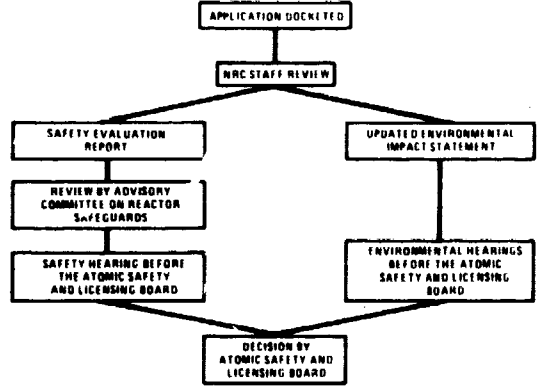
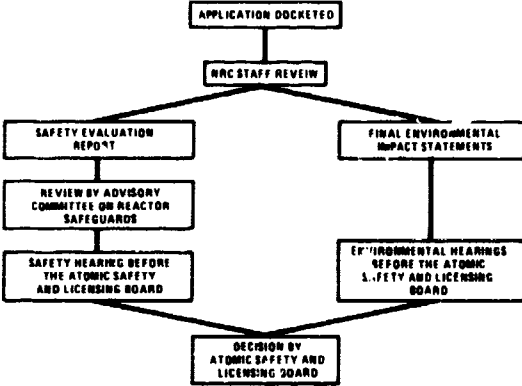
CONSTRUCTION PERMIT

CONSTRUCTION PERMIT - PUBLIC SERVICE ELECTRIC AND GAS COMPANY



OPERATING LICENSE

OPERATING LICENSE - PUBLIC SERVICE ELECTRIC AND GAS COMPANY



During the licensing process, the application for a manufacturing license must undergo three separate reviews on safety-related matters: (1) a detailed technical review by the NRC staff, culminating in the issuance by the staff of a safety evaluation report; (2) a review by the Advisory Committee on Reactor Safeguards, an independent body of experts in the various technical disciplines important to reactor safety; and (3) a review by the Atomic Safety and Licensing Board after a formal hearing with opportunity for public participation. Similarly, the application must undergo a two-phase review on environmental matters with the preparation of two environmental statements. The first covers the environmental impact on the city of Jacksonville from the operation of the manufacturing facility. The second statement is generic in nature and considers the proposed uses of the floating nuclear powerplants as offshore generating stations. Following preparation of each of the two environmental statements, comments are solicited from Federal, State, and local agencies and from members of the public. A single environmental statement is then issued taking into account all comments received. As with safety-related matters, a review on environmental matters is held before the Atomic Safety and Licensing Board after formal hearings with opportunity for public participation.

Although the utility (plant owner) will not build the floating plants, it must obtain a construction permit and an operating license from NRC. Here, the licensing process will be similar to the case of the construction and operation of a land-based nuclear plant. Under the construction permit review, the utility need not submit any information or analyses previously considered under the manufacturing license review, but it must submit information to demonstrate that the site on which the plant is to be operated falls within the site conditions specified in the manufacturing license. If granted, the construction permit will allow the construction of the offshore station including the breakwater enclosure and the required onshore support facilities. The permit will also allow the floating plant to be moved to its intended offshore location.

Under the operating license review, the utility must demonstrate that the construction of the floating nuclear plant has been substantially completed in conformity with both the manufacturing license and the construction permit. If granted, the operating license will allow fueling of the nuclear reactor and operation of the plant for 40 years.

STATUS OF THE LICENSING REVIEW PROCESS

In May 1977 the Atomic Safety and Licensing Board completed public hearings on almost all safety aspects of the Offshore Power Systems application to manufacture the eight floating plants. The Licensing Board had ruled, however, that hearings on environmental matters would wait until the completion of all environmental statements, currently scheduled for late 1978. ^{1/} Since the date of that ruling--in June 1977--the Licensing Board has collectively decided that hearings on environmental issues would be held as various environmental statements and reports become available. In July 1978 the hearings resumed. Once the last environmental statement is completed, NRC anticipates that the hearings can be concluded and a decision on the manufacturing license application can be made by the Atomic Safety and Licensing Board in about 3 months--or early 1979.

In addition, hearings were required on safety-related and environmental matters related to the application to construct the Atlantic Generating Station. These hearings were scheduled to begin in November 1977, but were never held, and the NRC staff told us that they would not begin until the hearings on the Offshore Power Systems application are completed--sometime in early 1979. This is based upon the objective that all generic safety and environmental issues should be resolved before deciding on the suitability of the Atlantic Generating Station site.

FACTORS INHIBITING THE LICENSING REVIEW PROCESS

The NRC staff has made several management decisions that have complicated and helped contribute to the 3-year delay in its review of the application to manufacture the floating nuclear powerplants. In our view, even though these plants are unique, the licensing process is unnecessarily fragmented and confusing to the parties participating in the proceedings. Specifically, we found that NRC made a decision to issue various parts to its environmental impact statement, then reissue at least one part in draft, and prepare additional studies where parts were found to be deficient. According to an official of the Council on Environmental Quality, this fragmented

^{1/}The last statement to be completed is an overall summary of the environmental effects associated with granting the manufacturing license.

approach to fulfilling the requirements of the National Environmental Policy Act has prevented not only the public but also other Federal agencies from gaining a whole understanding of the impact of the floating nuclear powerplant proposal. Listed below are the various parts which NRC has prepared to the environmental impact statement.

	<u>Draft</u>	<u>Final</u>
Part I (Manufacturing Facility)	7/74	10/75
Part II (Generic Offshore Siting)	12/75	9/76
Part II Addendum (Generic River and Estuary Siting)	3/78	6/78
Liquid Pathway (Risk) Study	9/76	2/78
Part III (Overall Summary)	10/76 5/78	Yet to be completed

In reviewing these various parts, we also found that the NRC staff, in its decisionmaking, has

- prepared a generic offshore siting statement of a type which added little to the licensing process;
- been slow, perhaps reluctant, to evaluate the various siting possibilities for floating nuclear plants, such as in rivers and in estuaries;
- been slow, perhaps reluctant, to address the consequences and risks of a certain hypothetical reactor accident, called a core melt, which has already been studied for a land-based plant.

The above decisions have also contributed to a 3-year delay in the licensing review of the application submitted by the utility, the Public Service Electric and Gas Company.

According to NRC, the 3-year delay in this licensing review is related to such things as late and inadequate responses from the company; assignment of reviewers to higher priority work; scheduling problems with the Advisory Committee on Reactor Safeguards; and the dependency of this licensing review on the review being conducted on the manufacturing license.

Preparation of a generic environmental statement which adds little to the licensing process

In September 1974 NRC decided to prepare an environmental impact statement (Part II) which assessed in a general way, and without a high degree of quantification, the environmental impacts from the proposed construction and operation of floating plants in the offshore waters. The statement analyzed average conditions expected to be found in the Atlantic Ocean and the Gulf of Mexico. NRC officials said the statement, which was subsequently issued in September 1976, was necessary under the NRC regulations implementing the Atomic Energy Act and the National Environmental Policy Act of 1974.

The statement did not, however, assess the cumulative environmental effects of a number of floating plants operating simultaneously nor did it assess whether floating plants could be located at specific sites. For these reasons, a staff member of the Council on Environmental Quality said the Council staff did not agree with this generic environmental statement. He also said the Council staff reasoned that while the operation of a single floating plant may produce a minimal effect on the marine environment, the effect from several plants operating simultaneously could be considerable. The Council staff advocated the preparation of a statement which made such an assessment. NRC disagreed with the Council because a cumulative assessment would be much too difficult to undertake.

During our review, officials from the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and Offshore Power Systems also commented on the merits of NRC's generic environmental statement. Aside from generating some very general data, these officials collectively said that this statement:

- did not provide assurance that eight floating nuclear powerplants could be located in the offshore waters of the Atlantic Ocean and Gulf of Mexico.
- did not preclude the preparation of any environmental information which would have to be developed once a utility decides to site a floating nuclear plant at a specific location.
- was not a true assessment of the offshore waters since each area is unique and generalization is not possible.

In summary, these officials indicated that the generic environmental statement which NRC prepared added little to the licensing process. NRC said the purpose of the NRC

generic environmental statement was only to determine for the decisionmakers whether there was reasonable assurance that eight floating plants could be sited with acceptable environmental impacts.

NRC's failure to evaluate siting possibilities in a timely manner

Various siting options are available for the operation of floating nuclear powerplants. These include (1) offshore --at least several miles from the shoreline, (2) nearshore --within one mile of the shoreline, (3) inshore--at sites excavated in the shoreline, and (4) rivers or estuaries. Each option could necessitate some changes to the mode of operation of the floating plant. For example, if a floating plant were sited inshore, it might have a closed cycle cooling system with aboveground transmission lines. If sited offshore, a floating plant might have an open cycle cooling system with underground transmission lines. Yet the generic environmental statement (Part II) issued in September 1976 primarily evaluated only the siting of a floating plant offshore. According to Offshore Power Systems officials, other options were not evaluated because NRC considered these options very similar to a land-based nuclear plant. NRC officials, however, said the generic environmental statement (Part II) assessed various siting alternatives including those in offshore ocean areas as well as riverine and estuarine locations.

After the generic environmental statement was issued, both the Environmental Protection Agency and the Council on Environmental Quality criticized the statement for its lack of adequate consideration of various other siting options. Subsequently, NRC officials agreed to extensively evaluate these siting options and issue that evaluation as an addendum to the generic statement. In March 1978 a draft of the addendum was made available to the Environmental Protection Agency and to other specified agencies for review and comment. The draft addendum stated that most rivers in the Atlantic and Gulf coasts do not have adequately large channels or overhead clearances, because of bridges, for the floating plant. Therefore, it excludes this option from any further consideration. For the other siting options, the addendum stated that a floating plant would create a wide range of adverse ecological impacts. Nonetheless, the addendum concluded that possibly specific locations exist where a floating plant could be sited. 1/

1/In June 1978 NRC issued the final addendum on generic river and estuarine siting. It contained the same conclusions as the draft.

After the Environmental Protection Agency reviewed the draft addendum, it wrote to NRC in May 1978 and recommended that siting options, other than offshore, be eliminated before granting a license to manufacture the eight floating nuclear plants. This agency also said that, based upon responses from its regional offices, there are no nearshore, inshore, or estuarine sites in the Atlantic and Gulf coast regions that would be environmentally acceptable for the floating nuclear plant.

Offshore Power Systems, on the other hand, has questioned the legality of the Environmental Protection Agency's position on nearshore, inshore, and estuarine siting. It has written to the Administrator of that agency asking him to review the position in light of the requirements of the National Environmental Policy Act.

NRC's failure to evaluate a reactor core melt in a timely manner

The possibility of a reactor core melt is one of the most critical safety-related concerns for both land-based and floating nuclear plants. If a nuclear reactor undergoes a major accident in which its cooling water is lost, the possibility exists that the nuclear core could overheat or even melt. If this were accompanied by a breach of the protective barriers surrounding the reactor, large amounts of radioactivity could be released to the environment. Nonetheless, in 1971 the Atomic Energy Commission judged a reactor core melt as being so improbable that it has not been used as a basis for licensing nuclear powerplants.

As part of its efforts to evaluate the effects of proposed commercial nuclear powerplants, NRC often has contracted with the Oak Ridge National Laboratory to review data submitted by applicants for licenses. Accordingly, Oak Ridge performed an analysis, including an evaluation of the data submitted by Offshore Power Systems, and prepared a draft report on the unique technical aspects of floating powerplants. As part of the draft, Oak Ridge addressed the possibility of a core melt on a floating plant and suggested a core catcher ^{1/} be used in the plant design. The NRC staff revised the draft and decided to delete the information on the core melt as well as the suggestion for the core catcher from the final report, dated March 1974, because NRC did not view the probability of core melt as an important safety concern.

^{1/}A core catcher is a device of special design installed in the containment building to capture the reactor core in case of a meltdown.

In November 1972 the Advisory Committee on Reactor Safeguards also raised the issue of a core-melt accident and questioned whether something should be built into the design. Because of the Committee's continued concern, the NRC staff finally decided in July 1975 to study the potential consequences of a core-melt accident on a floating plant.

Even though it further fragmented the environmental statement, NRC elected to issue this liquid pathway study separately, in draft form, in September 1976. The study reported that the risks of a core-melt accident on a floating plant were less than or equal to that of such an accident on a land-based plant. 1/ Subsequently both Federal and State agencies criticized the study for its inadequate discussion of a core-melt accident. Because of the extent of this criticism, NRC revised the draft study. The final version was issued in February 1978. This final study concludes that the risks of a core-melt accident on a floating plant would be 6 to 30 times greater than the risks of such an accident on a land-based plant.

Based upon this study, NRC now believes additional melt-through protection is required in the barge base to increase the time before the core breaches its containment. NRC has stated that rather than use a core catcher the manufacturer should replace the material in the concrete pad beneath the reactor vessel. NRC also has said that no floating nuclear plant will be sited in rivers and estuaries unless the amount of radioactive materials reaching the surrounding waters can be limited in the event of a core-melt accident.

Offshore Power Systems, however, disagrees with the NRC conclusion that the risks of a core-melt accident on a floating plant would be 6 to 30 times greater than the risks of such an accident on a land-based plant. According to them, if NRC had also considered land-based nuclear plants located on lakes and small rivers in its study, a significantly fairer perspective would be conveyed to the reader of the study. The following summary was prepared by Offshore Power Systems ranking floating nuclear plants and land-based nuclear plants at various types of sites.

1/See page 16 of our report for information on the contents of the study.

- Increasing risk
1. Land-based plant--ocean
 2. Land-based plant--large river
 3. Floating plant--ocean
 4. Land-based plant--lake
 5. Land-based plant--estuary
 6. Floating plant--large river
 7. Land-based plant--small river
 8. Floating plant--estuary
- ↓

Offshore Power Systems also says that analysis of core-melt accidents in NRC environmental statements is a challenge to existing NRC regulations, is beyond NRC policy, and conflicts with court decisions which have consistently recognized that (1) such accidents are not credible and (2) environmental consequences need not be evaluated for light water reactors. Accordingly, the company says the design change called for by NRC has no legal basis.

LICENSING FUTURE PLANTS

If Offshore Power Systems obtains its license, any future owner of a plant built at the manufacturing facility need only prove the acceptability of its site to obtain a construction permit and an operating license. For this reason, the standardized design of the floating plant could most likely reduce, in time and costs, the licensing review process as well as the costs of the plant.

Normally it takes more than 10 years to plan, design, construct, and license a customized land-based plant for commercial operation. For the licensing requirements, safety and environmental issues must be reviewed for each application. Under the licensing policy established by NRC for a floating nuclear plant, most safety-related issues, as they pertain to the design of the floating plant, should be analyzed once during the manufacturing license review. After these issues are resolved, NRC said they would no longer be considered in the licensing review process for individual floating plants. On the other hand, environmental issues, according to NRC, would be analyzed each time a construction permit and operating license is filed for a floating plant. This is necessary to evaluate the unique environmental aspects of specific sites.

While it may well take more than 10 years to license the first floating nuclear plant, the number of years needed to license future plants could be reduced considerably. Offshore Power Systems projects that, with the advantages of a standardized design, these plants may be licensed in as little as 6 or 7 years.

DEPLOYING FLOATING NUCLEAR
PLANTS IN VOLUME

Offshore Power Systems currently has contracts for the purchase of four of its floating nuclear powerplants. Whether there will be a market for the other four plants it intends to manufacture, plus any beyond these eight, is uncertain. Information developed by the Office of Technology Assessment ^{1/} indicates that more than 40 floating plants could be deployed by the year 2000. This estimate agrees with projections by Offshore Power Systems which says it could build four plants per year.

An intervenor to the manufacturing license proceeding said that if floating nuclear powerplants are deployed in volume, these plants, collectively, could have a detrimental effect on the environment. The NRC staff has told us it does not believe Offshore Power Systems could manufacture more than 40 floating plants by the year 2000. This is because the Offshore Power Systems license application has projected only a one-unit per year manufacturing rate. Consequently, NRC has limited its licensing review to the eight floating plants contained in the Offshore Power Systems application.

^{1/}The Office of Technology Assessment was created in 1972 as an advisory arm of Congress to help legislative policymakers anticipate and plan for the consequences of technological changes.

CHAPTER 3

UNRESOLVED QUESTIONS

NRC has been conducting a licensing review of the floating nuclear powerplant since 1973. It has prepared a safety evaluation report and a three-part environmental impact statement on the manufacturing license application of Offshore Power Systems. Also, it has prepared a safety evaluation report and a draft environmental impact statement on the construction permit application of Public Service Electric and Gas Company. Yet certain questions about the floating nuclear plant have been raised by various Federal agencies, interested States, intervenors to the licensing proceeding, or persons simply concerned about the safety of the floating nuclear plant. As the licensing review process continues, answers to these questions may be found. However, at this point in time, the following important questions remain, in our view, unresolved.

- Is more information needed on the risks of a core-melt accident on a floating nuclear plant?
- Will the Atlantic Generating Station site meet the requirements for a floating nuclear plant?
- Does the weight of the floating nuclear plant represent a problem?
- Have methods been developed for handling and recovery of nuclear fuel and radioactive waste from a floating nuclear plant?
- Has a method been developed for decommissioning the floating plant and breakwater?
- Will a floating nuclear plant have an adverse effect on tourism?
- Will a floating nuclear plant minimize the environmental effect of powerplant operation?
- Will the State of New Jersey provide a grant for use of the Atlantic Generating Station site?

IS MORE INFORMATION NEEDED ON THE RISKS OF A CORE-MELT ACCIDENT ON A FLOATING NUCLEAR PLANT?

If a core-melt accident should occur, neither NRC nor anyone else is quite sure what the results would be. In a floating plant the hot molten core could melt through the

containment floor and barge, permitting the release of radioactivity to the water, the atmosphere, and the food chain.

In February 1978 NRC issued the final study on the risks of a core-melt accident on a floating plant. The study concluded that the risks of such an accident on a floating plant will be 6 to 30 times greater than that expected on a land-based plant. Also, the study indicated that it is not likely that the consequences of a core-melt release could be mitigated at the site of the floating nuclear plant.

In its revised draft environmental statement (Part III), NRC apparently decided it was necessary to reduce the risk for a core-melt accident on a floating nuclear plant. NRC asked that the applicant replace the concrete pad beneath the reactor vessel with a material that provides additional time before melt-through by the reactor core and which does not react with the core debris to form a large volume of gases. NRC, however, has not specified what reduced level of risk is desired nor how this design change should lead to achieving that level of risk. Thus, even if the applicant complies and makes some change to the concrete pad, NRC will be in no position to judge the merits of the change.

In the revised draft environmental statement, NRC also estimated that a core-melt accident could have economic and social impacts totaling tens of billions of dollars. Because of this, we believe that additional information is needed on the risks of a core-melt accident on a floating nuclear plant.

Further, if a core-melt accident should occur, NRC maintains that the radioactive releases to man could be mitigated depending upon the intensity of effort applied. For the floating plant, NRC has generally described such mitigations which would involve restriction of beach areas and consumption of seafood. However, NRC has not specifically identified who would undertake such mitigating action and how such action is to be accomplished. Any application, such as the one submitted by Public Service Electric and Gas Company, to site and operate a floating nuclear plant at a particular location needs to include this specific information.

WILL THE ATLANTIC GENERATING
STATION SITE MEET THE REQUIRE-
MENTS FOR A FLOATING NUCLEAR PLANT?

A floating nuclear plant can only be exposed to those environmental conditions for which it has been designed. Otherwise, the plant's operation may pose an undue risk to the health and safety of the public.

Offshore Power Systems, as part of its manufacturing license application, developed a list of operating conditions for the floating nuclear plant it is designing. The conditions include such factors as water temperature, water depth, wave motion, earthquake and tornado occurrences, and air temperature. Any utility proposing to purchase and operate a floating plant must prove that the site selected meets the operating conditions.

NRC has found that the Atlantic Generating Station site off the New Jersey coast exceeds these conditions in the following areas:

1. Height of waves in the basin.
2. Basin water temperature.
3. Tornado forces.
4. Stress on the mooring anchor points.
5. Earthquake forces.

While the height of waves in the basin is still being discussed by all the parties involved, Public Service Electric and Gas Company has recently submitted additional information to NRC hoping to prove that its site does meet the conditions for basin water temperature. In addition, an NRC official told us that Offshore Power Systems has informally agreed to redesign the plant to meet the operating conditions pertaining to tornado forces and stress on the mooring anchor points. For the final condition relating to earthquake forces, however, Offshore Power Systems plans to change the requirements of the condition itself.

A member of the NRC staff told us that resolution of all these items will be necessary before construction permit hearings on the Atlantic Generating Station can begin. After all items have been resolved, NRC will decide whether the changes to the plant design or to the requirements of the operating conditions, if any, warrant a reopening of the safety hearings. However, the staff could give no firm indication as to when the items would be resolved and the decision made.

DOES THE WEIGHT OF THE FLOATING NUCLEAR PLANT REPRESENT A PROBLEM?

In 1976 an employee of Offshore Power Systems made allegations about the safety of the floating nuclear plants. One allegation was that Offshore Power Systems is "completely in the dark" about plant weight and that the plant has always been in trouble with weight problems. This was viewed by the allegor as an important safety issue because the increased immersion from being overweight could cause the plant to hit bottom during wave motion and to break up.

NRC investigators looked into the allegation and found that plant weight had indeed been a problem and that Offshore Power Systems had undertaken a weight reduction program in 1975 to remedy this situation. The investigators' report concluded that the allegation about weight problems was factually correct but no special corrective action was needed at that time because Offshore Power Systems had already reported it to NRC and the licensing staff was reviewing the matter. The NRC investigators were not able to substantiate that part of the allegation about Offshore Power Systems management being in the dark about plant weight.

Our review of the safety evaluation report prepared by NRC on the Offshore Power Systems application found no discussion of plant weight or any indication that plant weight had been a problem. An NRC official told us that monitoring plant weight is a relatively simple matter and that NRC is relying on Offshore Power Systems in this area. If plant weight should become a problem, this official said NRC could handle it during the operating license review of the Public Service Electric and Gas Company application.

However, if NRC waits until the operating license review phase, the plant will be substantially under construction and corrections will be more costly and harder to make. In addition, if the plant weight is not adequately monitored and controlled, problems could occur during plant tow. A Coast Guard official said it is important to control plant weight so that the barge maintains a particular position in the water during travel from the manufacturing facility to its intended permanent location. Therefore, the Coast Guard plans to inspect the floating plant and barge before it departs from the manufacturing facility.

Once at its operating location and placed within the breakwater structure, weight limitations could make it extremely difficult to modify the plant if that becomes necessary. For example, adequate shielding in nuclear plants for radiation protection purposes for both the accident and normal operating conditions is a critical design problem. Addition of concrete and steel is often required, particularly on new plant configurations, and could present the floating nuclear plant with difficult post-operational requirements. Almost all currently operating nuclear plants are undergoing expansion of the at-reactor fuel storage pools in order to make up for lack of a permanent disposal site for high-level waste. This, or similar modifications, could be difficult to overcome on a floating plant.

Our review has shown that NRC is not duly concerned about the weight of the plant and consequently has not

established any type of program to insure that the plant weight stays within allowable limits. More importantly, NRC has not set any limits for acceptable plant weight. Thus, even if NRC monitors the plant weight, it cannot know when plant weight is becoming a problem.

HAVE METHODS BEEN DEVELOPED FOR
HANDLING AND RECOVERY OF NUCLEAR
FUEL AND RADIOACTIVE WASTE FROM
A FLOATING NUCLEAR PLANT?

The transfer of nuclear fuel and radioactive materials from an offshore floating plant involves moving loaded casks on and off a barge and a voyage to a shore facility. This transfer could present some hazards differing from those of a land-based plant.

In 1976 allegations were made by an employee ^{1/} of Off-shore Power Systems that the method for offloading highly radioactive materials was incomplete, faulty, and unproved. Additional allegations questioned how would materials dropped overboard be recovered and what is the procedure if the transport vehicle sinks. NRC investigated these allegations. In its August 1976 report, the NRC investigators reported that the allegations were factually correct but said that the problem was largely site specific and, primarily must be resolved by the plant owners. Additionally, the report indicated that the NRC licensing staff was aware of these matters and was reviewing them as part of the ongoing licensing process.

We reviewed reports prepared by the NRC staff on the Atlantic Generating Station. These reports fail to disclose that a problem exists with the offloading of highly radioactive materials or to identify the method that will be used to accomplish this task. Accidental dropping of the approximately 100-ton spent fuel shipping cask could have serious consequences if the cask would damage other fuel or the spent fuel storage pool. The Environmental Protection Agency has commented that the draft environmental impact statement on the Atlantic Generating Station does not discuss dropping a fuel cask at the shore service facility during or following offloading from the barge. Since the service facilities will most probably be located in Atlantic City--a populated industrial area--the final environmental statement, according to

^{1/}This is the same employee who made the allegations discussed on page 18.

the agency, should discuss the potential for such an accident and its impact.

Additionally, we found no evidence of any procedures being developed for the recovery of materials accidentally dropped overboard or the recovery of the transport vehicle should it sink. Dropping a 100-ton cask into a small transfer barge, for example, would quite likely permit the cask to drop right through the transfer barge, sinking both the cask and the barge.

NRC said this information had not been included in these reports because the probability of a barge accident is low. Besides, NRC believes that because the radioactive materials are enclosed in protective casks, the consequences would be minimal if material should be dropped overboard or the barge should sink. Moreover, NRC says their recovery would be a fairly routine matter.

We disagree with this position. Because barge transport of nuclear materials such as spent fuel in ocean waters has been limited, there is little basis to say that recovery of material dropped overboard would be a fairly routine matter.

HAS A METHOD BEEN DEVELOPED FOR
DECOMMISSIONING THE FLOATING
PLANT AND BREAKWATER?

When a floating nuclear powerplant is no longer in use --it has an expected life of 40 years--it and the breakwater could continue to present radiological or navigational hazards. NRC has cited four possible ways to decommission or dispose of the floating plant. These options, which all require removal of the plant from the breakwater, include

- permanent lay-up or mothballing of the plant after internal radioactive components have been removed and disposed of as radioactive waste;
- dismantling of the plant with onshore disposal;
- decontamination and sinking at sea; and
- temporary lay-up for about 50 years followed by dismantling.

From the standpoint of economic and environmental considerations, NRC views dismantling with onshore disposal of radioactive components as the most desirable. Many questions remain unanswered on the other decommissioning methods. For instance:

1. In permanent lay-up NRC has not determined whether the plant and barge can be maintained in a water-tight condition or if the structural integrity of mothballed plants can be guaranteed for thousands of years.
2. In decontamination and sinking, NRC has not determined if acceptable sites exist where an entombed plant could be sunk or if national and international laws permit such disposal.
3. In temporary lay-up and dismantlement, NRC has not determined if the barge can be maintained in a seaworthy condition long enough to permit sufficient radioactive decay to simplify dismantling--possibly 110 years after plant operations--or if the entombed plant can be guaranteed for structural integrity.

In addition, the breakwater may create quite a different problem. NRC has said that for environmental reasons the breakwater will probably not be removed at the end of the 40-year operating period. NRC said that after this amount of time it will have become a habitat for a large quantity and variety of marine life and its removal would cause a far greater disruption to the environment than its original installation.

The cost of removing the breakwater is also a consideration. NRC said its removal would require an engineering effort equal to or greater than its installation. The time required for breakwater removal will probably be equivalent to that for construction while the cost of removal would exceed the construction cost.

Alternatives to removing the breakwater include either perpetual care or alternative uses, such as a safe harbor, a sport-fishing center, or a site for future floating nuclear plants. If the breakwater goes unused, perpetual care is necessary to prevent it from being a navigational hazard. NRC stated that because of environmental impacts and cost-benefits, the most suitable alternative is as a site for replacement floating nuclear plants.

Questions remain about the decommissioning of a floating nuclear plant and there is the likelihood that the breakwater, once installed, will not be removed. Despite this, NRC has said a decommissioning plan, including the option to be taken for the floating nuclear plant and the breakwater, will not be decided upon until the end of the 40-year period.

In a recently issued report on decommissioning nuclear facilities ^{1/} we discussed the problems of cleaning up the remains from nuclear facilities, including reactors. We recommended that the Chairman of NRC require specific plans at the time of licensing, including the decommissioning method to be used and a funding mechanism to assure that facility owners pay the costs of decommissioning.

WILL A FLOATING NUCLEAR PLANT HAVE AN ADVERSE EFFECT ON TOURISM?

The siting of a floating nuclear plant approximately 3 miles offshore will be visible from shore. In 1976 NRC contracted with consultants at Florida State University for a study on the impact of offshore nuclear plants on recreational behavior. The study, which was published in October 1977, was intended to serve as NRC's basis for responding to this issue which was raised by an individual in the public hearings. The study chose four sites for evaluation: The Panama City Beach --Fort Walton Beach area of northwest Florida; the Clearwater-St. Petersburg Beach area of south Florida; the south shore of Cape Cod, Massachusetts; and the Atlantic County--Ocean County beach areas of New Jersey.

At each site 600 individuals were interviewed on the beach by the use of a questionnaire. Each person was asked if he or she would return to that beach if a nuclear power-plant were offshore. Between 22.8 percent and 26.5 percent of those interviewed indicated an unwillingness to return to the beach if the plant were sited directly offshore at a distance of 3 miles.

But the study concluded that the 22.8 percent to 26.5 percent is probably exaggerated. Taking the following factors into consideration, the study hypothesized that it is unlikely that more than 5 percent to 10 percent of the beach visitors would stop visiting their present beaches if a nuclear power-plant were sited 3 miles offshore.

1. It is unlikely that people will be willing to sacrifice the advantages of the beaches they have chosen to visit in the past because of an offshore floating nuclear plant.

^{1/}"Cleaning Up the Remains of Nuclear Facilities--A Multibillion Dollar Problem" (EMD-77-46, June 16, 1977).

2. The habitual nature of beach-going makes changes in beach preferences unlikely.
3. Most respondents had given little, if any, prior consideration to the questions asked.
4. If individuals were aware of NRC approval of the plant, the impact on nearest possible beach areas would be reduced by half.
5. There is no evidence of reduction in beach visitation at four land-based plants observed.
6. Individuals and society reflect a willingness to take risks.

We question this study's conclusion. We believe the questionnaire was heavily biased against locating nuclear powerplants offshore. Throughout the questionnaire are statements which encouraged the person interviewed to respond in a negative manner. For example, at several different points in the questionnaire, the person being interviewed was asked to conjure up in his mind the consequences of an accident from a floating nuclear plant and compare this with other natural disasters such as an earthquake or tidal wave. Thus, the 22.8 percent to 26.5 percent may indeed be exaggerated. However, in our opinion, the study provides no basis for quantifying the extent to which the presumed exaggerated figure should be revised downward. We believe this practice of undertaking a heavily biased study and then adjusting it downward, for whatever reasons cited by the author, is highly unusual.

Because of the problems we have found, we believe the study cannot be counted on as a basis for any decisionmaking. If NRC intends to use the study, it should be redone to more accurately reflect the percentage of those persons who would not return to a given beach area if a floating nuclear powerplant were sited offshore.

The NRC staff said the Florida State University study is only one part of its total assessment which is still underway on the effect of floating nuclear powerplant siting on tourism. In addition to this study, the staff said it has considered

--various studies of the social and economic impacts from construction and operation in the vicinity of operating nuclear powerplants,

--a staff survey of recreational behavior at water-oriented recreational facilities in the vicinity of operating nuclear powerplants, and

--the literature of human behavior relative to exposure to natural hazards and the literature on risk taking.

The matter of tourist avoidance was an issue in controversy before the Atomic Safety and Licensing Board at the time of our review.

WILL-A-FLOATING-NUCLEAR-PLANT-MINIMIZE-THE ENVIRONMENTAL-EFFECT-OF-POWERPLANT-OPERATION?

One of the main concerns about a floating nuclear plant is its impact on the environment. Offshore Power Systems has said that a floating plant may have no greater, and in many cases actually less, impact than a land-based plant. This is because the discharged water will be rapidly dissipated by the vast ocean waters. The thermal effect will be minimized such that there will be a temperature rise of only 3 to 5 degrees Fahrenheit within 5 acres of the site.

Also, the massive breakwater will serve as an artificial reef for many forms of marine life. Ocean plants and animals are expected to colonize the breakwater, thereby providing some fish with new feeding grounds and helping to increase the quantity and number of types of marine life in the area.

This assessment of a floating plant may be somewhat one-sided. The favorable environmental effects may be offset by the adverse effects of station construction and operation. For example, NRC admits a floating nuclear plant will have adverse effects on marine life from dredging of the seabed and installing the breakwater and transmission lines. During construction of the offshore station, placement of the breakwater will remove approximately 47 acres of ocean surface and ocean bottom from natural use. Placement of the undersea transmission lines will disturb about 127 acres.

NRC also says that the release of chemicals and heat during the operation of the floating nuclear plant will have adverse effects on marine organisms. These organisms will also be subject to striking the screens of the cooling water intake structures. Fish congregating in the warmth of the discharged water during the winter months will be susceptible to death due to cold shock during plant shutdown.

Officials with the National Oceanic and Atmospheric Administration and the Environmental Protection Agency provided us a mixed response on the expected net environmental effects of a floating nuclear plant. It may be that only after station construction has begun or a floating plant has operated for a matter of time can the environmental effects be assessed. NRC plans to require any owner of a floating nuclear plant to

periodically report on the environmental effects from station construction and plant operation.

WILL THE STATE OF NEW JERSEY PROVIDE A
GRANT FOR USE OF THE ATLANTIC GENERATING
STATION SITE?

The State of New Jersey has ownership of the Outer Continental Shelf for a distance of 3 miles from its shore. Before operations can begin at the Atlantic Generating Station site, control of the site must be transferred to Public Service Electric and Gas Company. As of May 1978, it was not known whether this transfer would be made.

The company, in June 1972, applied to the State of New Jersey for a grant to acquire the 186-acre site. In a letter dated June 15, 1976, the New Jersey Attorney General said that the present New Jersey statutes do not authorize the conveyance of the Outer Continental Shelf for siting a nuclear powerplant. If such an interest is to be granted legislation would be required.

As of May 1978, a bill proposing such action by the State legislature has not been introduced but officials of the company said a proposal would be made later in 1978. In our discussions with officials of the State of New Jersey, we received a mixed response as to whether an act providing a grant would pass the legislature.

NRC's position is that the absence of the right to use the proposed site should not preclude continuation of its licensing proceeding. NRC said its practice is to pursue administrative procedures while State and local proceedings are underway. Also, NRC says that its rules do not preclude going forward with construction permit proceedings where the applicant does not own the site.

While we do not disagree with the NRC position, the need for control of the site from the State of New Jersey is critical to NRC review of the license application by Public Service Electric and Gas Company. If a grant is not obtained, the licensing review will represent a substantial and unnecessary cost to the public (NRC), the applicant, and parties opposing the application. Generally, we found that NRC was not encouraging the applicant to seek this grant as early as possible nor was it keeping abreast of the likelihood of appropriate legislation being passed by the State of New Jersey legislature. If the utility does not obtain the grant for this site, it may have to find a new location to protect its \$200 million investment. This will require another construction permit application and NRC review.

Because of recent developments, the NRC staff said it is now suspending its review of the application. Specifically, on December 27, 1977, the Public Service Electric and Gas Company issued a press release stating that it was negotiating with Offshore Power Systems for a 3-year delay in delivery of the first floating nuclear plant. The press release also implied that the utility would be discussing alternative sites with the New Jersey Department of Energy. The NRC staff said these developments mean a long suspension of the staff review of this application and a question as to whether the current site will be the ultimate site chosen. If the utility desires at some future time to resume the project, the NRC staff said a new application or updated application would have to be filed and a new review process begun.

CHAPTER 4

CONCLUSIONS; OBSERVATIONS; RECOMMENDATIONS; AND AGENCY COMMENTS

The manufacture and operation of the floating nuclear powerplant could quite possibly pose more problems than can be reasonably anticipated at this time. Its uniqueness requires that special attention be given to the safety and environmental aspects of its operation. Although NRC has prepared a number of studies on the floating plant, it has yet to resolve various safety and environmental issues which various parties have raised during the licensing review. This review was continuing at the time we performed our work.

The most significant issue facing the floating nuclear powerplant concept is a core-melt accident. However remote, such an accident could release radioactivity affecting the water, the atmosphere, and the food chain. Yet, the risk of a core-melt accident producing a severe health and safety hazard has yet to be fully explored by NRC. Although NRC has calculated the relative risk of a core-melt accident for a floating and a land-based nuclear plant, it has not quantitatively established an acceptable level of risk for the floating plant.

Moreover, means for mitigating the effects of a core-melt accident have been generally described but NRC has not yet required that specific procedures be developed. Such procedures are counted on to reduce the overall consequences associated with a floating plant.

Additionally, problems have occurred with the weight of the floating nuclear plant but NRC has not addressed them in its safety evaluations. The floating plant and barge, like any other seagoing vessel, must not exceed a certain weight during its tow and mooring within the protective breakwater. Also, the plant weight may be a limiting characteristic if major or minor modifications are required after the plant begins operation. NRC has not yet shown due concern for potential plant weight problems and consequently has neither required that weight limitations be established nor formulated any program to monitor or control the weight of the floating plant.

Methods have not been developed for the transportation and handling of nuclear fuel and radioactive waste nor has a plan been developed for the recovery of this material should it fall overboard or if the transport vehicle were to sink. Additionally, a specific plan or method of funding has not been prepared for decommissioning the floating plant and the

breakwater. NRC believes there is nothing unique in the floating nuclear plant that would necessitate the development of such information on an exception basis. However, the transportation and handling of nuclear waste and spent reactor fuel for a floating plant will involve ocean-going travel which has not been a common practice. Also, the decommissioning of the floating plant and the breakwater will require a significant effort by the utility owner. We believe these areas are critical to any decision to license the floating nuclear plant and should be addressed in the review process.

If the floating nuclear plant is licensed for operation, its siting off the New Jersey coast may have a significant adverse impact on tourism at local beach areas and thus effect the regional economy. An NRC consultant has analyzed tourist avoidance and issued a report in October 1977. We question the study's conclusion. The questionnaire used in the study was heavily biased against locating nuclear powerplants offshore. Moreover, the study provides no basis for quantitatively reducing the results of the questionnaire. We believe this practice of undertaking a heavily biased study and then adjusting it downward is highly unusual. Therefore, the study should be redone.

Regardless of the resolution of the preceding issues, the need for a grant from the State of New Jersey may preclude the siting of two floating plants off that State's coast. We believe that if the licensing review should start again, the utility should be encouraged to determine as early as possible if the State is willing to provide such a grant and NRC should keep abreast of this situation.

RECOMMENDATIONS

Because of the unique and critical nature of a nuclear powerplant operating in an aquatic environment, answers to important safety and environmental issues must be resolved in the licensing process. We recommend that the Chairman, Nuclear Regulatory Commission, before concluding its review of the manufacturing license for eight nuclear powerplants should

- establish an acceptable level of risk for a core-melt accident on a floating nuclear plant;
- identify those changes which must be made to the design of the floating nuclear plant to achieve that level of risk; and
- require that weight parameters be developed for the safe operation of the floating plant and insure that these parameters are met.

We also recommend that before concluding its review of the operating license for two floating plants off the coast of New Jersey, the Chairman, Nuclear Regulatory Commission should

- identify specific methods for handling the loading and offloading of radioactive material and the recovery of such material in case of an accident;
- require specific procedures be developed for mitigating the consequences of a core-melt accident;
- require that a specific decommissioning plan be prepared for the floating plant and the breakwater, including a funding mechanism to assure that the facility owner pays the cost of decommissioning; and
- reanalyze the effect on tourism.

Further, we recommend that if the licensing review starts again, the Chairman should determine as early as possible if the State of New Jersey is willing to provide a grant for the siting of two floating powerplants off that State's coast. This may involve establishing a milestone date in the licensing review process by which time the applicant should have obtained the necessary grant. Otherwise, the Chairman should once again suspend the licensing review.

AGENCY COMMENTS

NRC sent, by letter dated August 2, 1978, its comments on our report. (See Appendix I.) NRC said our report, in its judgment, does not present an accurate, complete, and current overview of the NRC policies and reviews related to the licensing of floating nuclear powerplants. First, NRC says the report recommends that NRC take a number of actions that it has taken or is taking. The following is a discussion of NRC's comments on our recommendations.

1. NRC took exception to our recommendation that the Chairman establish an acceptable level of risk for a core-melt accident on a floating nuclear plant. It said that a range of acceptable risks for land-based nuclear plants has already been defined and the floating nuclear plant falls within it. However, we do not believe that NRC has comprehensively evaluated the risks of a core-melt accident on various land-based nuclear plants. For example, in testimony before the Advisory Committee on Reactor Safeguards during May 1978, the NRC staff admitted it had not applied a liquid pathway study--analyzing core-melt releases to groundwater, rivers, or other bodies of

water--for land-based nuclear plants. Also, if NRC has already established that the floating nuclear plant meets an acceptable level of risk, it is unknown why it would further require Offshore Power Systems to change the material in the concrete pad beneath the reactor vessel.

2. On another issue, NRC said our recommendation to require changes be made to the design of the floating nuclear plant to meet an acceptable level of risk has already been done. We disagree. Even though NRC has required that design changes be made, it has not established, in our opinion, an acceptable level of risk. Without this, we believe the changes required by NRC serve little purpose.
3. NRC said that our recommendation to require that weight parameters be established for the safe operation of the floating plant and to insure that these parameters are met is unnecessary. It said a "no grounding" criterion has been established and this criterion would satisfy any safety concern about the weight of the floating nuclear plant. However, more than simply establish a criterion, we believe NRC should actively consider plant weight as a safety issue. Weight problems have occurred in the past and could, once again, create difficulties for the floating nuclear plant.
4. NRC said our recommendation to require that specific procedures be developed for mitigating the consequences of a core-melt accident have already been taken. Specifically, it mentioned that the staff has asked Offshore Power Systems to replace the material in the concrete pad to provide additional time before melt-through by the reactor core. However, in testimony before the Advisory Committee on Reactor Safeguards, the NRC staff admitted that it neither had established a specific time before melt-through nor does it have any in mind. Thus, we do not believe that specific procedures have been developed.
5. NRC said that our recommendation to require a specific decommissioning plan for the floating nuclear plant and the breakwater at the time of licensing was neither prudent nor in the public interest. NRC also said it would rather determine that there are feasible and acceptable methods for decommissioning nuclear powerplants instead of requiring, before licensing, the specification of a particular plan. However, in our report "Cleaning Up the Remains of Nuclear

Facilities--A Multibillion Dollar Problem," we state that NRC has not paid much attention to one of the biggest problems that may confront the public in the future--that is, who will pay the cost of decommissioning nuclear powerplants? We believe that the cost of decommissioning should be paid by the current beneficiaries, not by future generations. Therefore, in our view, NRC should make advance planning for decommissioning mandatory at the time of licensing, including a specific decommissioning plan and provisions for funding. If, at some later time, NRC should determine that an alternative means for decommissioning would be more appropriate, then it could make any adjustments that are necessary to its initial plan.

6. NRC disagreed with our recommendation to reanalyze the effect on tourism. It said that GAO questioned a study on tourism although the GAO staff admitted no special expertise in statistical or behavioral analysis. On the contrary, as part of our review, people in GAO who are expert in statistical analysis evaluated the study in question and reached the conclusion that it needed to be redone.

Also, NRC said the report on one hand recognizes that the NRC licensing review for floating nuclear powerplants involves new and unique issues yet criticizes the slowness of the staff review regarding these issues. On the contrary, our report criticizes a number of management decisions that we believe have complicated the NRC review of the application to manufacture the floating plants. (See page 8.)

Finally, NRC said there is no discussion of various inter-agency agreements developed principally by the Commission to assess the broad environmental and safety aspects of the floating nuclear powerplant concept. As part of our review, we contacted a number of officials with various other agencies to assess the Commission's efforts in evaluating the floating nuclear powerplant and to get their views on which safety and environmental issues have not yet been evaluated in sufficient detail. Their views were considered in preparing our report.

CHAPTER 5

SCOPE OF REVIEW

We reviewed documents, studies, reports, correspondence, and other records, and interviewed officials at

- NRC headquarters, Bethesda, Maryland;
- Environmental Protection Agency headquarters, Washington, D.C.;
- National Oceanic and Atmospheric Administration headquarters, Washington, D.C.;
- Council on Environmental Quality headquarters, Washington, D.C.; and
- Department of the Coast Guard headquarters, Washington, D.C.

We contacted officials from Offshore Power Systems, Public Service Electric and Gas Company, the State of New Jersey, and intervenors participating in the licensing proceedings. Also, we attended several sessions of the licensing proceedings.

We submitted a series of questions to the NRC staff based upon information contained in an Office of Technology Assessment report on the coastal effects of offshore energy systems. Responses to those questions are used, where appropriate, in the report.

We also requested written responses on the contents of our draft report from nine outside parties--(1) Offshore Power Systems, Inc.; (2) Public Service Electric and Gas Company of New Jersey; (3) former Director, Office of Nuclear Reactor Regulation, NRC; (4) former Director, Division of Reactor Development and Technology, Atomic Energy Commission; (5) Environmental Protection Agency; (6) staff member, Council on Environmental Quality; (7) Environmental Policy Institute; (8) Union of Concerned Scientists; and (9) MHB Technical Associates. Their comments are used, where appropriate, in the report.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 2 1978

Docket No. STN 50-437

Mr. Monte Canfield, Jr., Director
Energy and Materials Division
United States General Accounting Office
441 G Street, NW
Washington, DC 20448

Dear Mr. Canfield:

The NRC staff has reviewed the second draft of a proposed report prepared by your office entitled, "Before Licensing Floating Nuclear Power Plants, Many Answers are Near at Hand" - June 1978, and offer the following comments regarding its content and recommendations:

In our judgment, the report will mislead its readers because it does not present an accurate, complete, and current overview of the NRC policies and reviews related to the licensing of floating nuclear power plants (FNP). We are specifically concerned with the following general points:

1. The report recommends that the NRC take a number of actions that the NRC has taken or is taking (See Enclosure p. 1, Items a and b, and p. 2 Items a and b).
2. The report on one hand recognizes that the NRC licensing review for FNPs involves new and unique issues yet criticizes the slowness of the staff review regarding these issues (See pp. 10-11 of the report).
3. Statements are made with respect to the technical adequacy of both NRC staff and associated contractor reviews relative to the NRC evaluations of complex technical issues. For example, the GAO criticized the analysis of the impact on tourism. The NRC staff has concluded, however, that the professional experience of the contractors is appropriate to their tasks. Further, our review of the tourism study prepared for the NRC has shown it to be an objective investigation (See Enclosure p. 3, Item d).
4. There is no discussion of the inputs provided by various agencies by way of NRC-initiated agreements to assess the broad environmental and safety aspects of the floating nuclear power plant concept. Examples of these agreements

Mr. Monte Canfield, Jr.

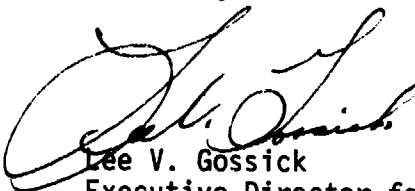
-2-

include the following: Interagency Regulatory Steering Committee, Memorandum of Understanding between the NRC and U.S. Corps of Engineers, Memorandum of Understanding between the NRC and the U.S. Coast Guard and cooperative agreements between the NRC and the NOAA.

NRC staff also disagrees with GAO's conclusions regarding other subjects including those related to FNP deployment in volume, the purpose of the generic environmental impact statement, and the effects of FNP operation on the environment. Our specific comments related to the recommendations presented in the report are provided in the enclosure to this letter.

We appreciate the opportunity to once again provide comments on this draft report and trust this letter will be included in the final version.

Sincerely,

A handwritten signature in cursive script, appearing to read "Lee V. Gossick".

Lee V. Gossick
Executive Director for Operations

Enclosure:
Comments on GAO Draft Report

Enclosure

NRC COMMENTS ON GAO DRAFT REPORT RECOMMENDATIONS

The GAO recommends that the Chairman, Nuclear Regulatory Commission, before concluding its review of the manufacturing license for eight floating nuclear power plants;

- a) establish an acceptable level of risk for a core-melt accident on a floating nuclear plant.
- b) require changes be made to the design of the floating nuclear plant to meet that level of risk.
- c) require weight parameters be established for the safe operation of the floating plant and insure that these parameters are met.

NRC Comments on GAO Recommendations (a), (b) and (c)

- (a) As noted in the Final Liquid Pathway Generic Study Report and the Revised Draft Environmental Statement, Part III, NUREG-0440 and NUREG-0127, respectively, there are differences in the magnitude of risks between the FNP design and land-based nuclear power plants. The risks of core-melt accidents are low for both the FNP and land-based power plants. The risks of core-melt events at an ocean-sited FNP are judged to fall within the upper portion of the acceptable range of risks for existing land-based plants while the risks of core-melt accidents at estuarine sited FNPs are greater than those for the ocean-sited FNP. The potential for severe environmental impacts due to a large prompt release of radioactive material from an FNP into the hydrosphere was the controlling factor which led to the placement of the FNP at the outer range of the spectrum of risks for existing land-based plants (See p. xii and p. 4-3 of NUREG-0127). The staff believes the level of risks for core-melt accidents at existing land-based plants is acceptable and that future land-based reactor designs may provide lower risk levels. Implicit in the analyses presented in NUREG-0127 is the view that the risks associated with the FNP should be comparable with present and/or future land-based designs.

Based upon the foregoing discussion, it is the staff's view that a level of acceptable risk for a core-melt accident at an FNP has been defined.

- (b) The FNP contains design features that are largely identical to a land-based nuclear power plant. As noted in NUREG-0127, certain FNP design and interface changes have already been recommended by

- 2 -

the staff (See p. xiv of NUREG-0127) to ensure that the FNP meets present NRC safety related criteria and, as well, provides an adequate level of protection for the environment.

- (c) GAO identified weight of the FNP as a safety issue that should be considered. The NRC has considered weight in perspective with the many other safety and environmental considerations and found that no additional safety concerns would be satisfied by considering weight alone and that the weight of the FNP is implicitly considered in the "no grounding parameter." This criterion is one of several site envelope parameters that the FNP design must satisfy. As noted in Table 1.2 of Supplement No. 2 to the Safety Evaluation Report, NUREG-0054 the "Plant must not ground under the influence of environmental loads." It should be emphasized that the NRC "no grounding" criterion includes a consideration of weight and loading effects among other parameters to insure meeting this site design requirement. For each specific site, this requirement dictates a minimum low water depth to insure that the FNP does not ground during normal and extreme environmental conditions. It should also be noted that the effect of weight on seaworthiness during tow will be reviewed by the Coast Guard as part of their permit review process for the FNP. Further, the spent fuel pool located on the FNP and referred to in the report has undergone a redesign to expand its capacity and the additional weight associated with this change has been considered in the "no grounding" criterion.

Thus, the staff believes the development of an NRC weight monitoring requirement as described by the GAO is unnecessary.

The GAO also recommended that before concluding its review of the operating license for two floating plants off the coast of New Jersey the Chairman, Nuclear Regulatory Commission,

- a) identify specific methods for handling the loading and offloading of radioactive material and the recovery of such material in case of an accident.
- b) require specific procedures be developed for mitigating the consequences of a core-melt accident.
- c) require that a specific decommissioning plan be prepared for the floating plant and the breakwater, including a funding mechanism to assure that the facility owner pays the cost of decommissioning.
- d) reanalyze the effect on tourism.

- e) Further, the GAO recommends that if the licensing review should continue, the Chairman determine as early as possible if the State of New Jersey is willing to provide a grant for the siting of two floating power plants off that State's coast.

NRC Comments on GAO Recommendations (a), (b), (c), (d) and (e)

- (a) The NRC position concerning loading and off-loading spent fuel casks on barges is that the development of specific handling methods and procedures will be required for review and approval by the NRC before an operating license will be issued and thus this GAO recommendation is consistent with our present policy.

However, it should be noted that Sections 6.13 and 12.6.9 of the generic environmental statement (FES-Part II, NUREG-0056) related to the OPS application and Section 5.6 of the draft environmental statement (NUREG-0058) related to the Atlantic Generating Station (AGS) application describe in some detail the activities associated with the transportation of nuclear materials to and from FNPs. The utility/owner of an FNP would have to conform to regulations established by the NRC (10 CFR Part 71), the Department of Transportation - U. S. Coast Guard (49 CFR Parts 170-189 and 46 CFR Part 146) and affected states regarding the packaging and shipping of nuclear materials. These regulations are intended to insure that the transport of such materials by land, sea or air to and from FNPs will be conducted with an acceptably low level of risk to the health and safety of the public and with adequate protection of the environment.

- (b) As noted previously, NUREG-0127 includes a staff recommendation for an FNP design change to mitigate the consequences of a core-melt accident. Mitigation procedures are also discussed in NUREG-0127, and will be factored into the staff analyses related to postulated core-melt accidents at specific FNP sites such as the proposed Atlantic Generating Station.
- (c) It is the NRC policy to determine during the licensing process that there are feasible and acceptable methods for decommissioning nuclear power plants (land-based or floating) rather than to require, before licensing, the specification of a particular plan. This allows for changes in regulations and improvements in technology as well as consideration of future alternative uses of the power plant site in 30 or 40 years between licensing and decommissioning.

Sections 9.5 and 12.4 of the generic environmental statement (FES-Part II, NUREG-0056) and Section 10.2.3 of the AGS draft environmental statement (NUREG-0058) discuss various alternative decommissioning techniques for both the FNP itself, the breakwater and associated transmission lines and shore facilities.

- 4 -

Decommissioning the FNP, including the breakwater poses some different, though no more serious problems, than land-based plants and viable decommissioning methods are available.

Since the NRC is currently reviewing its policy with regard to requiring the development of preliminary decommissioning plans by applicants, we conclude that the GAO recommendation to require a specific decommissioning plan at the time of licensing is neither prudent nor in the public interest.

- (d) Although the GAO staff admits to no special expertise in statistical or behavioral analysis, the GAO questioned the conclusions reached in the study concerned with the adverse effects of FNPs on tourism (NUREG-0394).

The questionnaire for the study was designed so that the direct question on avoidance was asked immediately after the initial questions concerning demographic characteristics and beachgoing behavior and prior to any questions concerning attitudes about nuclear power; therefore, these questions could not influence the initial avoidance response. The assumption of initial overestimate is not associated with the sequencing of questions but rather is based on well documented research. (See pp. 132-134 of NUREG-0394). The adjustments made to the initial estimates of intended avoidance and the rationale for modifying verbal responses when predicting actual behavior are described on pp. 95-97 of NUREG-0394. The authors of NUREG-0394 provided testimony during OPS hearings held in July 1978 and the staff believes the hearing record supports their study as a valid piece of behavior research.

- (e) The general NRC policy with regard to our review of applications for nuclear power plants prior to acquisition of the associated site is unless other events render a Commission proceeding moot, the Commission's review process will not be stayed based on what might or might not happen at some future date. However, since the application for a riparian grant was filed in June 1972 and is still pending before the New Jersey Department of Environmental Protection, and since the applicant has recently announced a three-year delay in delivery of the FNPs, the NRC will, when appropriate reinstitute its review of this project only after receipt of assurances from the State of New Jersey regarding the granting of riparian rights.

PRINCIPAL OFFICIALS RESPONSIBLEFOR ADMINISTERING ACTIVITIESDISCUSSED IN THIS REPORT

Tenure of office
From To

Nuclear Regulatory Commission

CHAIRMAN:

Joseph M. Hendrie	Aug. 1977	Present
Marcus A. Rowden	Apr. 1976	June 1977
William A. Anders	Jan. 1975	Apr. 1976

EXECUTIVE DIRECTOR FOR OPERATIONS:

Lee V. Gossick	Jan. 1975	Present
----------------	-----------	---------