Chapter II

MAJOR FINDINGS AND SUMMARY

The following are the major findings of this assessment of the three energy systems which have been proposed for deployment off the coast of New Jersey and Delaware. A summary of the assessment of each of the technologies is included after the findings.

- **No significant damage to the environment or changes in patterns of life in either New Jersey or Delaware is anticipated during operation of the three systems at** presently projected levels. However, careful planning, engineering, and strict operational monitoring are required for each of these complex systems. To a large extent, such planning and monitoring will depend on the quality of oversight by the responsible Federal agency.
- Future deployment of ocean technologies on a scale larger than that anticipated at the present time could create serious conflicts among users and impose excessive burdens on ocean and coastal environments. No formal mechanism exists or is planned for resolving conflicts or directing research to discover the cumulative social and environmental consequences of vastly expanded uses of the oceans.
- Changes in Federal practices are necessary to reduce delays in determining offshore oil and gas resources, to provide full attention to State and local needs and potential impacts, and to assure strict enforcement of operating standards to minimize ocean and coastal pollution. Consolidation of authority within the Department of the Interior is essential to supervision of offshore development and the coordination of operations with State and local governments.
- While floating nuclear powerplants may offer economic and environmental advantages over land-based nuclear plants, the siting of nuclear plants on water may present unique accident risks which have not yet been comprehensively assessed by the Nuclear Regulatory Commission.
- Tankers that would use deepwater ports off New Jersey and Delaware pose a greater pollution and safety threat than the ports themselves. Confining tanker operations to a port several miles from the coast may offer environmental and safety advantages, provided that the tankers using the facility are strictly regulated.

- There are specific alternatives which, if substituted for each of the proposed offshore projects, could supply equivalent amounts of energy to the Mid-Atlantic region. None, however, offers clear social, environmental, or economic advantages. Increased imports are an alternative to offshore oil and gas development. Onshore nuclear plants and coal-fired plants are alternatives to floating nuclear powerplants. Greater reliance on small tankers is an alternative to deepwater ports. Reduction of energy consumption could offer long-term advantages, but there are no specific plans at the State or national level for an energy conservation program that might eliminate the need for the energy supplies which would come from one or more of the proposed offshore systems.

A principal product of this assessment is the development of public policy issues associated with the deployment of each offshore technology and the identification of congressional options for addressing those issues.

Chapter III contains a complete presentation of the issues and options.

OFFSHORE OIL AND GAS SYSTEMS—SUMMARY

The submerged Outer Continental Shelf (OCS) lands of the Mid-Atlantic were classified by geologists as a potential source of oil and natural gas in the late 1950's, but they did not become a priority target for development until the 1970's.

Following the oil embargo imposed by the Organization of Petroleum Exporting Countries in October 1973, accelerated leasing and development of the Mid-Atlantic OCS was made a high priority item in the Administration's plan for lessening U.S. dependence on foreign sources of oil.

In 1974, studies by the U.S. Geological Survey estimated that as much as one-third of the U.S. oil reserves for the future were most likely to be discovered in the OCS regions. In the Mid-Atlantic, estimates were that oil production could be as much as 7 percent of the 1973 national production level and gas production could be as much as 8 percent of the 1975 national production level.

As first announced, accelerated OCS development called for leasing a total of 10 million acres in a single year, an amount equal to what had been leased during the previous 21 years.

Although the Bureau of Land Management (BLM), Interior's lead agency in leasing, had been examining the possibility of an accelerated program for 2 years before the 1973 decision was made, it was not prepared for a sudden change of this magnitude. In the period since the acceleration program was announced, BLM has been chronically short of staff, particularly the specialists required for analyzing coastal and onshore impacts in frontier States. BLM was also unprepared for the adverse reaction of Atlantic Coastal States to the 1973 accelerated leasing decision.

The Governors of both New Jersey and Delaware publicly favor early exploration of the Mid-Atlantic OCS for oil and natural gas, but their support is qualified. Both have argued for changes in Federal OCS policy as a condition of their full support.

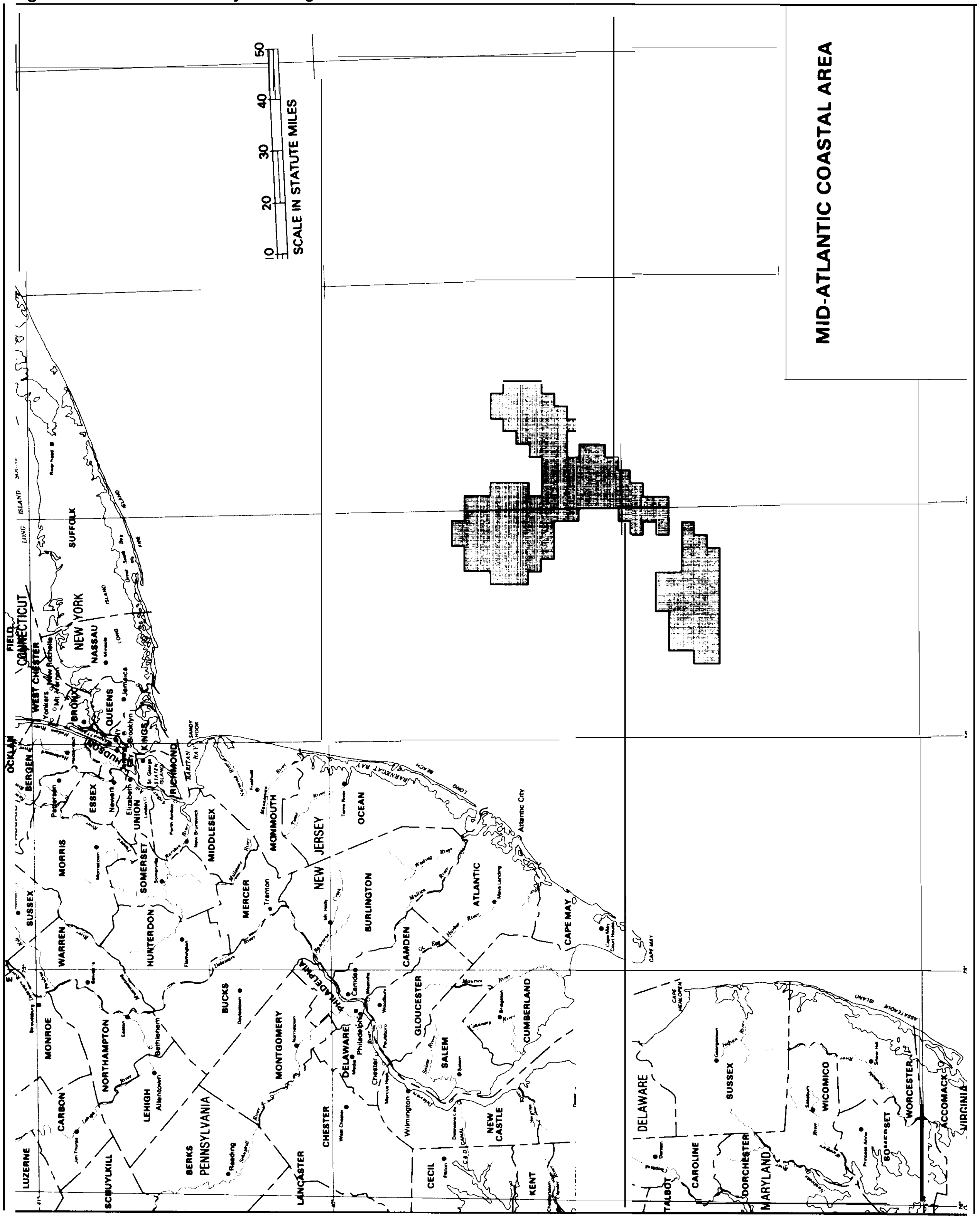
The desire for change stems from several factors. One involves basic uncertainties about environmental and economic impacts of a technology which is alien to the Mid-Atlantic even though it is familiar to the Gulf of Mexico. Another involves a series of lapses in communication and coordination between the States and the Interior Department which have raised doubts among State officials about the capability of the Federal Government in planning for operation of offshore oil and gas systems.

The Mid-Atlantic OCS program intensified pressure on the State governments, particularly from residents along the coast, to protect their beaches. Because existing law restricts major decisions about OCS development to the Federal Government, State officials have argued for a role as active participants, rather than observers, in three general areas. They are:

- Drafting of oil and gas regulations and enforcement plans which could affect the quantities of oil that may be spilled during offshore development;
- Selection of areas to be leased which will affect locations of such facilities as onshore staging areas, pipeline landfalls, tank farms, and gas processing plants; and
- Approval of development plans which set a pattern of deployment of technology that would prevail in the area during the life of a Mid-Atlantic oil and gas field.

State officials also desire more centralization of responsibilities and authority within

Figure 11-1. Baltimore Canyon Trough lease sale area



Source Office of Technology Assessment and U S Department of the Interior

the Interior Department to facilitate the flow of information to the States.

This report contains detailed descriptions of each of the component elements in a typical offshore oil and gas system, starting with geophysical survey ships which are used to gather preliminary data on resources and continuing through technology used for exploration drilling, production drilling, transportation, storage, and processing. Deployment of technology is traced over time for two assumptions-one in which 1.8 billion barrels of oil and 5.3 trillion cubic feet of gas are discovered and recovered and another for 4.6 billion barrels of oil and 14.2 trillion cubic feet of natural gas.

It is estimated that 25 platforms could be installed offshore, each with 24 producing wells, within 14 years after the initial lease sale to produce the 1.8 billion barrels of oil at an average peak rate of 313,000 barrels per day. Under the 4.6 billion barrel assumption, there could be 52 platforms, each with 24 producing wells within 15 years after a lease sale. Peak daily rate for this assumption would be 650,000 barrels.

Onshore, the oil and gas distribution network, averaging both assumptions, would cover about 3-square miles with pipeline rights-of-way, staging areas (of up to 170 acres), tank farms (covering 50 to 75 acres each), and gas processing plants (on sites of about 100 acres each). If drilling platforms were fabricated in either State, land needs would increase by about 1,000 acres.

Five areas in the New Jersey–Delaware region could serve as staging areas for offshore development, three coastal sites and the port complexes of New York City and Philadelphia–Camden. All three coastal sites—Atlantic City and Cape May, N.J., and Lewes, Del.—would meet such staging area requirements as availability of harbors for supply boats, accessibility by rail, proximity to lease sites, and availability of land for storage and service facilities. Service firms under contract to oil companies would choose staging areas on the basis of lowest overall operating costs.

Earlier studies by the Council on Environmental Quality, the American Petroleum Institute, and the Department of the Interior have produced varying projections of the physical, biological, and social changes that would result from offshore development in the Mid-Atlantic OCS. The earlier studies used different assumptions about the amounts of oil and gas that may be recovered and different State and/or regional boundaries for consideration. When these projections are adjusted to a common base, however, they fall within the same general range of effects that are estimated in the OTA study.

It is concluded that, if a major spill occurred at a drilling or production platform 50 miles at sea, the odds are one in ten that an oil slick would reach the beaches of New Jersey and Delaware.

The danger of oil striking a beach would increase if a spill occurred as a result of a pipeline rupture nearer to shore. The danger would decrease if a spill occurred at structures farther than 50 miles from shore. The platforms expected as a result of the first Mid-Atlantic lease sale will be located approximately 54 to 100 miles from shore. The distance lowers the risk of oil striking the beach and also makes the structures invisible from shore.

One element of the offshore oil system that would require particularly careful planning is the placement of pipelines in coastal areas. There is general agreement that pipelines should be routed to avoid marshlands, a design that would be difficult to achieve along the New Jersey or Delaware coast, virtually all of which is backed by marshlands,

Direct employment in New Jersey and Delaware would peak at about 9,000 workers

if the high estimate of 4.6 billion barrels of recoverable oil is correct and at about 4,500 workers if the median estimate of 1,8 billion barrels is correct. Capital expenditures would total between $2 billion and $4 billion. Peak land requirements for the high estimate would be about 1,645 acres in the New Jersey–Delaware region. Of that, 320 acres could be coastal land around coastal harbors and the remainder would be inland. Seven hundred acres would be required for pipeline rights-of-way that probably would parallel existing railroad lines or highways.

Analysis of the tax systems of a variety of coastal States, including New Jersey and Delaware, indicates that per capita tax revenue from OCS-related installations onshore would be significantly higher than the statewide average per capita revenues from other sources, except during the first 2 or 3 years of development. The principal reason is that the major onshore installations, such as tank farms and pipelines, are capital intensive, and therefore produce substantial sales and property tax revenues. However, this estimate is for statewide revenues only. It is quite possible that particular localities within a State will experience net adverse budgetary impacts during the course of OCS development, since there is little reason to expect that the tax revenue-producing onshore facilities would be located in the tax jurisdiction of the communities that must provide public services and facilities for the population supporting offshore exploration and development. This problem may also occur between States if the oil and gas are not landed in the same State in which the main support bases are located. It is also possible that a locality could experience a net negative fiscal impact if extraordinary expenditures for public facilities such as roads are required to support OCS development.

The major source of potential impacts on air and water quality onshore would be any new refinery capacity that might result from OCS development. Ambient air quality standards, particularly those related to oxidant levels, could be a significant constraint on new or expanded refinery capacity. Concentrations of waterborne pollutants in refinery effluent are relatively small and probably would not significantly affect the quality of a receiving stream. Refinery cooling, however, could produce thermal pollution problems in Delaware Bay or Newark Bay, both of which are already very close to the maximum permissible load.

Dramatic changes in regional energy prices should not be expected to follow OCS development. Lower transportation costs might give New Jersey and Delaware a price advantage compared with some other regions of the country. But future prices would depend, in part, on oil and gas price control policies.

As a result of its study, OTA has identified the Federal-State conflicts as the major issues. Eight specific OCS issues are treated in this report. They are:

Federal Management System .—Federal management of the offshore oil and gas program is fragmented within the Department of the Interior and coordination with other Federal agencies which share jurisdiction is ineffective. (See pages 43–46.)

Regulation and Enforcement.—Inadequate regulation and enforcement of offshore oil and gas technology could result in more accidents and more oil spills than would occur if a more effective system were implemented. (See pages *47–50.)*

Oil Spill Liability and Compensation.—Existing laws are not adequate either to assign liability or compensate individuals or institutions for damages from oil spills resulting from exploration, development, or production in the Baltimore Canyon Trough area. (See pages 51 –56.)

Oil Spill Containment and Cleanup.—There

is no assurance that the technology utilized in the Baltimore Canyon Trough or in any other OCS frontier region would be adequate for oil spill surveillance, containment, and cleanup. (See pages 57–59.)

Environmental Studies.—Environmental research and baseline studies are not formally coordinated with the Interior Department's leasing schedule and there is no requirement that information gathered be used in the decisionmaking process for sale of offshore lands and subsequent operation. (See pages 60-62.)

State Role.—The limited role of State governments in the decisionmaking process for OCS development under existing laws and practices may lead to unnecessary delays and improper planning for such development. (See pages 63–66.)

Pollution Research.—The effects of pollutants which may be discharged during OCS operations cannot presently be determined with any accuracy and recent research efforts have not clarified conflicting claims by oil companies and environmental groups regarding the amount and consequences of marine pollution. (See pages 67–69,)

Conflicting Ocean Uses.—There are potential conflicts between OCS oil and gas activities and vessel traffic engaged in commercial shipping and fishing activities. However, there has been no comprehensive study and analysis to identify all conflicts and to find ways of resolving them. (See pages 70–75.)

OFFSHORE OIL AND GAS SYSTEMS—FINDINGS

Effects of OCS Development

Oil and natural gas can be produced in the amounts presently projected off the Mid-Atlantic coast without significant ***damage to*** the environment or disruption of patterns of life in New Jersey or Delaware if operations are carefully designed, planned, and monitored. However, careful planning, engineering, and strict operational monitoring are required for each of these complex systems. To a large extent, such planning and monitoring will depend on the quality of oversight by the responsible Federal agencies. (See pages 150– 160.)

Changes in lines of authority within the Department of the Interior would improve the Department's ability to supervise offshore development and to coordinate operations with State and local governments. (See pages *43–46*, 1 30–131 .)

Federal-State Relations

States cannot participate in a meaningful way in the process that leads to major leasing and OCS decisions under present policies. The State role at present is little more than that of commentator. (See pages 131–140, 155- 156.)

Existing laws and regulations do not clearly specify the information about OCS activities to which States are entitled, a lapse that encourages disputes over rights to data between State and Federal officials. (See pages 63–66, 125, 138–140, 147–150.)

Federal efforts to deal with State concerns are fragmented among many departments and agencies and seldom reflect a sense of need for coordination, clear lines of communication, and close working ties. (See pages 43–46, 130, 152–155, 161 –165.)

The Interior Department's relations with

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State governments are improving but relations still depend more on individual judgments by Interior Department officials than on formal administrative procedures on which the States can rely. (See pages 139-140.)

- Changes in Federal OCS policies and practices have lagged behind changes in the social and political climate in the Mid-Atlantic in which offshore development will occur. The lag is particularly important with respect to environmental concerns and a desire among States for greater access to Federal information and decision making. (See pages 63-66, 127–1 31.)

- As of mid-1976, the Office of Coastal Zone Management had not asserted itself as coordinator of State and Federal activities involving the effects of offshore development on the coastal zone. (See pages 43–46, 136-138.)

- Concerns of New Jersey and Delaware officials over environmental and social impacts of offshore development are compounded by their doubts about the quality of Federal management of the leasing program and doubts about the effectiveness of the enforcement of OCS regulations. (See pages 63–66.)

- Neither Delaware or New Jersey wants to delay offshore development unnecessarily, but both are prepared to seek legal remedies if development in the Mid-Atlantic proceeds without what they consider adequate State participation in decisions. (See pages 159–160.)

Planning

- Federal requirements under the Coastal Zone Management Act that Federal activities be consistent with a State's coastal zone management plan have played no role as yet in Mid-Atlantic OCS activities because neither New Jersey or Delaware has completed coastal zone management plans. (See pages 136–138.)

- The exact location of OCS facilities and the magnitude of development impacts will not be known until Outer Continental Shelf "frontier areas" have been explored and the size and location of petroleum resources have been determined. (See pages 133, 143-144, 146– 172.)

Regulation, Safety, and Pollution

- The regulation of offshore technology by the U.S. Geological Survey (USGS) is based on general guidelines to the industry with minimal inspection and enforcement, USGS regulations are more concerned with specific pieces of equipment than with the total oil and gas production system. (See pages 47-50, 130, 146, 152–155, 161–163.)

- Techniques exist, but are not always used, for setting design standards and installation practices and for testing all major items of equipment involved in OCS operations. (See pages 47–50, 152–155, 161 –163.)

- Federal regulations are not sufficiently precise with regard to standards for construction of offshore platforms or pipelines. (See pages 47–50, 152- 155.)

- The purpose of the Interior Department's OCS environmental studies program and its role in the management of OCS activities is not clearly defined. In their present form, environmental surveys conducted under the auspices of this program are not useful either in writing environmental impact statements or in making OCS leasing decisions. (See pages 60–62, 134–135.)

. Federal pollution research efforts are not as well coordinated as are those sponsored by private industry. (See pages 67–69, 167–169.)

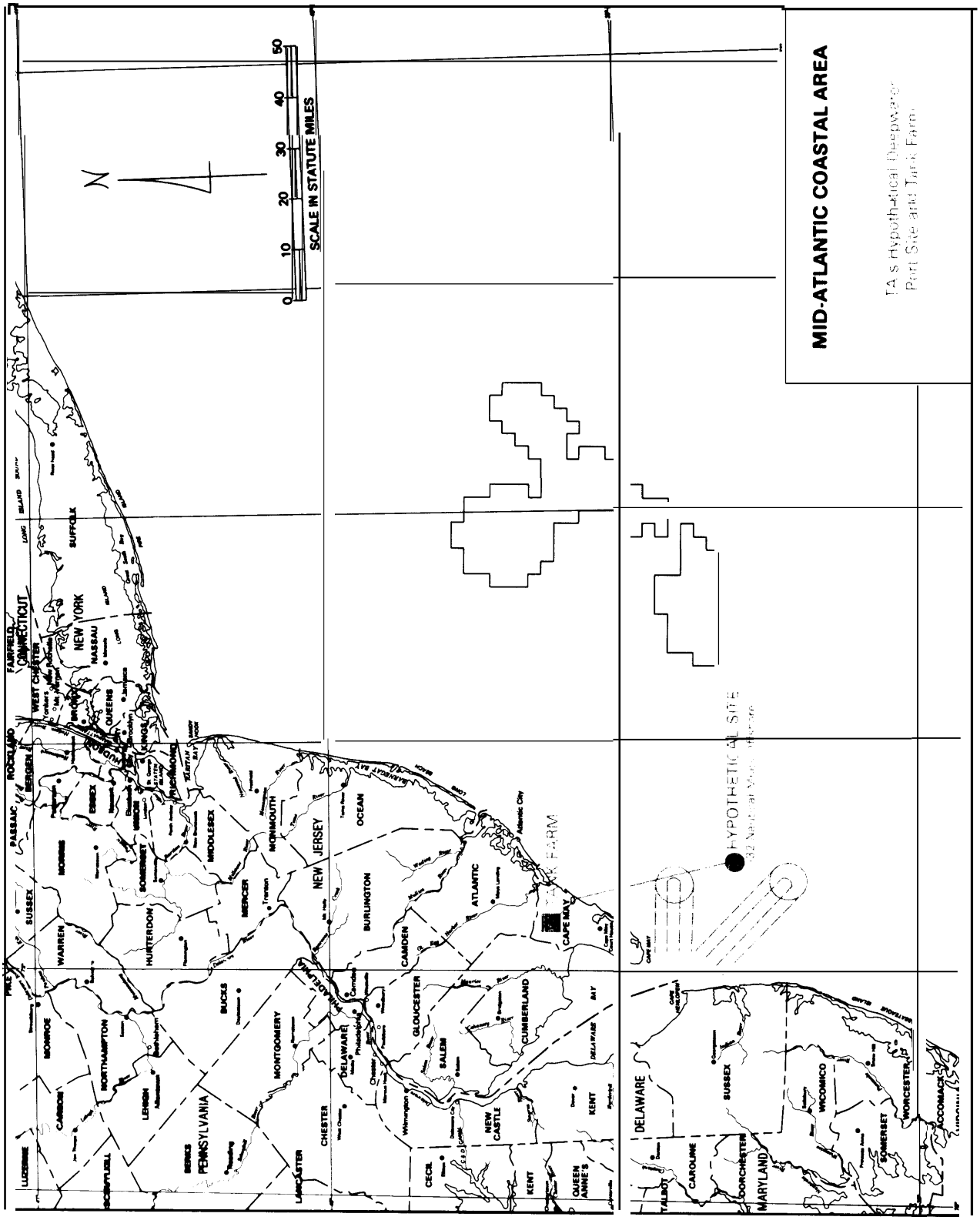
Oil Spills

- Under some weather conditions, oil spills from a platform as far as 50 miles at sea could reach the New Jersey and Delaware coasts but it is not possible to predict the point of impact. (See pages 165–166.)
- Weather, wind, and ocean currents will affect the dispersion, trajectory, chemical composition, and ultimate disposition of oil spills. These conditions vary from season to season, and even from day to day, but research on ocean conditions in OCS areas has a low budget priority. (See pages 165–166.)
- The Federal Government does not set definitive standards for the industry to follow in carrying out its responsibility to provide cleanup equipment in the event of a major oil spill. USGS does not inspect cleanup equipment but relies on industry to make its own inspections. (See pages 57-59, 166- 167.)
- USGS procedures for monitoring discharges of oil and other pollutants during OCS operations are inadequate and the agency does not use monitoring equipment that is available and in use by other Government agencies. (See pages 57–59, 166–169.)
- Under existing Federal practices there are no standards that cleanup and containment equipment, which would be available in the Mid-Atlantic, must meet, and no assurance that a major oil spill actually could be confined and removed from the water even if the best equipment is available. (See pages 57–59, 166– 169.)
- At the present time, the laws of an adjacent State would be used to determine a lessee's liability for oil spill damages but neither New Jersey or Delaware laws provide for compensation to injured parties. (See pages 51–56.)

Impacts

- Drastic changes in regional energy prices will not result from offshore development in the Mid-Atlantic. (See pages 171–172.)
- A net fiscal benefit to Mid-Atlantic State governments probably will result from onshore facilities related to offshore development but there may be localized fiscal problems and the advantage would not occur until after the first 3 years of offshore activity. (See pages 157– 159.)
- Discovery of offshore oil would not necessarily lead to construction of new refineries in the Mid-Atlantic. In fact, existing air quality regulations might prevent construction of new refineries in New Jersey and Delaware. (See pages 169–170.)
- The major impacts on air and water quality in the region would result from expanded refineries and from gas processing plants. (See pages 170– 1 71.)
- There is no formal mechansim for resolving conflicts among the many users of the ocean or for directing research to discover the cumulative environmental consequences of expanding the use of the ocean for energy development and other purposes. (See pages 37-42, 70-75, 155–156.)

Figure II-2. Hypothetical deepwater port site offshore New Jersey coast



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DEEPWATER PORTS — SUMMARY

In the late 1960's, energy supply patterns and environmental concerns seemed to justify construction of at least one deepwater port for supertankers off the coast of New Jersey and Delaware.

By 1976, that was no longer the case. A series of changes in State laws and Federal policies, capped by the inflation and uncertainty of supplies that followed sharp increases in world oil prices, had changed the region's petroleum distribution system dramatically.

Plans for expanding old refineries and building new ones were on the shelf. Increases in demand for petroleum products were being met by Gulf Coast and Caribbean refineries. Inflation had doubled original estimates of the cost of a deepwater port.

Extensive interviews with industry officials and analysis of feasibility studies disclose that—barring future changes as drastic as those of the early 1970's—the oil industry will not revive Mid-Atlantic deepwater port plans for at least 10 years.

New tax policies, changes in environmental laws, changes in oil prices or sharp increases in Mid-Atlantic demand for imports could change the picture again. It also is possible that environmental or political goals could prompt States to build a deepwater port even if it were not attractive on purely economic grounds.

In the meantime, the oil industry is moving ahead with plans to build two deepwater ports off the shores of Texas and Louisiana that eventually can handle 10 million barrels of oil a day. A program of refinery construction and expansion is underway in both Texas and Louisiana to handle imports of crude oil.

During the period of strong Government and industry interest in Mid-Atlantic deepwater ports, several sites and types of terminals were studied, including a sea pier located inside Delaware Bay. Of these, the technology most likely to be placed in waters under Federal jurisdiction is a large monobuoy complex located far enough from the coast to serve the largest supertankers in the world fleet. These are 480,000 deadweight ton (dwt) ships, a quarter-of-a-mile long, that carry up to 3.7 million barrels of oil and require 110 feet of water depth for maneuvering. One site that could accommodate the largest tankers is 32 miles off southern New Jersey where waters are 110 to 115 feet deep.

Oil could be pumped from the site through underwater and overland pipelines to the Delaware River refinery complex which includes seven refineries with a total capacity of 890,000 barrels of petroleum product per day. The capacity of the refineries could be nearly doubled without acquiring additional land.

During the course of this study, several bulk-oil terminal designs were analyzed. The monobuoy was selected for detailed study because it is a proven technology, already in operation in more than 100 deepwater ports around the world, and because it is less expensive, safer, and more accessible in rough weather than other designs.

A monobuoy is a floating steel drum, 30 feet to 50 feet in diameter, which is anchored over a buried pipeline leading to shore. Tankers tie up to the buoy, connect the buoy's floating rubber hoses to their cargo compartments and pump oil through the hoses and into the pipeline.

Under 1976 conditions, the cost of building and operating a monobuoy complex off Delaware Bay would make the price of transferring oil through the deepwater port higher than the existing system, which uses lightering barges. Another barrier is

Delaware's Coastal Zone Act which prohibits pipeline landfalls in that State. New Jersey's Coastal Area Facilities Review Act does not prohibit pipeline landfalls outright but both the present and immediate past Governors of New Jersey are on record in opposition to deepwater port development in their State.

Thus, the descriptions of technology and the likely consequences of its deployment which are discussed in this study are purely hypothetical. Basic changes in policy and the economics of oil distribution will be necessary before a deepwater port can be deployed in the region.

Given the lack of interest in a Mid-Atlantic deepwater port on the part of Government officials and the oil industry, the matter is not a major public issue at this time. The passage of the Federal Deepwater Port Act of 1974 also has reduced the number of issues of Federal concern.

However, this study has identified several potential issues. They include:

Tanker Design and Operations.—Tanker spills are the source of five to fifteen times as much oil as all offshore drilling and port operations combined; yet pollution control regulations are far less stringent for tankers than for either deepwater ports or offshore oil and gas operations. (See pages 76–79.)

Oil Spill Containment and Cleanup at Deepwater Ports.—The use of offshore deepwater ports may reduce the risk of certain oil spills and environmental damage below that of transporting crude oil by smaller tankers into the congested New York Harbor and Delaware Bay. Even the very small risk of a catastrophic spill from a supertanker, however, dictates that stringent pollution control and cleanup systems be used. (See pages 80–82.)

Standards in State Waters.—Under existing Federal law, operators of deepwater ports in State waters could ignore the safety and environmental pollution standards that apply to ports outside the 3-mile limit. (See pages 83-85.)

Adjacent Coastal State Status.—Differing interpretations of statutory criteria for determining adjacent coastal State status make it difficult to predict which States could qualify for that status in the future and whether some States may be deprived of the benefits of such status. (See pages 86–89.)

DEEPWATER PORTS—FINDINGS

Construction

. A deepwater port is not likely to be built to serve the Mid-Atlantic during the next 10 years. (See pages 186–188.)

. Industry is not likely to abandon its existing marine transportation system for supplying the Mid-Atlantic with oil products as long as there is no clear cost advantage. (See pages 173-178, 186–188.)

. Expanded or new refinery capacity would be necessary to make a deepwater port economically feasible, But existing Federal and State air quality regulations make construction of new refineries along the Delaware River and Bay unlikely in the foreseeable future, although existing refineries may be expanded without exceeding pollution standards. (See pages 186– 188.)

Environment

. Because a decision to build a deepwater port would logically follow—not force—

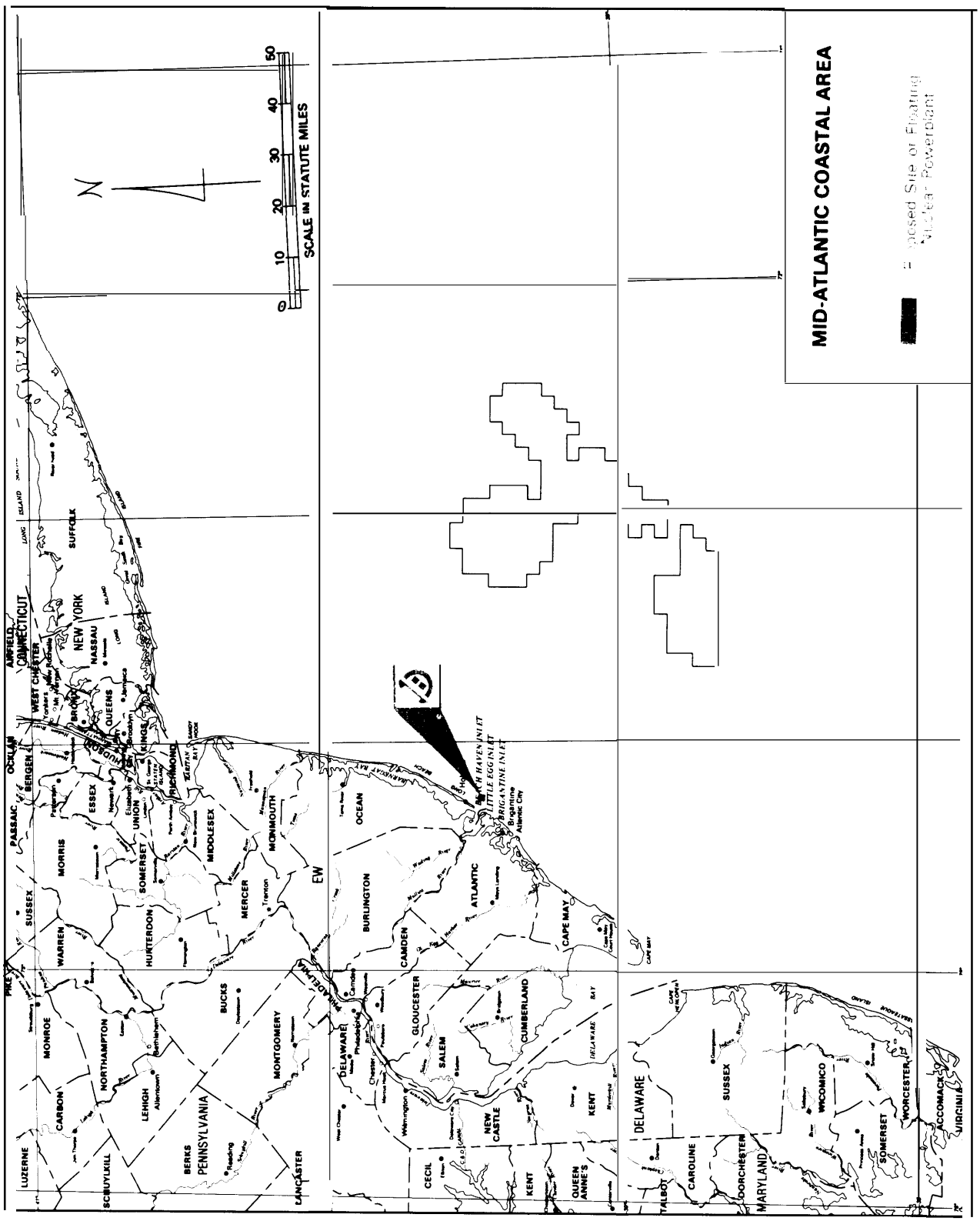
a decision to build new refineries, a port is likely to be postponed at least until, and if, refinery capacity in the Mid-Atlantic expands significantly. (See pages 186–188.)

- A deepwater port system would offer environmental advantages over small tankers operating in existing ports. Presently, small tankers spill twice as much oil that can damage the coastal zone as would be spilled in a deepwater port system. (See pages 193–194.)
- The most serious threat of oil spills as a result of a deepwater port system comes from the tankers using the port. Yet, tanker regulations are less strict than port regulations. (See pages 76–79, 195– 196.)
- Because of the serious design limitations of containment and cleanup equipment, even the most advanced equipment will be effective only about 55 percent of the time in winter seas off the Mid-Atlantic coast. These facts emphasize the importance of preventing spills rather than regulating cleanup equipment. (See pages 80–83, 193–194.)

Planning and Procedures

- Coast Guard Vessel Traffic Surveillance Systems are not required for deepwater ports in State waters and budget priorities in the Coast Guard could delay installation of these systems for the ports. (See pages 83-85, 185- 186.)
- There is disagreement among Federal officials, State governments, and other interested parties as to statutory criteria for determining which States near a deepwater port are eligible for economic assistance and regulatory powers of the Deepwater Port Act. (See pages 86–89, 195.)
- Applications for the construction and operation of deepwater ports in State or territorial waters are not under the jurisdiction of the Deepwater Port Act and there is minimal coordination between the two agencies which do have jurisdiction —the Army Corps of Engineers and the Department of Transportation. (See pages 83-85, 185–1 86.)

Figure II-3. Proposed site of the floating nuclear powerplant



Source Off Ice of Technology Assessment and Public Service Electric &I Gas Co

FLOATING NUCLEAR POWERPLANTS—SUMMARY

Late in 1972, New Jersey's largest public utility company concluded that floating nuclear powerplants moored off the coast would solve a major problem faced with all large-scale generators—access to cooling water. The company, Public Service Electric & Gas Co., which generates more than 60 percent of the State's power, also concluded they could be built for less money and be less environmentally damaging than land-based plants. Access to cooling water was crucial to the company's future plans. At the time its customers were using electricity at rates that meant doubling Public Service's generating capacity every 8 years—a rate of growth well above the national average—and the number of sites for new plants that could be built without cooling towers was severely limited.

During the period of steep growth in demand in the late 1960's and early 1970's, the offshore plant was a critical element in Public Service's long-range plans for providing new generation facilities. Its construction schedule called for having large amounts of new generating capacity in place by the early 1980's. Two land-based nuclear plants near Salem, N. J., were running 5 years behind schedule. Construction of two more nuclear units was delayed when objections to the use of Newbold Island in the Delaware River forced Public Service to relocate the project to Hope Creek, just north of the Salem plants. Lead times for land-based plants elsewhere in the State were running between 8 and 12 years.

In September 1972, after conducting its own site surveys off the New Jersey coast, Public Service contracted to buy the first two floating plants to be produced by Offshore Power Systems, Inc. In 1973, Public Service signed a contract for two more floating plants.

Today, after 3 years of analyzing the offshore power concept, staff members of the Nuclear Regulatory Commission (NRC), and some other Federal agencies have come to the same general conclusion about the cost and environmental impact of floating nuclear powerplants. These staff judgments are tentative and are not in any sense formal endorsements of the concept or the construction plans. The Public Service proposal still must work its way through a series of reviews, public hearings, and decisions by Federal and State agencies and meet challenges from environmental groups, New Jersey beach communities, and some nuclear scientists and engineers who say that the systems are unnecessary, and may be unworkable or unsafe. Before an offshore nuclear plant can start generating power it must clear three separate stages of licensing. The first of these probably will not be completed before 1977.

The preliminary NRC staff reviews nevertheless have provided enough encouragement to the companies involved in the floating nuclear powerplants—the Atlantic Generating Station Units 1 and 2—that they have spent more than $120 million thus far for plans, environmental studies, and in tooling up for production.

Public Service plans to have the first plant operational in 1985 and the second in 1987.

Each plant is designed to generate 1,150 megawatts (MWe) of power, a supply that Public Service estimates will provide about one-third of the additional power it plans to be generating by 1987. The plants are designed to generate power for 40 years, after which they will be shut down and decommissioned.

Several advantages of supplying electricity from offshore stations have been advanced in recent years by supporters and some analysts

of the concept. Promoters of offshore plants take the position that:

- Unlimited supplies of cooling water are available at ocean sites and the environmental consequences of discharging heated water into the ocean will be minimal compared with the consequences of discharging heated water into rivers, lakes and bays.
- Offshore construction eliminates the disruption of coastal marshlands and estuaries to a great extent.
- The floating power concept moves in the direction of standardized nuclear plant designs, a goal the Nuclear Regulatory Commission (then the Atomic Energy Commission) set in 1972.
- Shipyard construction of plants will shorten the time required to put a nuclear plant in operation after a decision is made to build it.
- Volume production can cut costs and improve quality control.

Federal and State agencies have been reviewing the offshore powerplant proposal informally since late 1971 and formally since July 1973, when the Atomic Energy Commission docketed an Offshore Power Systems application for a permit to build eight floating nuclear powerplants.

During that time, the Atlantic Generating Station has received encouragement from the staff of the Council on Environmental Quality, which views the proposal with "guarded optimism." The Nuclear Regulatory Commission's Office of Nuclear Reactor Regulation has declared the project "generally acceptable" as to environmental impact and risk. The same office concluded in a Safety Evaluation Report published in September 1975 that with some modifications in design "there is reasonable assurance that . . . [the reactors could be installed] without undue risk to the health and safety of the public."

During preheating conferences on the Offshore Power Systems application for a manufacturing permit, interveners have challenged many of these claims, questioned design features, raised doubts about the need for any new generating capacity in the area, and argued that the technology is unproven and should not be tested near New Jersey communities.

The State of New Jersey, which has not sought official intervener status, has complained to the Nuclear Regulatory Commission that neither of two environmental impact statements NRC has published "faces up fully to all the risks [of floating plants] about which you owe the public your professional advice."

In a May 4, 1976, letter to NRC, David J. Bardin, New Jersey Commissioner of Environmental Protection, wrote that the most important lapse was in not addressing the possible consequences of a major accident "on the ground that such failures were unlikely to occur."

Some of the major points that interveners have argued in preheating conferences since 1974 are:

- The plant will be vulnerable to external hazards such as ship collisions, airplane crashes, and severe storms. Damage to the plant could result in dispersal of radioactive materials injurious to human health and aquatic life.
- Transportation and handling of radioactive fuel and wastes involve risks to human safety and health and to the marine and coastal environment.
- Evacuation in case of an accident will be difficult, especially in summer months, and there are no adequate plans or procedures for such emergencies.
- Fear of nuclear accidents will reduce the appeal of the area for recreational uses

and have a detrimental effect on the region's tourist -based economy,

- Other impacts that could be adverse include industrialization of the ocean around the site, onshore support facilities, dredging, and defects in underwater electrical transmission lines.

- NRC should prepare a comprehensive, programmatic EIS on the construction of floating nuclear powerplants located offshore.

More than 15,000 New Jersey and Delaware residents were contacted by OTA as part of the public participation program of this study. From these participants, more than 1,000 responses dealing specifically with the floating nuclear plant were selected for analysis. The analysis showed that the public was generally well aware that advantages and disadvantages must be weighed in deciding whether to build a floating nuclear plant. The analysis, along with press reports and statements at public hearings, also showed that the public sees the disadvantages as involving questions of safety, environmental degradation and high construction costs. The advantages include increased energy supplies with resulting economic expansion and cheaper power than would be possible with continued use of oil-fired generating plants.

Specific concerns about safety involve possibilities of accidents, leakage of radioactive waste and unresolved questions about the permanent disposal of nuclear waste. There was a perception among those who answered the OTA questionnaire that floating nuclear powerplants are experimental and that there is no experience on which to base estimates of risk and reliability.

One of the advantages cited in questionnaires and workshops is that nuclear powerplants are less polluting generally than fossil-fueled plants. In turn, participants saw advantages in floating plants over land-based plants in their distance from shore and the elimination of pressures on New Jersey water supplies for cooling water.

In this study, OTA has analyzed available information on costs, benefits, environmental impact, safety, waste disposal systems, transportation, transmission cables, and decommissioning activities associated with the floating plants. The study does not attempt to evaluate controversies about the safety and performance of nuclear plants in general; these are beyond the scope of the coastal effects analysis, It concentrates, instead, on exploring differences between the designs of floating and land-based plants and comparing the advantages and disadvantages of each,

The major issues identified by OTA in its study of the floating nuclear plant are:

Risks From Major Accidents.—The Nuclear Regulatory Commission (NRC) is not evaluating the risks from accidents in floating nuclear plants comprehensively enough to permit either a generic comparison of the relative risks from land based and floating nuclear plants, or an assessment of the specific risks from deploying floating plants off New Jersey. (See pages 90–98.)

Deployment in Volume.—As many as 59 floating nuclear powerplants could be built by a single manufacturer by the year 2000 but no policy analysis of the impacts of deploying that many plants in U.S. coastal waters has been done or is contemplated. (See pages 90-101.)

Technical Uncertainties.—Several technical aspects of the deployment, operation, and decommissioning of floating nuclear powerplants have not been analyzed thoroughly enough to permit judgments about the relative risks of the overall system. (See pages 102–105.)

Siting of Floating Powerplants Outside U.S. Territorial Limits.—Because there is no physical barrier to location floating nuclear

powerplants more than 3 miles offshore, proposals for siting plants outside territorial limits are possible. However, U.S. authority to regulate floating nuclear powerplants outside U.S. territory is not clear under existing international law. (See pages 106–111.)

FLOATING NUCLEAR POWERPLANTS—FINDINGS

Energy Supply

- The two 1150 megawatt floating nuclear plants proposed to be located offshore New Jersey could produce about 10 percent of the State's electrical needs projected for 1990. (See pages 197–200.)

Planning and Procedures.

- No detailed procedure or design standards have been developed for transporting fuel to a floating plant or for carrying irradiated fuel and other radioactive wastes to shore. (See pages 102–105, 214–218.)
- Offshore sites for nuclear powerplants offer advantages over shore-based sites in terms of impacts on the marine environment. (See pages 106-111, 200–201, 222, 229.)
- The floating nuclear powerplant concept of standardizing design may provide a method for controlling escalating costs of nuclear power plants. (See pages 200–201, 225–228.)
- There are several decommissioning options for the floating nuclear plant, but only the one of dismantling the radioactive internals at the plant site and disposing of them appears to be technically and economically feasible. (See pages 102–105, 219–222.)
- Existing international law does not specifically settle the question of jurisdiction over a floating nuclear powerplant located beyond national territorial limits, and the Nuclear Regulatory Commission appears not to have authority under present law to approve siting of a U.S. nuclear powerplant in waters outside of U.S. jurisdiction. (See pages 106–111.)
- Federal licensing of floating nuclear plants is confined to rather narrow technical and administrative questions related to building eight plants and deploying two of those plants off the coast of New Jersey. It does not consider the implications of approving the larger scale deployment of floating nuclear powerplants. (See pages 99–101.)
- The one U.S. company now developing a capacity to build floating nuclear powerplants intends to build and market four such plants a year after 1985. Operating at peak capacity beginning in 1977, this company could produce 59 floating nuclear plants by the year 2000. (See pages 99-101.)

Safety

- The nuclear reactor and floating barge are proven technologies but the combination of the two as a system is not, (See page 203.)
- A critical review of completed studies discloses little foundation for concluding that either construction or routine operations of the two plants at the Atlantic Generating Station would endanger public health or environment. (See pages 224–229.)
- In the unlikely event of a core-melt acci-

dent in a floating plant, the molten core eventually would melt through the bottom of any barge and release radioactive materials directly into the ocean where they could contaminate beaches and be absorbed in the food chain. (See pages 90–98, 232–236.)

- The probability of a core-meltdown accident in a floating nuclear powerplant is comparable to the probability calculated in WASH–1400, commonly known as the Rasmussen Report, for land-based plants. However, the expected consequences of releases of radioactive materials as a result of a core-melt at a floating plant could be significantly different. (See pages 90–98, 230–237.)
- The probability of an atmospheric release of radioactive materials may be as much as seven times greater for a core-melt at a floating plant than for a core-melt at the land-based plant, as calculated in WASH–1400. However, the amount and consequences of the release may be reduced by design features and offshore siting of the plant. (See pages 90–98, 230–237.)
- The Liquid Pathways Generic Study being prepared by the Nuclear Regulatory Commission and Offshore Power Systems comparing the radiological consequences of accidental release of radioactive materials into water at floating plants and land-based plants is not as comprehensive as WASH – 1400's analysis of the consequences of accidents, partly because it does not consider economic impacts. (See pages 90-98, 233–236.)

ALTERNATIVES TO OFFSHORE TECHNOLOGIES—SUMMARY

New Jersey and Delaware would have a limited number of alternatives over at least the next two decades if any or all of the proposed offshore energy systems were not deployed.

Without strong national leadership in conservation and energy supply programs, the most likely course for the Mid-Atlantic region during the next 20 years is to extend the energy system that already is planned or in place.

ALTERNATIVES TO OFFSHORE TECHNOLOGIES—FINDINGS

- There are specific alternatives which, if substituted for each of the proposed offshore energy projects, could supply equivalent amounts of energy. Increased imports are an alternative to offshore oil and gas development. Onshore nuclear plants and coal-fired plants are alternatives to floating nuclear plants. Greater reliance on small tankers is an alternative to deepwater ports. None of the specific near-term alternatives offer clear social, economic, or environmental advantages. (See pages 238-246.)
- Reduction of energy consumption could offer longer term advantages but there are no specific plans at the State or national level for an energy conservation program that might eliminate the need for energy supplies that would come from one or more of the proposed offshore systems. (See pages 240–244.)
- Utility managers will choose existing and tested technologies that are most apt to match the consumption levels in their forecasts and will assign reliability of power supply a higher priority than cost. (See pages 239-240.)
- The most promising alternatives for stretching out supplies of fossil fuels are programs to improve insulation of homes and offices, changes in automobile design to increase mileage, and use of existing technologies to increase the amount of power generated per unit of fuel. (See pages 240–242.)
- Coal is a potential substitute for every basic fuel in the United States and supplies could last for more than a century even if consumption were to quadruple. However, massive conversion to use of coal would entail major changes in transportation networks, in air quality standards, new mining techniques, and new miner-training and safety programs. (See pages 243-244.)
- Utility companies and other energy suppliers in Mid-Atlantic States will not factor supplies of oil and natural gas from the Baltimore Canyon Trough into their future plans until exploration establishes likely production levels. (See pages 238–239.)
- No single new technology or change in the way existing technologies are used is likely to provide more than a small percentage of total energy requirements before the end of the century. Solutions to energy problems will be found in putting together many relatively small conservation and supply programs. (See pages 240–246.)
- Given existing laws, regulations, fuel

supplies, and technologies, New Jersey utilities report that they would replace floating nuclear powerplants with shoreline floating plants, land-based nuclear plants, and coal-fired plants, in that order of preference. (See pages 238–240.)

. Solar energy will not contribute much to energy supplies before the end of the cen - tury unless Federal programs to cut solar installation costs and private plans to market solar products are given higher priorities than they now enjoy. (See page 241.)