

June 16, 1978

SECY-78-319

## COMMISSIONER ACTION

For: The Commissioners

From: Edson G. Case, Acting Director, Office of Nuclear Reactor Regulation

Thru: *for* Lee V. Gossick, Executive Director for Operations *Lee J. Duchs*

Subject: RESPONSE TO REQUEST FROM THE CALIFORNIA PUBLIC UTILITIES COMMISSION FOR A "DETERMINATION OF ACCEPTABILITY" OF SITING AN LNG TERMINAL WITHIN 5 MILES OF AN EXISTING NUCLEAR POWER PLANT

Purpose: Approval of a letter to Robert Batinovich, President of the California Public Utilities Commission (CPUC).

Background: In 1975 Western LNG Associates filed an application with the State of California and the Federal Power Commission (FPC) to construct a terminal for the receipt, storage, and handling of large quantities of liquefied natural gas. The review of that application has prompted a request by the State for input from the Commission, as discussed below.

The hazards of LNG are the subject of considerable debate. Responsibility for evaluation and regulation of LNG-related hazards are shared amongst several Federal Agencies. A recent interagency task force report has been prepared entitled "Draft Report of LNG Safety and Siting", which describes the division of authority amongst various government agencies, and outlines the histories of research into, and Congressional consideration of, LNG safety. It is included herein as Enclosure B.

By California law, the California Public Utility Commission (CPUC) must decide by July 31, 1978, whether or not to issue a permit for an LNG terminal at one of several candidate sites selected by the California Coastal Commission. Unless they can find that the decision would not be in the interests of public safety and welfare, they are further required to choose a site 4 miles south of San Onofre, or another 5 miles south of Diablo Canyon. At either of these sites, the proposed LNG traffic would result in frequent LNG tanker transits off-shore under circumstances in which a major shipping accident could be capable of engulfing the nuclear power plants in flammable gas.

Reviews of the risks of LNG-related activities close to licensed reactors have been conducted by the NRC staff in two instances:

- 1) In 1973 LNG importation proposals were made which would have led to LNG tanker traffic on the Delaware River, passing about 2 km from Hope Creek and Salem units. Although one LNG proposal has been withdrawn and the other is virtually assured of being disallowed, the Hope Creek issue is now in its second appeal.
  
- 2) An LNG facility (Cove Point) has been constructed approximately 4 km from the operating Calvert Cliffs facility. Natural barriers effectively protect Calvert Cliffs from accidents at the LNG facility, but the off-shore docking terminal is 5.6 km from the nearest Calvert Cliffs safety-related structure. We have negotiated with the Coast Guard to prevent closer approach by tanker traffic, and to assure constant tugboat assistance. NRR has issued a Safety Evaluation on the Calvert Cliffs LNG matter that concluded that the risk, given extensive Coast Guard controls, is acceptably low. However, a detailed LNG contingency plan will also be required to be developed over the next several months.

In addition to our licensing reviews of the LNG activities near Calvert Cliffs and Hope Creek/Salem, the staff has provided comments on FPC's (now FERC) environmental impact statements on various proposals to construct LNG terminals (including the Western LNG Associates Terminal application now being reviewed by the State of California). As is discussed at length in Enclosure B, the Federal responsibilities are not well defined, and the regulations governing LNG facilities and traffic are still in various stages of development.

Discussion:

The staff's contact with the State of California began several years ago (Enclosure C provides relevant correspondence). Throughout this period, staff and consultants for the State of California have contacted the NRC staff to advise us of the status of their reviews and to obtain pertinent background information regarding our reviews and interests.

The LNG Terminal Act of 1977 requires the California Coastal Commission to identify and evaluate remote onshore sites for an LNG terminal and submit a final site ranking to the Public Utilities Commission (PUC) by May 31, 1978. On January 31, the Coastal Commission voted to retain five proposed sites for study and ranking out of 82 which had been initially considered. Those five sites listed in geographical order from North to South are: (a) Rattlesnake Canyon, San Luis Obispo County; (b) Point Conception, Santa Barbara County; (c) Las Varas, Santa Barbara County; (d) Deer Canyon, Ventura County; (e) Horno Canyon, San Diego County. Under the Act, the Coastal Commission will base its ranking of these sites (and set appropriate conditions, if any, to apply to each site) based on the policies of the Coastal Act. The Coastal Commission has recently submitted its report to the PUC. The PUC must make a decision as to whether to issue such permit for an LNG terminal by July 31, 1978. If a permit is issued, it must be for the first-ranked site, Horno Canyon, unless the PUC determines that there is an immediate need for LNG which cannot be met by timely operation of the first-ranked site or that it is inconsistent with public health, safety and welfare. In that event, the PUC may then issue a permit for a lower-ranked site if such approval can insure timely importation, distribution, and utilization of LNG. The PUC must also accept the conditions recommended for each site by the Coastal Commission, subject to certain listed exceptions.

The LNG Terminal Act required the Coastal Commission to hold formal public hearings in each of the counties where a proposed site is located. These have been conducted. The purpose of these hearings was to receive testimony on how the Commission should rank the sites and on appropriate terms and conditions that might be imposed to mitigate adverse impacts on coastal resources. Testimony did not address the issue of whether or not an LNG terminal is needed or specific engineering requirements which should be imposed to enhance public safety, which are matters within the jurisdiction of the PUC in separate proceedings.

While the State's staff have been well aware of our concerns regarding LNG, the Coastal Commission's recommendation to the Public Utilities Commission ranked two sites ahead of the applicant's preferred Pt. Conception site. The first-ranked site, Horno Canyon, is roughly 4 miles south of the San Onofre site. The second-ranked site, Rattlesnake Canyon, is about 5 miles south of Diablo Canyon.

It is to be noted that none of the alternative sites for consideration by the CPUC possesses a natural harbor or protected waters, a requirement not mentioned in the California LNG Siting Act of 1977. The FERC is contesting the constitutionality of this Act, and believes the best site to be Oxnard, California, which is a port.

The Horno Canyon site is on federal land, and DOD staff have indicated that they will not agree to its proposed use (Enclosure D). The Rattlesnake Canyon site is by far in the most exposed waters, and would require immense off-shore construction to build the terminal. The LNG applicant is a corporation half of which is owned by PG&E; we understand that should Rattlesnake Canyon be issued a permit for an LNG terminal, PG&E may withdraw from the enterprise. In testimony at the Coastal Commission, San Luis Obispo, April 10, 1978 Western LNG Terminal Associates stated that Rattlesnake Canyon involves the most hazardous marine operations of any of the sites. It was stated "unlike the other sites, it is not certain that even the construction of a breakwater will reduce the risk of marine accidents to an acceptable level". In summary, regardless of the outcome of either the NRC or the CPUC consideration of this matter, construction of an LNG terminal at either of the first two sites is doubtful.

The letter from Mr. Batinovich, President of the CPUC (Enclosure C) requested:

"an NRC determination as to the acceptability of locating an LNG facility within 4-5 miles of an existing nuclear generating station. In the alternative, a clear set of specific NRC guidelines for the location of potentially hazardous facilities in proximity to nuclear reactors is sought."

The proposed response (Enclosure A), basically reiterates previous staff recommendations. Namely: (1) a preference for an LNG site which is more removed from nuclear facilities than either Horno Canyon or Rattlesnake Canyon (2) a suggestion that if either of the two sites is selected, that the conditions of the license be set so as to minimize the risk to nuclear facilities and (3) a recognition that an evaluation (whose outcome is unclear) of the acceptability of continued operation of the nuclear facility will be required if either of the two sites is selected.

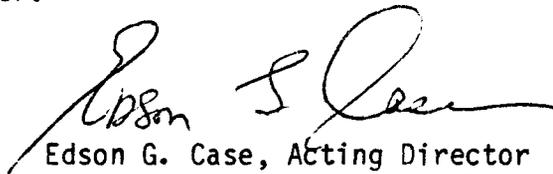
The staff believes that an LNG terminal within 4-5 miles of an existing nuclear generating station is acceptable. However, the ship traffic to and from the terminal may pose an unacceptable risk unless suitably controlled which (as noted earlier) is the issue on Calvert Cliffs, where actions to reduce the risk are inherently more feasible because of the protected waters and traffic restrictions of the bay.

The State of California has funded extensive studies of ship traffic risks and ways to reduce the risk. The NRC staff has received two reports on such studies which appear to indicate that LNG risks can be made very low if proper attention is given to various aspects of the activity.

The CPUC is empowered to set forth any necessary conditions, and the California - sponsored risk control studies are still underway.

Recommendation: In view of the foregoing the staff has prepared the draft letter in the form proposed and recommends it for the Chairman's signature.

Coordination: The Office of the Executive Legal Director has no legal objection to this paper.



Edson G. Case, Acting Director  
Office of Nuclear Reactor Regulation

**Enclosures:**

- A. Proposed Letter, Chairman Hendrie to President Batinovich, CPUC.
- B. Draft Report of the Interagency Task Force on LNG Safety and Siting.
- C. Correspondence between NRC and California on LNG.
- D. Testimony of Camp Pendleton Officials.

Commissioners' comments should be provided directly to the Office of the Secretary by close of business Wednesday, June 28, 1978.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT June 22, 1978, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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Enclosure A

Proposed Letter, Chairman Hendrie to President Batinovich, CPUC

DRAFT

Mr. Robert Batinovich  
President,  
California Public Utilities Commission  
Sacramento, California

Dear Mr. Batinovich:

Thank you for your telephone call and letter of June 6, 1978 advising me of the status of your review of the Western LNG Terminal Associates application. Your letter noted that the CPUC must decide on the siting question by July 31, 1978.

The NRC staff has been aware of and commented on this application over a number of years. They have repeatedly advanced the position that, as a matter of preference, LNG terminals and LNG shipping routes should be located some distance away from nuclear power reactor sites.

As you pointed out, the Coastal Commission has selected two sites, which are relatively close to nuclear reactors, as the most preferred. Since they are well aware of our concerns, their ranking implies a view on their part that the Horno Canyon and Rattlesnake Canyon sites are, or can be made acceptable - notwithstanding the presence of nearby nuclear facilities.

Your letter of June 6 stated:

"The CPUC requests an NRC determination as to the acceptability of locating an LNG facility within 4-5 miles of an existing nuclear generating station. In the alternative, a clear set of specific NRC guidelines for the location of potentially hazardous facilities in proximity to nuclear reactors is sought."

We have, in considering this request, reviewed Mr. Denton's responses to the California Coastal Commission staff, which were partially quoted in your letter, and find that we are in general agreement with those responses. We believe that the determination you request must be decided upon by consideration of the issue raised in Mr. Denton's letter of April 12, 1978:

"The nearby presence of an LNG terminal, even if that terminal were so designed and situated that it did not place a direct hazard to a nuclear plant, could bring with it the increased possibility of the close approach by LNG tankers or flammable gases released from these tankers. Such a possibility would have to be considered in deciding whether or not the nuclear power plant could be operated safely without undue risk to the public."

Our staff believes that, in principle, it is feasible to design an LNG storage and gasification facility such that a severe accident at that facility would not jeopardize the continued safety of a nuclear generating station four or five miles away. However, we believe that LNG tanker traffic to and from the facility may constitute an unacceptable risk to nearby nuclear generating stations.

We understand that the State of California has contracted for studies to identify measures to reduce risks of LNG tanker accidents during transit or docking. We would expect that these studies would also

identify measures that could, if implemented, result in reduced risks to a nuclear power plant in the general vicinity of LNG ship traffic. The development and implementation of measures which could be shown to reduce the risk to acceptably low levels would nevertheless result in a residual risk not present at other sites.

More importantly, our reviews of the LNG traffic associated with the Cove Point terminal and its potential impact on the Calvert Cliffs Nuclear Power Plant have shown that measures to limit the risk from LNG traffic, while feasible, are difficult to establish and constitute burdens to the Coast Guard, our licensees and the operators of the LNG traffic. We would anticipate very much greater difficulties in effecting appropriate safety measures in the open coastal waters of California, due to the larger volume of traffic and more hazardous maritime conditions, than in the Chesapeake Bay.

In the event either of the two highest ranked sites is selected by your Commission, it would be necessary to conduct an evaluation, whose outcome is unclear, of the acceptability of continued operation of the nuclear facility in question. The burden of demonstrating adequate safety of the nuclear generating station would lie with the NRC licensee, while the Coast Guard and the owners and operators of the LNG tankers could bear much of the burden of implementing the appropriate safety measures.

Mr. Robert Batinovich

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In summary, we believe that an LNG facility located within 4-5 miles of an existing nuclear generating station will pose an added threat to the health and safety of the public which must be mitigated and that such siting should not be permitted if there are other sites which are also favorable from an overall environmental, economic and safety standpoint. Should you decide to propose either Horno Canyon or Rattlesnake Canyon sites, we would urge that the permit include a condition that the permittee develop measures with appropriate Federal and State agencies and the licensee of existing nuclear stations to assure that the risk of an LNG accident will not jeopardize the continued safe operation of the existing nuclear station.

Joseph M. Hendrie  
Chairman

**Enclosure B**

**Draft Report of the Interagency Task Force on LNG Safety and Siting**

DRAFT

LIQUEFIED NATURAL GAS (LNG)  
FACILITY SAFETY & SITING

(Draft Report by the subgroup of the Federal  
Interagency Task Force on LNG Imports.)

April 4, 1978

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LIQUEFIED NATURAL GAS (LNG)  
FACILITY SAFETY AND SITING

Report by the Subgroup of the Federal Interagency  
Task Force on LNG Imports

The task of this subgroup was to assess all aspects of safety relating to the transportation, storage and handling of LNG with the major thrust focusing on safety and siting of LNG facilities as they relate to LNG import projects. The results of this effort are to be used in the formulation of a National LNG Import policy.

The information contained in this report was assembled by representatives of the Department of Transportation (DOT) - Office of the Secretary (OST), Materials Transportation Bureau (MTB), United States Coast Guard (USCG); and the Department of Energy (DOE) - Office of the Secretary, Federal Energy Regulatory Commission (FERC), and the Economic Regulatory Administration (ERA). In addition, the services of two contractors were used in the development of information on LNG Safety and Siting. The Arthur D. Little report on LNG Safety, dated January 1977, is included as Appendix 1. The Ecology and Environment, Inc. (EEI) report on the Safety Aspects of LNG Importation is included as Appendix 2. The group also referred to reports and studies by the Office of Technology Assessment (OTA), several states, and information resulting from public hearings, and meetings with representatives of industry and the public.

During the past several years, "LNG Safety" has been of major concern to many governmental agencies, organizations, and individuals. The subject has been represented and publicized over the full range from being technically sound and adequate to one of horror and completely inadequate.

This review attempts to identify the basic issues on the broad scope of LNG operations and develop alternatives to assist in the establishment of not only a National LNG Import program, but a uniform national approach to dealing with LNG safety and siting.

## Background

Within the last few years, liquefied natural gas (LNG) has become an essential commodity important to the overall energy needs of the nation. It has become indispensable in maintaining adequate supplies of natural gas in many urban areas during periods of peak demand.

LNG technology is proven and has a 18-year history of successful international baseload operations with deliveries to countries such as Japan, England, France and Italy. LNG technology in the U.S. for peakshaving and satellite operations has been successfully employed over the last 12 years. LNG peakshaving facilities were used extensively this past winter to help meet emergency needs.

LNG has a long history of safe operation with almost 20 years of international LNG trade involving approximately 3,000 deliveries since the LNG Tanker "Methane Pioneer" made the first trip in 1959. There have been 15 LNG ships in operation since 1967 logging half a million miles without a major accident or fatality. In the U.S. there are nearly 100 LNG baseload, peakshaving and satellite facilities which have more than 1 million hours of safe operation. Several additional large baseload terminals for the storage and handling of imported LNG are being constructed or planned on the East Coast. In addition, other terminals are being planned for the Gulf and West Coast.

Projecting the growth of both peakshaving and baseload facilities, as well as the satellite facilities, is difficult in light of uncertainties in worldwide energy economics today. However, a continuing growth is expected over the next 10 years with perhaps some 100 new facilities being constructed during this period.

A great deal of concern exists concerning safety and location of these LNG facilities. This is particularly true with regard to LNG installations in urban areas which have become a matter of major concern to special interest groups, regulatory authorities, and legislators.

LNG can be and is being transported, handled, and stored in a safe manner. It is hazardous material, but treated accordingly and handled in a responsible manner, can be safely imported into the U.S. in large quantities. Other more hazardous materials are being handled in the U.S. on a daily basis, in significant quantities in a safe manner.

There is currently a lack of uniformity in the existing criteria employed to assure an adequate level of safety at the large number of LNG facilities. The result is some confusion on the part of the industry and regulatory authorities concerning what safety measures and techniques should be employed at a particular facility and consequently, the public very often tends to make unreasonable demands regarding the location and construction of new facilities.

At the present time, the safety regulatory jurisdiction over LNG safety and siting of facilities can involve Federal, State and local agencies, depending on the particular location. The approval process for a facility can take over three years before construction can start.

## Conclusions

The involvement of so many government agencies at all levels has created a lengthy approval process involving a wide range of regulations, permits and various other types of approvals.

Specific conclusions are as follows:

1. Federal responsibility for safety of LNG facilities is not clearly defined. The DOE (ERA and FERC) and DOT (MTB and CG) are each exercising authority for safety.
2. No Federal policy exists for the siting of LNG facilities with the Federal position to the States and local governments being unclear.
3. There are no standard or uniform guidelines for risk analysis in evaluating LNG facility site locations.
4. There has been no composite evaluation of research work (done by industry, government, and individuals) on safety or risk assessment to determine the best information applicable to a national policy.

## Discussion

The Federal, State and local governments, the public, Congress and industry are all concerned and have each taken certain actions in their respective areas.

The primary Federal agencies, State and local governments and others that are involved in the safety and siting of LNG facilities are identified below with major activities in each area listed.

## Federal Agencies

### Department of Transportation

The Secretary has the overall safety regulatory responsibility over such facilities and has delegated this to two operational elements, Materials Transportation Bureau, and the United States Coast Guard.

The Office of Pipeline Safety Operations (OPSO) of the Materials Transportation Bureau issued an advance Notice of Proposed Rulemaking concerning safety of LNG facilities on April 21, 1977. In order to eliminate the overlapping of, and conflicts between, the OPSO regulations and those proposed by the Coast Guard, and to assist the owners and operators of LNG facilities which would be subject to both Coast Guard and OPSO regulation, a Memorandum of Understanding (Appendix 3) has been negotiated and signed by the two agencies.

Under the Natural Gas Pipeline Safety Act of 1968, the Materials Transportation Bureau (MTB), through its Office of Pipeline <sup>Safety</sup> Operations, administers safety regulations applicable to pipeline facilities used in the transportation, including storage, of LNG.

One exception to the authority of MTB precludes prescribing of the location of any LNG facility. However, the safety standards can be determinative of where an LNG facility can be located. For example, a standard requiring minimum distances between a facility and private or commercial residences or a standard requiring location of a facility on a stable land mass could effectively preclude the location of a facility in areas of high population density or seismic activity. In short, the MTB does have the authority to say where LNG facilities cannot be located. It remains the role of the Federal Energy Regulatory Commission and, in the case of purely intrastate LNG facilities, the appropriate state and local regulatory bodies to say where they can be located.

In the case of already existing LNG facilities, current statutory authority allows MTB to prescribe new operational and maintenance requirements, but is only allowed to impose physical plant modification requirements if found on a case-by-case basis that a facility "is hazardous to life or property."

The Office of Pipeline Safety Operations (OPSO) in MTB has issued safety standards for the storage, handling and transportation of LNG and related facilities in Part 192.12 of 49 CFR, referencing the National Fire Protection Association, NFPA 59A 1972.

In addition, OPSO published an advance Notice of Proposed Rulemaking, April 21, 1977, to prescribe new Federal safety standards for LNG facilities covering the design (including site selection), construction, operation and maintenance. (Appendix 4)

The notice focuses on what is seen as the three risks associated with an LNG spill. First, the risk of thermal radiation. Second, the risk of a natural gas cloud emanating from a spill. Third, the risk of a catastrophic spill of LNG which could impede or overwhelm the containment measures.

The notice specifically addresses the need for (1) better impoundment systems, (2) stronger site security, (3) diking around transfer lines, (4) separation distances between critical components, (5) protection against seismic and other environmental forces, (6) frequent plant inspections and monitoring, (7) procedures to qualify and train personnel, (8) procedures to construct and operate the facility, (9) plans for fire prevention and firefighting, and (10) improved storage tank design and testing.

The deadline for comments on the advance notice was December 1, 1977. The comments received have been detailed and extensive, and we are now evaluating the comments. DOT expects to issue a Notice of Proposed Rulemaking later this year.

The U. S. Coast Guard under the Magnuson Act (50 USC 191) and the Ports and Waterways Safety Act of 1972 (33 USC 1221-7) has the responsibility for port safety. This responsibility applies to any vessel, bridge or other structures or any land structure or shore area immediately adjacent to these waters. The Coast Guard is undertaking or has undertaken the following actions that can relate to LNG:

1. Controls LNG vessel traffic movements
2. Regulates design and construction of LNG vessels

3. Regulates, under Letter of Compliance Program, safety of foreign LNG vessels arriving in U.S. ports.
4. Studying the explosibility of large unconfined vapor clouds for liquefied gases (including LNG).
5. Developing standardized techniques for assessment of hazards of cargo spills (including LNG). This is being performed by Arthur D. Little, Inc. under Coast Guard contract.
6. Studying LNG fire safety (e.g., fire control and extinguishment, structure, and personnel protection).
7. Studying "rollover" in liquefied gas tanks on vessels and ashore (including LNG).
8. Developing safety regulations for terminal and port facilities (including LNG).

It is the Coast Guard's position that the hazards associated with each hazardous material should be carefully evaluated and consistent regulatory action taken with due consideration to the risks associated with each hazardous material. Coast Guard report - Views & Practices (Appendix 4)

The regulating of LNG vessel movements, vessels and waterfront facilities as an integral part of the Coast Guard's ongoing hazardous materials regulatory program, issues a high level of safety of LNG marine transportation and facilities. There are many hazardous materials, such as gasoline, carried on our nation's waterways in much greater quantities than LNG and there are many hazardous materials, such as anhydrous ammonia, ethylene oxide, and chlorine, which are more dangerous than LNG and yet are being carried every day on vessels in the United States. In fact, a case could be made that liquefied petroleum gas (LPG), which is carried in far greater quantities than LNG, is more dangerous than LNG.

It is the Coast Guard's position that the hazards associated with the carriage of any hazardous material should be carefully evaluated and consistent regulatory action taken in consideration of specific and relative risks associated with each hazardous material.

As LNG imports increase, the Coast Guard has been adjusting and will continue realigning its resources to respond in an appropriate manner to the safety, security and environmental protection concerns.

Since 1972 the Coast Guard has been supervising the importation of LNG through Boston Harbor to the Distrigas facility in Everett, Massachusetts. Currently, the Coast Guard is preparing for the imminent start of operations at major LNG facilities at Cove Point, Maryland, on Chesapeake Bay and on Elba Island in Savannah, Georgia. Future LNG facilities are planned for the Gulf and Pacific Coasts.

With respect to the movement of vessels, it is Coast Guard policy that specific direction and control should be exercised by local Coast Guard officials acting in accordance with general guidelines issued by the Commandant. It is believed that local Coast Guard officials, having detailed knowledge of local port and waterway configurations, hazards, vessel traffic characteristics, cargo patterns, marine practices and customs, and environmental and economic matters, are in the best position to determine what specific vessel traffic management actions are appropriate.

Coast Guard District Commanders and Captains of the Port regulate LNG vessel movements and other traffic under the authority of the Ports and Waterways Safety Act of 1972 (33 USC 1121-7). Under 33 CFR Part 160, these local Coast Guard officials have been delegated authority to direct vessel movements to prevent damage and to control vessel traffic in areas determined to be especially hazardous, or under conditions of reduced visibility, adverse weather, vessel congestion, or other hazardous circumstances.

Using this authority, Coast Guard District Commanders and Captains of the Port have issued and are continuing to issue orders and directions regulating the movement of vessels carrying LNG, LPG and other hazardous materials. When these orders and directions are issued on a continuing basis they are issued only after there has been consultation with state and local governments and the representatives of marine industry, port and harbor authorities, environmental groups and other interested or affected parties.

Among the possible actions which local Coast Guard officials might take is the establishment of water or waterfront safety or security zones around or near the vessel or facility. This authority has been delegated to Coast Guard District Commanders and Captains of the Port under 33 CFR Parts 165 and 127.

Other steps which these Coast Guard officials may take to enhance the safety of LNG or LPG vessel movements could include, among others, requiring the vessel to be escorted; specifying tug assistance; restricting transits to periods of good visibility; and restricting other traffic during the movement of LNG vessels.

In addition to regulating the vessel traffic associated with the movement of LNG, the Coast Guard regulates the LNG vessels themselves. Acting under its Tanker Act authority (46 USC 391a) and its Dangerous Cargo Act authority (46 USC 170) the Coast Guard has established a Letter of Compliance (LOC) program regulations governing the design, construction, inspection and operation of LNG carriers.

The LOC program (46 CFR Part 154) requires that the owner of any foreign flag vessel transporting certain hazardous materials in bulk, including LNG and LPG, into or out of United States ports must obtain authorization from the Coast Guard prior to issuing the Letter of Compliance, the Coast Guard reviews the vessel plans by using criteria equivalent to those used in the review of a similar design for U.S. registry.

Plan review is considered complete after plans, specifications, and inspection and test reports have been found satisfactory and evidence has been received that the vessel has been constructed in accordance with approved plans and meets all other international standards. Following plan review, the vessel owner is notified that the plan review has been completed and that the vessel will be examined at its first U.S. port of call.

Upon arrival at the first port of call in the United States, representatives of the Captain of the Port and Officer in Charge, Marine Inspection will board the vessel. The boarding party examines the vessel's arrangement and cargo system, including tanks, piping, machinery, and alarms. In addition, the boarding party observes the material condition of the vessel, vessel operation, cargo handling operations, firefighting capability, and personnel performance.

Following satisfactory examinations, a Letter of Compliance will be issued. For subsequent vessel arrivals, the COTP, in conjunction with the OCMI, will make such reexamination as he considers necessary to insure that the vessel has been maintained as initially examined. This will be in addition to the regular biennial reexamination required for LOC renewal.

The basic Coast Guard regulatory requirements for the design, construction and testing of liquefied gas ships are contained in Subchapter D, Rules and Regulations for Tank Vessels (specifically 46 CFR Part 38 for liquefied flammable gases) and the various other Subchapters under 46 CFR addressing marine safety. These regulations cover certification of U.S. vessels carrying liquefied gases and are the basis for review of foreign flag vessels prior to issuing Letters of Compliance. By utilizing the same set of requirements for U.S. flag and foreign flag vessels for the cargo containment and transfer systems and related safety features, a consistent level of safety is achieved.

The Coast Guard has assured and will continue to assure the safest possible operation of LNG-carrying vessels in U.S. waters. To date there have been several hundred shipments of LNG from Kenai, Alaska to Japan and several from Lake Charles, Louisiana, to Britain; there have been many deliveries to Boston and New York, plus a few barge trips from Boston to New York. All were carried out successfully. During calendar year 1976 Coast Guard COTP's reported 1,723 marine transfer operations involving 2,388,000 tons of LPG and 46 marine transfer operations involving 1,335,000 tons of LNG without incident.

### Department of Energy

The Federal Energy Regulatory Commission (FERC), formerly the Federal Power Commission (FPC), has the responsibility under the Natural Gas Act to approve applications for interstate Natural Gas facilities including LNG, and the issuance of a certificate of public convenience and necessity (economic). Under the National Environmental Policy Act the FERC is also responsible for the preparation of an environmental statement for each new interstate facility proposed.

With the passage of the Department of Energy (DOE) Organization Act of 1977, the Federal Power Commission (FPC) had jurisdiction over the site selection of LNG import facilities. Under various sections of the Natural Gas Act (Sections 3 and 7) the FPC evaluated the proposed import facilities to ascertain whether they met the general standard of being in the public interest. The FPC adopted as a minimum the various Department of Transportation (DOT) regulations associated with the design construction and operation of these facilities, including the shipping, and where it deemed appropriate, imposed additional safety requirements. Under the National Environmental Policy Act (NEPA) an Environmental Impact Statement (EIS) is required for any major federal action which could significantly affect the environment. Since the approval of these projects were deemed to be a major federal action, each project has had an EIS prepared. These EIS's include an assessment of the safety characteristics. The DOE organization Act transferred the decision-making authority for all imports and exports of natural gas to the Secretary of Energy. The Secretary had delegated this authority to the Administrator of the Economic Regulatory Administration (ERA). This entire approach to site selection has been criticized since it was perceived to limit the safety and siting review to only those locations considered by the project sponsors, and their selection of potential sites were influenced primarily by economic considerations.

## SUMMARY OF FERC AND ERA DECISIONS ON SAFETY

There have been four LNG import cases decided by the FERC and ERA. These cases include Distrigas Corporation, Trunkline LNG Company, Pacific Indonesia LNG Company, and El Paso Algeria Company (El Paso I). The following information summarizes the safety decisions for each of these cases.

The safety decisions set down by the DOE for Distrigas Corporation are as follows:

1. A system of low temperature detectors will be installed in appropriate locations along the cryogenic transfer line to supplement existing transfer line surveillance.
2. The program to study LNG storage tank vibration will be continued. As a result of this study, a comprehensive report on the status, extent of the tests, and analysis of the remedies will be submitted to the Federal Energy Regulatory Commission staff together with follow-up reports.
3. Any significant changes in the design, construction, or operation procedures at the Everett Terminal will be submitted to the Commission on a timely basis.
4. The applicant will provide sufficient notification to the Commission concerning the nearing to completion of facility modifications. Moreover, before the new facility begins operation, the Commission staff will (1) have a final site inspection conducted by the National Bureau of Standards and (2) hold a technical conference with representatives of the applicant.

The Trunkline LNG decision enumerated a series of safeguards that would be implemented in the design, construction, and operation of the facility. These conditions include:

1. Trunkline shall increase the proposed deliverability of the five water ferry systems in order that both the fire hydrant loops system and the individual tank deluge system would be able to operate at maximum capacity in the event of an emergency.
2. Trunkline will provide a means of fire-fighting a potential LNG fire at the storage tank, dikes, and dumps.

3. Output of the emergency generator will be increased so that all electric-powered detector devices, alarms, and fire fighting equipment at the terminal should remain operative in the event of a power failure.

4. Applicant will outline procedures to be used to evacuate nearby areas and suspend local highway and shipping traffic necessitated by a major accident. These procedures will include immediately notifying nearby inhabitants of any potentially dangerous situation that can arise and mobilizing emergency personnel such as Civil Service, hospitals, police, and fire departments.

5. Use of an interlocking safety system, similar to the one proposed for Consolidated Aluminum Corporation, will be provided for all other industries which may locate in the vicinity of the LNG plant and marine terminal.

6. Provide means to contain an LNG spill at the unloading dock to insure that a rupture of an unloading arm on line will not spill into the water. Detailed drawings of the LNG spill containment system will use known technology and will be provided to the Commission prior to the operation of the terminal.

7. After approval for operation, it was recommended that the Commission require semiannual operational reports within 45 days after each period ending December 31 and June 30 describing facility operations for the period covered particularly noting any abnormal operating experience or behavior. Abnormalities include rollover, geysering, cold spots on the tank, fires, equipment and piping failure, nonscheduled maintenance or repair, rapid vaporizations, vapor liquid releases, negative pressures within the storage tank, and higher than predicted boil-off rates. The technical information supplied by the applicant should provide sufficient detail to allow a complete understanding of these events. In the event that an abnormality endangers the facility, the operating personnel, or nearby residences or industries, the Commission should be notified immediately.

8. The capacity of the dike surrounding the proposed spoil disposal area for the dredging of the berthing area should be adequate to contain all spoils that are deposited.

9. Steps should be taken to avoid the spilling of fuels, lubricants, pipe coating agents, and the harmful substances during construction and operation of the facility.

10. Any significant changes in facility design, construction, or operating philosophy should be reported to the FERC on a timely basis.

11. Trunkline should coordinate with the U.S. Coast Guard prior to the operation of the terminal to investigate and establish further vessel traffic safety procedures to be implemented during LNG tanker transit.

The Pac Indonesia case had the following safety stipulations assigned to it:

1. An inspection and review system should be established modelled after the California Public Utility Commission proposal. This system mandates that 90 days after approval of an application, the applicants must present detailed procedures and schedules for a "Final Safety Analysis Report." The intervenors will be given 45 days to comment on this submission and can file their own safety proposal contemporaneously with the applicant's filing.

2. The inspection and review system will also provide for an ongoing review of the design of the facility as well as its construction by an inspector and should include extensive quality control efforts. The functions of an inspector could be performed by a governmental or private organization with the costs borne by the applicants. This system would also include a means whereby interested parties can bring the risk of potential hazards to the attention of an inspector. Conflict between an inspector and the applicants will be resolved by the Department of Energy.

3. A further requirement of this decision included the use of underground storage tanks unless the applicant could make a showing that the original tank design was more advantageous.

4. Regarding undersea piping facilities, the applicants must show that the placement of these pipes will not be more beneficial than the design for which approval was requested.

5. The safety system must include fire control water to all water sprays and high expansion foam units for a continuous 24-hour period after a maximum credible earthquake.

6. Storage tanks must be lighted and well marked for air traffic.

In the El Paso Eastern Company decision the FERC set down the following conditions:

1. El Paso should file all significant changes in facility designs, construction, operations, or operating philosophy with the Commission. When final design plans are near completion and before hardware construction begins for the plant and terminal facilities, the Commission will be given sufficient advance notice so that a technical conference may be held.

2. El Paso will file semiannual operational reports within 45 days after December 31 and June 30 for each year with the Commission. These reports will describe facility operations noting any abnormal operating experiences or behavior. Abnormalities will include rollover, cold spots, equipment failures, non-scheduled maintenance, rapid vaporization and "ceysering," vapor or liquid releases, negative pressures within the tanks, and higher-than-predicted boil-off rates. In the event that any abnormality is of sufficient magnitude to indicate the possibility of damage to the facility or injury to operating personnel, the Commission would be notified immediately.

3. El Paso will establish procedures to be utilized in the event of an accident with the Coast Guard, Civil Defense, hospitals, police and fire departments. These procedures will include immediate notification of nearby inhabitants of any potentially dangerous situation, the mobilization of local emergency personnel, the evacuation of nearby areas, and the suspension of local highway and shipping traffic. Moreover, routes to be used by emergency personnel to reach the LNG terminal, and evacuation routes, should be planned and test driven. All these procedures will be filed with the Commission, and El Paso should train appropriate operating personnel to carry out these procedures.

### Council on Environmental Quality (CEQ)

The CEQ has responsibility under the National Environmental Policy Act to review for adequacy the environmental impact statements prepared by other Federal agencies. (FPC in the case of LNG projects) In the LNG safety area, CEQ is primarily concerned with the lack of sound criteria for siting LNG facilities. CEQ issued guidelines for the development and issuance of environmental impact statement. It has also proposed an interagency study of LNG safety with the objectives of defining and assessing the risks associated with the LNG import program. This study would also provide a basis for sound decision-making regarding terminal site selection and other questions relating to terminals as well as LNG ship and barge operations. The CEQ proposed that those agencies with an interest in LNG provide funds for this study, however, most agencies including OPSO and USCG declined. A special request was then made by CEQ to OST in a letter dated March 19, 1975. This request was also declined for lack of funds. The proposal for the study was eventually dropped.

### Maritime Administration (MARAD)

MARAD administers programs to aid in the development, promotion, and operation of the U. S. merchant marine, including conducting research and development activities to improve the efficiency and economy of the merchant marine.

The MARAD contracted with the National Bureau of Standards (NBS) for a study of LNG insulating materials.

### Environmental Protection Agency (EPA)

EPA endeavors to abate and control pollution systematically, by integration of research, monitoring, standard setting, and enforcement activities. EPA has completed a study of risk assessment of storage and transportation of LNG and liquid petroleum gases.

### General Accounting Office (GAO)

The GAO is looking into the LNG safety question to determine if the safety issue has been adequately addressed. GAO feels that LNG will be the subject of Congressional hearings and legislation this year and wants to be in a position to provide information and assistance to Congress in these efforts. In December 1976, a study was initiated to cover LNG baseload, peakshaving and satellite facilities as well as

Liquid Petroleum Gas (LPG), and naphtha. It is understood that the primary emphasis will be in the area of sabotage and natural disasters. The study is completed and the draft report is currently under review.

### State and Local Government

State and municipal governments have drawn up their own safety codes and ordinances, imposing additional safety features for specific facilities under their jurisdictions.

To date, Massachusetts, New Jersey, New York and Rhode Island have adopted state safety standards for LNG facilities. Rhode Island has also adopted standards for siting. In New York City, LNG facilities also require the approvals of several agencies including the Board of Standards and Appeals, the Department of Ports and Terminals, and the New York Fire Department. Massachusetts, New Jersey, and California have proposed standards for siting. California has also proposed standards for safety.

### Public Concern

A great deal of public concern with LNG safety has been expressed through the actions of both elected and appointed public officials. By participation in officially sponsored meetings of their own, public interest groups, both local and national, have influenced the news media. To date, public concern for LNG facilities has been expressed almost exclusively by or on behalf of local opposition groups whose members live close to proposed LNG sites. Major areas of concern are overall LNG safety, LNG safety as a political issue, the credibility of the LNG industry, and the importance of safety relevant to other issues such as property values and insurance rates.

### Congressional Interests

The Congress has shown a strong interest in the safety and siting of LNG facilities. In November 1976 the Senate Committee on Commerce prepared a "staff working paper" on legislation for the siting and operation of LNG facilities and for LNG accident liability. The purpose of this working paper was to develop legislation to be considered by the 95th Congress. To date, no legislation has been introduced in the Senate.

Senators Magnuson and Hollings of the Senate Commerce Committee have requested the Office of Technology Assessment (OTA) to do a "state of the science" study of LNG safety.

Senator Stevens has offered an amendment to S. 682 (Tanker Safety Act of 1977) to include LNG ships in the provisions governing oil tanker safety standards.

On May 3, 1977, Congressman Dingell introduced in the House H. R. 6844, "Liquefied Natural Gas Facility Safety Act", a bill to regulate the siting, design, construction, and operation of facilities to be used for the transportation, storage, and conversion of liquefied natural gas. He has also introduced two additional bills on the same subject (H. R. 11586 dated March 15, 1978, and H. R. 11622 dated March 15, 1978).

### Industry Activities

The gas industry has recognized the special characteristics of LNG by making use of the substantial cryogenic technology developed as part of the U. S. space program and employing the knowledge of experienced and qualified engineers and contractors. The industry, through the American Gas Association (A. G. A.), has funded and sponsored LNG safety research since 1963 and currently, through the Gas Research Institute. Since that year almost 40 programs involving several million dollars have been sponsored by the industry. In addition, other industry associations have sponsored substantial amounts of research into the potential hazards of LNG and required safety features as well as the development of codes and standards through code making organizations. The National Fire Protection Association (NFPA) has emerged as the leader in the development of standards for LNG safety. As stated earlier in this report, the Federal Government (DOT) has adopted the NFPA standards in the Federal Regulations as an interim standard until a review of LNG safety can be made and comprehensive standards can be developed.

### LNG Safety Research

The safety of LNG transportation and storage has recently received a lot of public attention. Within the last two months Congressional hearings have been held, the CBS television program "60 Minutes" has looked at the issues, and a number of provocative articles have appeared in national publications. Accidents such as the LPG spill in Waverly, Tennessee and the break-up of the oil tanker Amoco Cadiz off the coast of France have raised further questions about the safety of transportation of large quantities of dangerous materials such as LNG.

In spite of the fact that the first (and only) major LNG spill occurred thirty years ago, very little is known with certainty about the hazards posed

by the substance. In the decades since, there has been much speculation and a good deal of research, but the behavior of a large unconfined release is still not well understood.

There are two primary reasons for the lack of a conclusive data base. First, research has been undertaken for different purposes by the gas industry, the Federal Government, and academia. No common set of assumptions or predetermined baseline has been used in most cases. Consequently, a number of mathematical models exist, each providing differing predictions about what will happen in the case of a spill. Second, almost all of the work to date has been theoretical. The instrumentation and specialized testing facilities needed for scale effects experiments have been limited. While there is abundant speculation about what might happen in the case of a spill, almost no hard evidence exists to substantiate any of the theories. As a result, substantial uncertainty remains about: (1) LNG fires and thermal radiation, (2) vapor cloud development, propagation, and ignition, and (3) detonation potential.

Today, the U. S. is in the process of making a considerable commitment to the importation of LNG. Many of the most significant decisions have already been made or will be made in the next couple of years as the major import terminals are approved and constructed. Thus, as the Congressional Office of Technology Assessment recently pointed out, ". . . it is unlikely that the United States can afford the time and money to conduct enough research to resolve the differences (about the conflicting predictions of LNG dynamics) and come to firm decisions about the safety and behavior of LNG." Yet, it is vital that adequate standards of safety be determined and adopted. This requires the immediate start of a coordinated and well focused research effort. The objective should be to provide useful information to support current decision making. This means that answers are needed in terms of months rather than years.

The highest priority of the research program should be to identify potentially dangerous elements in the overall system and to describe operational and structural specifications that will minimize and mitigate the hazard. This can be done now despite the limited understanding of LNG. As a matter of fact, over a year ago in a study of LNG safety, the Arthur D. Little Company (Appendix I), found, ". . . none of these uncertainties is sufficient to prevent a reasonable and adequate assessment of the safety of LNG facilities and operations from presently being made." At a minimum, consideration should be given to: (1) water and land transportation systems and operations, (2) major terminal and smaller storage facilities design and operation, (3) possibilities for human error, (4) the ability of natural phenomena such as storms, floods, or seismic events to disrupt transportation, unloading, and storage, and (5) the ability of facilities to withstand externally-caused events such as projectiles

aircraft crashes, and adjacent explosion or fires. Mitigation measures that would prevent, limit, and control possible accidents should be examined.

Once the preliminary intensive effort to design safe systems has been concluded, a second stage of research focusing more on the behavior of LNG may be desirable. The type of research to be conducted should be determined by the decisions that have already been made about safety and siting. For example, large scale experimentation may or may not be necessary depending on how much LNG activity is occurring in or near population centers. Whatever the scope of further research, the prime determinant should be the prospects for generating additional information that can and will be used by LNG regulators and operators.

Specific organizations that have been involved in or developed plans for research are:

Department of Transportation - The Bureau's OPSO has sponsored three studies of LNG technology. A 1974 study provided state-of-the-art information relating to design, location, construction, operation, and maintenance of LNG facilities. It also provided a review of codes and practices along with an evaluation of trends in LNG safety considerations. A separate supplement gave information on major research work. Topics covered include: Vaporization and Cloud Dispersion; Spills on Water; Superheat Explosions, Stratification and Rollover; Thermal Radiation; Detonation and Deflagration; and Fire Control.

OPSO has also participated with the Coast Guard, the Energy Research and Development Administration, and the American Gas Association in funding experiments at China Lake to examine the characteristics of burning LNG on the surface of water and of an ignited LNG cloud.

OPSO sees a need for large scale testing to validate predictive modeling. There is need for more work to advance the state-of-the-art for measures and procedures (e.g., diking; impoundment insulation, diffusion techniques, plant personnel protection) to control or mitigate known risks. Research currently in progress for earthquakes design should certainly be continued and possibly expanded.

In addition, the Coast Guard has been deeply engaged in LNG research for many years. Recognizing the novel nature of LNG, the Coast Guard initiated an active research program to describe the potential hazards which could result from an accidental release. The first effort was begun in 1968 to evaluate the effects of spilling LNG onto water. This program has progressed from laboratory size tests up to 1500 gallon spills.

The current program is being conducted at Naval Weapons Center, China Lake, California to study pool spreading phenomena; flame size; thermal radiation; and flame speed through vapor clouds. Tests have been run which show that ignition of a vapor cloud formed from the accidental release of LNG will burn, but it will not detonate. The China Lake effort is currently being jointly sponsored by the Coast Guard, the Department of Energy, the American Gas Association, and the Materials Transportation Bureau.

In addition to the studies of spill phenomena, the Coast Guard has sponsored three major research projects directly relating to LNG safety, including cargo tank design criteria, fire protection system requirements, and personnel qualification requirements. Approximately twenty other broader research projects are directly applicable to LNG.

A detailed listing of the Coast Guard's LNG research efforts is shown on pages 21 - 24 of this report.

FEDERAL FUNDING OF SAFETY RESEARCH

TABLE ~~III~~ COAST GUARD, POT, RESEARCH AND DEVELOPMENT RELATING TO LIG, LFG, AND NAFTHA

REPORT TITLE OR PROJECT DESCRIPTION	REPORT DATE (STATUS)	TYPE OF RESEARCH	CONTRACT COST (DOLLARS)	CONTRACTOR	SUMMARY
"Hazards of LNG Spillage in Marine Transportation" (NTIS-AD-705078)	Feb. 1970	Basic	25,000	Bureau of Mines	Provided a basic understanding of LNG behavior on water, including boil off rates, spill spread rates and vapor dispersion. Boil off formed and the energy input to the cloud was drawn almost exclusively from the gas/air mixing. Dense cloud layering persisted until below its lower flammable limit.
"Hazards of Spillage of LNG into Water" (NTIS-AD-754498)	Sept. 1972	Basic	75,000	Bureau of Mines	Continued above work in flameless explosions and vapor cloud burning. Concensus that the explosion phenomenon is hydrocarbon concentration sensitive and that the vapor cloud burning evidences a flashback to source.
Vapor Cloud Explosion Study					
Phase I "Explosion Hazards with Spills of Large Quantities of Hazardous Materials" (NTIS-AD-A001242)	Oct. 1974	Basic	C.G. *667,000 ERDA 300,000 OPSO 50,000 AGA 75,000	U.S. Naval Weapons Center at China Lake, California	Developed a theoretical model Phase I - <del>Summarize the explosion hazards associated with large spills of hazardous materials, i.e., LNG, and</del> ideal explosions and calculated the dispersion of a large LNG spill. Large hemisphere tests of flame propagation through unconfined vapor clouds of propane were run, <del>and the</del> <i>results of previous work for the future was prepared</i>
Phase II	In Draft (final) Nov. 1977	Basic	Incl. in Phase I Costs	"	Phase II - Hemisphere tests of various gases were continued. Explosive booster used in attempt to detonate free methane. No detonations observed. Tube investigations also conducted to determine run-up distances to detonation.
Phase III	In Progress	Basic	Incl. in Phase I Costs	"	Phase III - Determine the fire hazards of an ignited spreading pool of LNG on water and from the ignition of the vapors of an already spread out vapor cloud. Also included were additional methane and methane/propene detonation tests.
Phase IV	In Progress	Basic	100,000	"	Phase IV - Eight spills of 1500 gallons of LFG onto water were made in August, 1977. Four spills had immediate ignition with varying spill rates, and four spills had delayed ignition with varying spill rates.
Phase V	In Progress	Basic	AGA 300,000 NASA 50,000 C.G. 125,000	"	Phase V - Four tasks (a) Development of rapid response methane sensor (b) Determination of solid explosive booster necessary to cause a steady state detonation in unconfined methane (c) Determination of thermal radiation from the maximum pool fire possible at MNC facility, and (d) Verification of wind-tunnel techniques by conducting vapor dispersion spill tests.
Predictability of LUG Dispersion from Aircraft	April 1977	Applied	50,000	In-house	Analysis of six models of LUG vapor dispersion concluded that the Smully Application Corp. (SAC) model was the most reliable of being superior to the

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TABLE XIII-1 COAST GUARD, DOT, RESEARCH AND DEVELOPMENT RELATING TO LNG, LPG, AND NATURAL GAS (CONTINUED)

REPORT TITLE OR PROJECT DESCRIPTION	REPORT DATE (STATUS)	TYPE OF RESEARCH	CONTRACT COST (DOLLARS)	CONTRACTOR	SUMMARY
"Prediction of Lifetime Extreme Accelerations for Design of LNG Cargo Tanks" (NTIS-AD-779635)	March 1974	Applied	260,000	Naval Ship Research and Development Center	Development of a model to predict the extreme accelerations needed for the design of the cargo tanks in LNG vessels. Predicted extremes were compared to the Chemical Transport Industry Advisory Committee (CTIAC) proposed rates.
"Tanker Structural Analysis for Minor Collisions" (NTIS-AD-A031031)	Dec. 1975	Applied	103,000	M. Rosenblatt and Son, Inc.	Evaluated the phenomena that contribute to the ability of a longitudinally framed-ship, particularly a tanker, to withstand a minor collision (cargo tanks remain intact).
"Recommendations for Qualifications of LNG Cargo Personnel" Three Volumes (NTIS-AD-A026108), <i>AD-779635, AD-779636, AD-779637</i>	April 1976	Applied	95,000	Operations Research, Inc.	Recommended standards for the training and other qualifications of personnel of LNG ships and barges.
"Chemical Hazard Response Information System" (CHRIS) and "Hazard Assessment Computer System" (HACS) Nine Vols.	March 1976 Sept. 1976	Applied	2,000,000	A.D. Little Inc.	Provides information essential for timely decision making during emergencies involving the water transport of hazardous chemicals. Consequent damage to people and property were not assessed.
"Fire Safety Aboard Vessels" (NTIS-AD-A030619) and "Small Scale Tests on Control Methods for Some LNG Hazards" (NTIS-AD-A033522)	Jan. 1976 May 1976	Hazard Analysis	249,000	University Engineers, Inc.	Analytical examination of cargo spill and fire hazard potential associated with the marine handling of LNG. (Emphasis on handling operations.) The maximum controllable fire was defined. Tested the effectiveness of water spray on vapor dispersion and pool fire radiation and of dry chemicals on pool fires and obstructed pool fires.
"A Survey of the Effectiveness of Control Methods for Fires in Some Hazardous Chemical Cargoes" (NTIS-AD-A026300)	March 1976	Hazard Analysis	39,000	University Engineers, Inc.	Assessment of fire safety of marine bulk chemical carriers was hampered by lack of data and the inability to confidently scale-up small scale tests of fire extinguishment.
"Vulnerability Model - A Simulation System for Assessing Damage Resulting from Marine Spills" (NTIS-AD-A015245) and "Vulnerability Model User's Guide"	On Going May 1975	Hazard Analysis	495,000	Enviro Control, Inc.	Simulation model to predict results of marine spill; i.e., toxic cloud or thermal radiation from a burning pool, and estimates injuries, deaths and property losses for a specific location. Based on CHRIS and HACS models.
TOTAL CONTRACT FUNDING			5,160,000		

\*C.G.: Coast Guard, ERDA: Energy Research and Development Administration, OPSO: Office of Pipeline Safety Operations, AAG: American Gas Association.

<u>Project Title or Project Description</u>	<u>Report Date</u>	<u>Type of Research</u>	<u>Contractor</u>	<u>Cost</u>	<u>Summary</u>
Evaluation of Liquid Dynamic Loads in Slack Cargo Tanks	Ongoing	Applied	Southwest Research Institute	\$50,000	A continuation of the previous study. Topics include a review of current tank sloshing mode followed by experiments to provide more sloshing data and to establish the response of LNG tank membrane structures under such forces. New model will then be prepared.
Ship Structures Committee Thermoelastic Model Studies of Cryogenic Tanker Structures (NTIS AD-771217)	1973	Applied	Sanders Associates, Inc.	\$30,000	Prepared a method for calculating the temperature and stresses of the hull metal after failure of an LNG tank. Calculations showed fair agreement with scale model tests.
A Study to Obtain Verification of Liquefied Natural Gas (LNG) Tank Loading Criteria (NTIS AD-A025716)	April 1976	Applied	Southwest Research Institute	\$50,000	Investigated the forces exerted by LNG in cargo tanks specifically whether those forces experienced due to tank loading were compatible with the requirements imposed by some eight public and private regulatory organizations.

FUTURE R&D PROJECTS

<u>Project Title</u> <u>Project Description</u>	<u>Report Date</u>	<u>Type of Research</u>	<u>Contractor</u>	<u>Cost</u>	<u>Summary</u>
Review and Analysis of Liquefied Natural Gas Research Program	Late 1978		National Academy of Science	\$97,000	<p>Subcommittee of the NAS Maritime Hazardous Materials Committee shall:</p> <ol style="list-style-type: none"> <li>1. Analyze the safety issues associated with LNG transportation handling and stowage which need to be addressed through research.</li> <li>2. Analyze the LNG safety research which has been completed, projected or planned.</li> <li>3. Determine if LNG research is sufficient to adequately provide answers to questions relating to LNG safety.</li> <li>4. Determine what questions, if any, concerning LNG safety need to be addressed.</li> </ol>
Continuation of "An Assessment of Predictability of LNG Vapor Dispersion from Catastrophic Spills on Water".	July 1978	Applied	Dr. Havens Univ. of Arkansas	\$19,089	Do a detail analysis of Science Applications Inc. vapor dispersion model.
Phase VI		Basic	U. S. Naval Weapons Center at China Lake, California	\$100,000	<ol style="list-style-type: none"> <li>1. Continue to study detonation potential of unconfined methane. Attempt to detonate using plane wave generated from explosion in pipe.</li> <li>2. Study formation from large spill. Ice could lower vapor rate.</li> </ol>

Department of Energy - The DOE has developed a comprehensive five-year plan (Publication DOE/EV-0002) as the result of an assessment of LNG safety and environmental issues.

Industry - The natural gas industry, through the American Gas Association and the Gas Research Institute, has done and is planning to do extensive research into the safety of LNG. Many individual companies have also done research in this area.

However, to date, LNG research efforts have been largely uncoordinated.

The Use of Population Criteria  
for Siting LNG Facilities

Increased useage of LNG poses some <sup>POTENTIAL</sup> ~~serious~~ safety problems. A large spill could result in a major fire with lethal thermal radiation, in a detonation causing a destructive blast wave, or in a vapor plume that drifts some distance before igniting or exploding. There is a general agreement that the probability of an accident is low. Yet there is also little dispute that the consequences could be disasterous.

One option for minimizing the risk of unacceptable damage to human life and personal property is to isolate as much as possible the transportation and storage of LNG from significant population centers. This would not necessarily lower the chance of a mishap, but would help to ensure that any adverse impact is mitigated.

Determination of what population exclusion or density criteria should be used in LNG siting decisions is a difficult task. The behavioral properties of a large, unconfined LNG spill are not well understood. For example, a preliminary proposal by DOT's Office of Pipeline Safety Operation would establish a thermal radiation protection exclusion distance from an LNG terminal equal to, in the case of parks and playgrounds, 3.6 times the square root of the area contained by the diking system. This would amount to exclusion distances up to a couple of thousand feet, and would, according to the analysis, provide sufficient time for exposed humans to seek shelter. An analysis by the consulting firm Ecology and Environment, Inc. suggests a larger thermal radiation protection zone may be desirable. The State of California has found that skin burn radiation damage can occur up to a distance of four miles. Similar uncertainty exists with respect to how far an LNG vapor plume might travel. Estimates range from a few hundred yards up to 50 miles for a 25,000 M<sup>3</sup> spill. Furthermore, nobody has been able to demonstrate that a vapor cloud can be detonated or determine the circumstance in which such a reaction is likely or possible.

The lack of a solid technical base about LNG dynamics means that danger zones around an accident cannot be predicted with confidence. Consequently, the establishment of population criteria is highly subjective and fundamentally political.

California is the first and only jurisdiction to make such a judgment. A law has been passed which limits population density to less than 10 people per square mile within one mile of the facility, and less than 50 people per square mile within four miles. This precludes any significant population center from being within what the State has determined to be the thermal radiation damage zone of a large LNG fire.

*ALTHOUGH A DIRECT COMPARISON CANNOT BE MADE BETWEEN LNG AND NUCLEAR FACILITIES,* A somewhat different way to limiting population exposure to a potential hazard is used by the Nuclear Regulatory Commission. Three safety zones are established around each nuclear power plant. The size of each zone is determined on a case-by-case basis taking into consideration plant engineering design and local geography and land utilization.

The first zone, generally six to eight hundred yards wide, is an exclusion area. Residence in this band is normally prohibited and most other activities are severely restricted. A low population zone, usually at least two miles in width, surrounds the exclusion area. The people allowed in this band must be of such a total number and density that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident. The final zone, the outer boundary of which must be at least one and one-third times the distance from the reactor to the outer boundary of the low population zone, excludes population centers of more than about 25,000.

Both the California and NRC standards result in approximately a four mile buffer around the facility. The NRC approach provides somewhat more flexibility because the controlling factor in the low population zone is capable to take protective actions, not rigid density standards. This permits some tradeoffs to be made between plant design and population i.e., the more safeguards at the facility the greater the adjacent population can probably be.

If the new California standards had been applied to facilities now in operation or under construction, these terminals could not have been built. Of locations now being seriously considered, only Point Conception, California and Matagorda Bay, Texas (if the transient tourist population is excluded) meet the density requirements. FERC has had conducted preliminary alternative site investigations for the Northeast Coast, the Gulf Coast, and the West Coast. These studies identified preferable locations for terminals based on an extensive list of criteria including oceanographic, navigational, economic, land use, and safety considerations. The purpose of the effort was not to select specific sites that would be mandated.

by the Federal Government, rather to get some idea of how many feasible locations there are. The criteria used precluded location near major urban areas. The sites that were identified as being most desirable from an overall standpoint generally had population densities (around either the terminal site or the transportation corridor leading to it) in excess of the California standards.

#### Options

- 1) Establish specific population density standards that all pending and future projects must meet.

This would be a highly volatile and essentially political issue. If it is the desired option Congress should be asked to set standards. In fact, this is already under consideration by the House Subcommittee on Energy and Power. Subsequent to recent hearings on HR 6844 to establish an LNG siting and project design policy, amendments are being considered that would establish specific population density limits.

One of the problems with setting rigid standards is what to do as population increases. It is possible that as this occurs our understanding of LNG safety and control will improve sufficiently to alleviate concern. Otherwise strict control either through zoning or through some type eminent domain authority would have to be legislated and implemented.

- 2) Establish a total exclusion area up to some distance from the facility surrounded by a low population zone (no specific density standard).

Under this alternative the operator would have to maintain an unused area around the facility of, for example, two thousand feet. This total exclusion area would be surrounded by a low population zone wide enough to preclude some level of thermal radiation exposure, for example,  $0.2 \text{ cal/cm}^2\text{sec}$ . The operation would be obligated to ensure that either the population in this zone does not increase (e.g., by buying the property) or for ensuring an adequate level of protection (e.g., better engineering safeguards or adequate evacuation plans). This option provides more flexibility for the operator over the lifetime of the project without increasing the consequences of an accident. The distances for the exclusion area and low population zone will have to be set. This could be a controversial process.

- 3) Establish a Federal Siting Committee that would identify the sites to be used for LNG terminals.

This option need not be adopted to ensure population density limitations. As this can be accomplished through option 1 or 2. The advantages of this alternative are that it would allow for wiser land use planning for the nations's coastal areas and it would help minimize the time required to decide on the suitability of a site for each new LNG import application since appropriate sites would be predetermined. The disadvantages are that it could conflict with other Agencies regulatory authority (e.g., Dept. of Commerce Coastal Zone Management Oversight), and could be viewed as unwarranted Federal interference in State and local land use decision-making.

- 4) Continue current case-by-case review of terminal siting.

Although few additional major LNG import terminals are anticipated, the costs and time involved in each siting decision have been and will probably continue to be prohibitive. Establishing basic groundrules, such as population density, for locating a facility would make the job easier for both applicant and reviewer.

Population Information Tables

The information presented in the following tables is in very rough form and useful only to provide a general idea of populations adjacent to possible terminal sites. In many cases the estimates are based on 1970 census data and may be significantly out of date. The sources of the figures were primarily impact statements and site ~~evacuation~~ studies prepared by consultants for FERC. The information is, unfortunately, often in terms that makes comparison difficult.

Population of Areas Surrounding LNG  
Terminal and Transportation Corridors

Facilities Under Construction

Cove Pt., MD

Elba Island, GA

Lake Charles, LA

Potential Sites <u>Gulf Coast</u>		Number of People	
		<u>Adjacent to Terminal</u>	<u>Adjacent to Transportation Corridor</u>
Port Isabel, TX	Within		
	1000 ft	None	few hundred
	1 mile	None	few thousand
	3 miles	2,500	(up to 60,000 seasonal (tourists)
	5 miles	3,600 permanent 60,000 summer seasonal	
Harbor Island, TX	Within		
	1000 ft	50 workers	undetermined
	1 mile	50 workers	1,300
	3 miles	1,300	1,300
	5 miles	1,300	1,300
Pascagoula Bay, LA	Within		
	1000 ft	480 workers	
	1 mile	480 workers	Not available
	3 miles	16,000	
	5 miles	27,000	
Matagorda Bay, TX	The city of Port O'Conner is just over 4 miles from the site. It has a permanent population of 840 and a peak daytime summer population of 4,850.		

Potential Sites  
West Coast

Population Density  
(persons/mi<sup>2</sup>)

	Within 1 mile	Within 4 miles
Oxnard, CA	1,849	3,229
Pt. Conception, CA	3	<60
San Onofre, CA	Not available	Approximately 400

# Results of Site Evaluation

North of Cross

## Alternative Sites

Impact Area/Criteria	Prudence Island (I)	Quonet Point Davisville (II)	Seas Island (III)	Cross Island (IV)	St. John (Lower Point) Bay of Fundy, New Brunswick, Canada
3. Presence of Factors Affecting Safety					
A. Shipping Accidents	Approximately 7.5 nautical mile approach inside Narrowsville Bay, includes 1 mile of dredged channel to southwest of island. 11.5 nautical mile traffic separation scheme required on all shore approach to Narrowsville Bay. Total distance 19 nautical miles.	Approximately 12 nautical mile approach inside Narrowsville Bay includes 4.5 nautical mile dredged channel to Davisville. 11.5 nautical mile offshore traffic separation scheme. Total distance 23.5 nautical miles.	Approximately 22 nautical mile approach up East Penobscot Bay from Sea Island, Maine, plus 20 miles to Matineus Bank for a total of 42 miles.	4 nautical miles from the Libby Island Light if open sea to the berth.	Approximately 8 miles from established shipping lanes.
B. Channel and Berth Depth	Berth is 43-49 ft. channel 28-60 ft. Dredging not essential but preferable to allow use of berth on southern or southwestern part of island 10.4-7.0 million cubic yards. Soft bottom feasible to dredge to 40 or 42 ft depth.	Berth is 27.5 ft. channel 27.5 ft. Dredging required of 27 to 30 ft depths for 500 ft width along 4.5 mile approach channel to 40 to 42 ft depth. Soft bottom feasible to dredge to 40 or 42 ft depth.	Berth is 39 ft. channel 47-100 ft. Dredging not essential, but preferable to deepen approach basin (0.1 million cubic yards total) (dredging of 0.267 million cubic yards of ledge also potentially desirable to remove ledge at 25 ft depth 11.5 nautical miles south-southeast of island).	Dredging not required. Berthing site at Northwest Harbor on Cross Island has depths of 45-55 ft. 0.25 mile from shore. Channel depth is 150 ft.	Channel is 40-300 ft. berth greater than 30 ft.
C. Channel Width	3,000 ft wide Fast Passage. Possible 500 ft wide dredged channel.	See Prudence Island.	1.5 mile wide East Penobscot Bay opens at natural channel.	0.75 mile wide clear, existing channel to the southwest.	Approach channel width not limited.
D. Bottom Conditions	Variable bottom character, mostly soft. Could utilize surplus Navy anchorages.	See Prudence Island.	Soft bottom and good holding characteristics.	Hard bottom with ledge, mud, and sand in the ship anchorage and maneuvering area.	Transition zone having pebbles and rocks near berth.
E. Configuration of Approach Channel	Shallow "S" configuration requires four turns at Bay entrance, one 20° turn from 010° to 030° T, one 77° turn from 283° to 000° T, one 60° turn from 000° to 300° T. Last four turns are in Narrowsville Bay.	Shallow "S" configuration requires four turns at Bay entrance, one 40° turn from 010° to 330° T, one 47° turn from 330° to 78° T, one 77° turn from 283° to 000° T, one 60° turn from 000° to 300° T. Last four turns are in 540 ft wide dredged channel.	"S" configuration, two 30° turns at Matineus Island entrance, one 63° turn at Owl's Head from 33° to 40°, one 18° turn from 040° to 022° and 40° turn from 022° to 312°. All turns are in 1.5 to 3.0 mile wide Penobscot Bay.	90° turn from the northeast approach heading southeast to the berth. No hazards or obstructions.	Direct route from established shipping lanes.
F. Adequacy of Charting	Scale of navigation charts 1:20,000. All navigation charts updated annually. U.S. Coast Pilot updated annually. "Notice to Mariners" published weekly.	Scale of navigation charts 1:20,000 (See Prudence Island notes).	Scale of navigation charts 1:40,000 and 1:20,000 (See Prudence Island notes).	Scale of navigation charts 1:40,000. (See Prudence Island notes).	1:50,000 scale charts available.
G. Presence of Hazards or Obstructions	No hazards or obstructions. New 2,500 ft channel across to berth site possibly needed with dredging to 40 or 42 ft depth. New Port Bridge has 213 ft clearance.	No hazards or obstructions. Existing 26,100 ft channel to Davisville needs dredging to 40 to 42 ft depth. New Port Bridge has 213 ft clearance.	No hazards or obstructions. 267,000 cubic yards of ledge could be removed to open harbor and offshore channel providing 0.5 mile south-southeast of berth.	No hazards or obstructions, no dredging required.	None identified in approach channel.
H. Ship Traffic Volume Near Berth, Turning Basin, and Anchorage	Berth on southwest shore of island. Navy anchorage X-1 and attendant restricted area located adjacent to west side of main ship channel to Providence average 36 vessels per month over 550 ft).	Davisville berth located at head of Quonet channel. (See Prudence Island for anchorage.)	Berth on southeast shore of island located 2 miles northeast of Seaport Station approach channel. Anchorage at head of East Penobscot Bay. 3 miles east of Seaport channel average 4.7 vessels per month over 650 ft).	Berth at Northwest Harbor on west of Cross Island. Little or no shipping traffic.	No other traffic in vicinity of berth.

LNG Liability  
(Subsection of Safety and Siting)

Summary

- ° The adequacy of insurance to cover the injuries and damages that could be expected from a major LNG accident is an integral part of the assessment of safety and siting issues. Despite all precautions, an LNG accident could occur and LNG tankers and liquefaction or terminal facilities destroyed. Serious accidents could cause loss of life and damages to nearby communities. Estimates of potential damage and, in turn, requisite insurance coverage vary widely depending on conclusions as to the safety of LNG.
- ° The law governing liability is extremely complex and far from clear. Federal maritime law is often inconsistent or incomplete, causing uncertainties as to legal remedies available in the event of a LNG accident. Confusion can result in instances where both maritime and non-maritime laws come into play. In addition, uncertainties are raised whether numerous state laws apply either separately or concurrently with Federal law.
- ° Some industry sources maintain that existing insurance arrangements are adequate to provide coverage in the event of a major LNG accident. They point out that LNG is an excellent risk in the insurance market and that insurance in excess of the value of the vessel could be easily obtained. They argue that terminals carry adequate insurance -- generally \$50-\$200 million -- and point to the strong financial position of LNG operators.
- ° A number of studies conclude that a LNG accident could leave injured parties with little or inadequate compensation. They point to the limited liability under existing corporate structures whereby LNG operators are capitalized separately, placing the assets of the parent company out of reach. Likewise, each LNG tanker is a separate corporate entity in

order to take advantage of statutory limitations on liability. Furthermore, accidents caused by force majeure or a third party with little insurance could result in avoidance of liability.

- ° New mechanisms to assure adequate compensation in the event of a major LNG accident could emerge. These could be patterned after similar mechanisms designed to cover other hazardous materials, such as nuclear power plants and major maritime accidents with potential for considerable damage and loss of life. These mechanisms could involve comprehensive insurance funds funded by all LNG operators, strict liability standards and minimum levels of protection, or a combination of private financial protection and government indemnity to fully cover claims arising from an accident.
- ° The Federal Government should give top priority to LNG liability issues. Concerned agencies should begin a thorough study of the adequacy of existing insurance arrangements and possible alternatives to provide adequate compensation in the event of a major accident. These should be analyzed from the standpoint of costs versus benefits, impact on the commercial insurance market, and experience with insurance arrangements for other hazardous materials. In cooperation with efforts underway in the Congress, the Administration should work toward legislation to eliminate both Federal and State legal uncertainties, simplify claims procedures, and establish strict liability. Alternatively, study would be made whether LNG, major oil spills, nuclear facilities, noxious gases and other hazardous materials should be regulated as a class, with major reform of the insurance structure initiated.

## Maritime Law

The Limitations of Liability Act of 1951 is one of the most important statutes in maritime liability law. The Act limits the liability of the owner of the vessel for accidents occurring without his knowledge or privity to the value of the owner's interest in the vessel and "her freight then pending." An exception is made for loss of life or bodily injury in which case liability is limited to \$60 per ton of the vessel. If a vessel is totally destroyed and its cargo discharged, the claimant can receive nothing unless a Federal statute supersedes the term of the Act.

With respect to LNG, an important legal question is raised in the event a major accident originates onboard an LNG ship and spreads to the terminal and nearby areas. Legislation and court rulings somewhat clarify that the vessel is totally liable for all damages, but its limits of liability are circumscribed by the 1851 Act and patterns of vessel ownership.

The concurrence of State-Federal maritime jurisdiction and attendant legal problems can confuse the liability issue. Certain states have promulgated statutes calling for strict State liability limits for oil tankers. To date, no state has enacted liability standards although a New York LNG bill could be interrupted as providing for strict liability for LNG owners for any accident occurring in port.

Injured parties may be unable to recover damages if the accident were due to an act of God, an act of war, or negligence since these cases are excluded under liability laws. The law is incomplete if fault rests with another vessel or third party carrying little insurance. ~~No~~ compensation is likely. In the event the accident occurs at the terminal site, State law is applicable, although it is unclear whether a showing of negligence would be required or if there is strict liability.

No international law governing LNG liability provisions exists. The International Maritime Consultative Organization (IMCO) issued a code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, but the organization has not addressed LNG liability provisions. The IMCO has been heavily involved with mixed results in liability and compensation damages from oil pollution by tankers. The International Convention on Civil Liability for Oil Pollution was issued in 1969 but it was soon rendered obsolete by tanker sizes. As a result, a Convention on the Establishment of an International Fund for Compensation for Oil Pollution damages was proposed to raise the limits of liability coverage and provide for full and adequate compensation. For the International Fund to become effective, inter alia, eight nations must have agreed to be bound by the International Fund Convention and in each signatory nation a total quantity of at least 750 million tons of oil must have been received by cargo owners liable for contribution to the Fund. The Convention has not come into force and the U.S. has signed but not ratified it.

Although the IMCO is perhaps the international organization with the most expertise to address LNG liability, it is unlikely to undertake the issue in the near future due to its experience with oil pollution compensation and liability. The U.S. could push for IMCO involvement, but it would be unsupported by other maritime nations with LNG fleets. In the meantime domestic law, which could serve as a precedent for other nations, will have to fill gaps and eliminate ambivalency in liability provisions.

### Other Problems Affecting Compensation

Intricate corporate ownership patterns of LNG vessels and terminals result in a complicated financial situation leaving the corporate assets unreachable for compensation purposes. It is characteristic in the shipping industry that each vessel is set up as a separate corporation in order to isolate the assets of the parent corporation. Thus liability laws become theoretical since in practice there is no recourse to the assets of the party at fault when a ship and its cargo are destroyed.

Similarly, the LNG terminal is a wholly-owned, separately capitalized subsidiary of larger natural gas companies. The natural gas importer/terminal operator purchases insurance that presumably could cover loss of terminal facilities, estimated at some \$200-\$300 million and second and third party damages. However, this insurance, known as protection and indemnity, (p and i) in many instances would do little more than compensate for the loss of terminal facilities, assuming they would have to be reconstructed at a higher cost due to inflation. In some instances, the vessel owner waives the right to sue the terminal operator if fault rests with the latter. The net effect is a reduced amount of coverage carried by the terminal. As part of its LNG report, GAO surveyed the liability insurance coverage per incident of LNG terminals and found amounts such as "to the fullest extent possible," \$50-100 million for third parties in excess of liability coverage; \$140 million with no provisions for third parties, etc. However, some private sources estimate damage could reach \$500 million based on damages resulting from incidents involving other hazardous materials.

Under existing practices, no federal agency assumes responsibility for assuring compensation of victims. Claimants face a time consuming and expensive process in order to receive compensation. Fault must be established, the extent of damages assessed, and the parent company's liability litigated.

### Possible Solutions to LNG Liability Problems

There is a growing concern for the need to shift the economic burden of LNG risks from nearby residents and property owners to the shipowners and terminal operators. Assuming costs are passed through the end-use consumer will bear any added insurance costs.

Solutions include setting of minimum limits of coverage, provisions for strict liability regardless of fault, and expedited litigation procedures. LNG could be viewed in the context of other hazardous substances, such as noxious gases, major oil spills, or nuclear facilities and comprehensive insurance schemes enacted to cover all hazardous materials as a class. This approach calls for a combination of private insurance financing and government indemnity. Funding could be based on risk and damage potential. Alternatively, a mandatory LNG insurance compensation fund, financed by an excess tax on imported quantities of LNG could be imposed. There is some precedent for this type of fund.

The Trans-Alaska Pipeline Authority Act (PL 93-153) modifies the Limits of Liability Act under certain conditions, and establishes a \$100 million Trans-Alaska Liability Fund, funded by a 5-cent-per barrel fee levied upon the oil owner. The Act establishes strict liability without regard to fault. The shipowner and operator are liable for the first \$14 million of claims and the Liability Fund covers the balance up to the established limit of \$100 million.

The Deepwater Port Act of 1974 also incorporates the fund concept and establishes a \$100 million Deepwater Port Liability Fund. Each barrel of oil loaded or unloaded at a deepwater port is assessed 2 cents which is contributed to the Fund. The Fund sets legislative precedent by inter alia permitting the United States Government to initiate a class action suit on behalf of damaged citizens in order to lessen an injured party's costs of litigation and streamline remedy procedures.

Legislation is pending in several congressional committees that establishes an LNG Damages or Compensation Fund, funded by a fee (cents/mcf) on natural gas received at the terminal. The Fund is to be used to pay for claims which exceed the liability limit set forth in the bills. In the case of vessels, this amount is \$75 million or \$1,000 per ton, whichever is less, and in the case of terminals, the upper limit is \$100 million. The bills generally provide for strict liability and expedited litigation procedures.

MEMORANDUM OF UNDERSTANDING  
BETWEEN THE UNITED STATES COAST GUARD  
AND THE MATERIALS TRANSPORTATION BUREAU  
FOR REGULATION OF  
WATERFRONT LIQUEFIED NATURAL GAS FACILITIES

I. INTRODUCTION

Within the Department of Transportation (DOT), the United States Coast Guard (USCG) and the Materials Transportation Bureau (MTB) exercise separate and overlapping safety regulatory authority affecting the siting, design, construction, maintenance, and operation of waterfront liquefied natural gas (LNG) facilities adjoining the navigable waters of the United States. The USCG derives its authority over such facilities from the Ports and Waterways Safety Act of 1972 (Pub. L. 92-340, 33 U.S.C. 1221-1227) and the Magnuson Act (50 U.S.C. 191). The regulatory authority of the MTB over these same facilities (as well as non-waterfront LNG facilities) is derived from the Natural Gas Pipeline Safety Act of 1968 (Pub. L. 90-481, 49 U.S.C. 1671 et seq.) and the Hazardous Materials Transportation Act (Pub. L. 93-633, 49 U.S.C. 1801 et seq.).

In recognition of each of the parties' respective regulatory responsibilities, the USCG and the MTB agree that a memorandum of understanding is needed to avoid duplication of regulatory efforts regarding waterfront LNG facilities and to maximize the exchange of relevant information.

II. RESPONSIBILITIES OF THE PARTIES

For the foregoing reasons, the USCG and the MTB agree to the following division of regulatory responsibilities with respect to waterfront LNG facilities and cooperation in carrying out those responsibilities:

USCG RESPONSIBILITIES

The USCG is responsible for establishing regulatory requirements for--

- (1) Facility site selection as it relates to management of vessel traffic in and around a facility;

- (2) Fire prevention and fire protection equipment, systems, and methods for use at a facility;
- (3) Security of a facility; and
- (4) All other matters pertaining to the facility between the vessel and the last manifold (or valve) immediately before the receiving tank(s).

MTB RESPONSIBILITIES

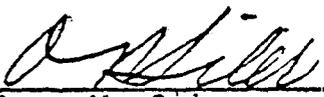
The MTB is responsible for establishing regulatory requirements for--

- (1) Facility site selection except as provided by paragraph (1) of the "USCG Responsibilities" set forth in this Memorandum; and
- (2) All other matters pertaining to the facility beyond (and including) the last manifold (or valve) immediately before the receiving tank(s) except as provided by paragraphs (2) and (3) of the "USCG Responsibilities" set forth in this Memorandum.

JOINT RESPONSIBILITIES

- (1) The USCG and the MTB will cooperate and assist each other in carrying out their respective waterfront LNG facility regulatory enforcement activities; and
- (2) The USCG and the MTB, in an effort to avoid inconsistent regulation of similar safety matters (including as between waterfront and non-waterfront LNG facilities), will consult with each other before issuing each Advance Notice of Proposed Rulemaking, Notice of Proposed Rulemaking, and final regulation affecting waterfront LNG facilities.

For the United States  
Coast Guard

  
\_\_\_\_\_  
ADM Owen W. Siler  
Commandant

Date 7 FEB 1978

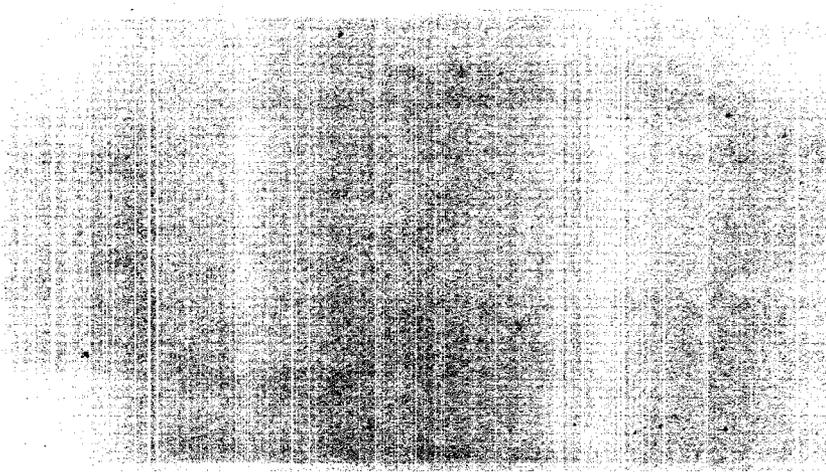
For the Materials Trans-  
portation Bureau

  
\_\_\_\_\_  
E. D. Santman  
Acting Director

Date FEB 1 1978

**Enclosure C**

**Correspondence between NRC and California on LNG**



C O P Y

San Francisco, California

PUBLIC UTILITIES COMMISSION

State of California

File No. 004-3

June 6, 1978

Honorable Joseph M. Hendrie  
1717 H. Street, N.W.  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Chairman Hendrie:

On September 16, 1977, California's Governor Brown signed Senate Bill 1081, the Liquefied Natural Gas Terminal Act of 1977. (LNG Terminal Act) This act grants the California Public Utilities Commission (CPUC) exclusive power to issue a permit for the construction and operation of a liquefied natural gas (LNG) terminal in California. On October 14, 1977, Western LNG Terminal Associates filed an application with the CPUC for a permit to construct and operate an LNG terminal at Point Conception, California. The LNG Terminal Act requires the CPUC to issue a decision on the application no later than July 31, 1978.

Further, the act provides that not later than May 31, 1978, the California Coastal Commission must submit to the CPUC the Coastal Commission's final report evaluating and ranking the sites which qualify for an LNG terminal. The Coastal Commission's report is deemed a recommendation to the CPUC, and the CPUC is required to issue a permit for construction and operation at the site designated as the highest-ranked site by the Coastal Commission. However, the CPUC may select a lower-ranked site if it determines with respect to each higher-ranked site that location of an LNG terminal at such site is not consistent with interests of public health, safety and welfare, or if it determines that it is not feasible to complete construction and commence operation of the terminal at such higher-ranked site in sufficient time to prevent significant curtailment of high-priority requirements for natural gas and also finds that approval of the lower-ranked site will significantly reduce such curtailment.

On May 31, 1978, the Coastal Commission issued its final report evaluating and ranking suitable sites for an LNG terminal as follows:

C O P Y

Honorable Joseph M. Hendrie  
June 6, 1978  
Page 2

- (1) Camp Pendleton-Horno Canyon (San Diego County)
- (2) Rattlesnake Canyon (San Luis Obispo County)
- (3) Point Conception (Santa Barbara County)
- (4) Deer Canyon (Ventura County)

Camp Pendleton, the highest-ranked site, is located five miles south of Southern California Edison's San Onofre Nuclear Generating Station while the second recommendation, Rattlesnake Canyon, is situated 3.6 miles south of the Pacific Gas and Electric Diablo Canyon Nuclear Generating Station.

In evaluating the pending application to construct and operate an LNG terminal at Point Conception, the CPUC must determine, on or before July 31, 1978, whether the highest-ranked sites, Camp Pendleton and Rattlesnake Canyon, are acceptable in terms of both public safety and timely delivery of gas supplies. To facilitate the resolution of this difficult question, the CPUC seeks guidance from the NRC with respect to its policy for locating nuclear generating facilities in the area of a potentially hazardous LNG facility or vice versa.

By letter dated April 12, 1978, Harold Denton, Director of the Division of Site Safety and Environmental Analysis at the NRC, informed Pat Weinstein of the Coastal Commission staff that:

"Part 100 of Title 10 of the Code of Federal Regulations permits two or more nuclear power reactors to be in close proximity if, and only if, they are so designed that an accident at one does not endanger the safety of any of the others. Our design requirements against other industrial and transportation facilities nearby are consistent with this requirement, namely that the safety of the nuclear power plant must not be dependent upon events at those facilities."

Mr. Denton further stated that:

"[A]t this time we are not prepared to offer specific suggestions for provisions in the construction and operation of an LNG terminal at Rattlesnake Canyon or Horno Canyon necessary to clearly demonstrate the compatibility of such a facility with the existing nearby nuclear power reactors. While a variety of measures might be taken to isolate the possible interaction between the two types of activities, the need for and value of any specific measure would require further study."

C O P Y

Honorable Joseph H. Hendrie  
June 6, 1978  
Page 3

In light of the Coastal Commission's recommendations of May 31, 1978 and in view of the statutorily-mandated decision date of July 31, 1978 precluding further study, the CPUC requests an NRC determination as to the acceptability of locating an LNG facility within 4-5 miles of an existing nuclear generating station. In the alternative, a clear set of specific NRC guidelines for the location of potentially hazardous facilities in proximity to nuclear reactors is sought.

In view of obvious constraints imposed by the July 31 decision date, a timely response is requested. Your consideration and cooperation in this matter of great importance is much appreciated.

Sincerely yours,

/S/  
Robert Batinovich, President



COPY

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

April 12, 1978

Mr. Pat Weinstein  
Onshore LNG Project Manager  
California Coastal Commission  
631 Howard Street, 4th Floor  
San Francisco, California 94105

Dear Mr. Weinstein:

Thank you for the information concerning your investigations of coastal sites. We appreciate your request for NRC comment before any final decision is made on the preferred site for the proposed western LNG terminal.

As you noted in your letter of March 13, there are two nuclear power reactor sites where potential accidents involving LNG traffic has been reviewed (Calvert Cliffs and Hope Creek/Salem). Our general criteria are that nuclear power reactors should not be located near hazardous industrial developments unless one of two circumstances are satisfied: (1) that the risks of an accident at a nearby hazardous industrial facility affecting the safety of the nuclear reactor be acceptably low or (2) that the design of the nuclear reactors be such that they can safely withstand an accident from other nearby facilities.

Part 100 of Title 10 of the Code of Federal Regulations permits two or more nuclear power reactors to be in close proximity if, and only if, they are so designed that an accident at one does not endanger the safety of any of the others. Our design requirements against other industrial and transportation facilities nearby are consistent with this requirement, namely that the safety of the nuclear power plant must not be dependent upon events at those other facilities. Certain hazards, however, are considered sufficiently unlikely at many sites that it is unnecessary to design against them specifically. At present, for example, it is physically possible that one of the LNG tankers now sailing the Pacific Ocean could be wrecked upon the California coast. The probability that this might actually occur near San Onofre or Diablo Canyon is, however, extremely remote, and this hazard has not been considered in the design of those plants.

The nearby presence of an LNG terminal, even if that terminal were so designed and situated that it did not place a direct hazard to a nuclear power plant, could bring with it the increased possibility of the close approach by LNG tankers or flammable gases released from these tankers. Such a possibility would have to be considered in deciding whether or not the nuclear power plant could be operated safely without undue risk to the public.

April 12, 1978

Although no LNG facilities are likely to be built on the Delaware River, other hazardous ship cargos do appear in traffic on that river, and an Atomic Safety and Licensing Board is presently deliberating upon the Hope Creek license application on those grounds. Also, LNG tankers are expected to approach to within about 6km of the Calvert Cliffs site. This situation is currently under review by the NRC.

In the material you provided, it was noted that the adequacy of a four mile "buffer zone" between Rattlesnake Canyon and the Diablo Canyon sites "to ensure containment of an emergency at one plant without involving the other requires further study". We would agree with that conclusion. The hazards of LNG tanker spills have been estimated by some authorities to persist to distances of up to 20 km under particularly adverse conditions. For lesser distances, it would be necessary to restrict the LNG traffic during those periods when such adverse conditions prevail. Where adverse winds are common and the separation distance is much smaller than 20 kms, such restriction may prove a significant burden to the LNG traffic.

Our safety requirements for nuclear power plants are intended to protect the public from radiation injury, and not to protect an applicant's investments. If LNG and nuclear facilities are sited in close proximity, similar populations are at risk from accidents at either, and measures that go to prevention of the initiating LNG accident would be more desirable than measures to mitigate the effects of such accidents in power reactor facilities. Careful study is required to assure that specific proposed measures to protect one element of society does not, in effect, increase the risk to others.

At this time we are not prepared to offer specific suggestions for provisions in the construction and operation of an LNG terminal at Rattlesnake Canyon or Horno Canyon necessary to clearly demonstrate the compatibility of such a facility with the existing nearby nuclear power reactors. While a variety of measures might be taken to isolate the possible interaction between the two types of activities, the need for and value of any specific measure would require further study. We recommend, since this option still exists, that the problem be avoided, by selection of a site for an LNG terminal that is more removed from the existing nuclear power reactors.

Mr. Pat Weinstein

- 3 -

April 12, 1978

Finally, we do not believe that a seawater exchange system between a nuclear power plant and an LNG terminal would be economically feasible, nor of significant net environmental benefit, because of the length of the pipelines.

For your information, we are enclosing the results of staff work on LNG hazards from other licensing actions (Hope Creek, Salem, Calvert Cliffs). In addition, we are including a report, IITRI J6405, which indicates that certain staff assumptions may be nonconservative. We have not yet completed a technical review of this work.

It may be helpful to discuss this matter further, and particularly to clarify the substance of the results of our prior reviews (as noted, this material is attached). If you desire a meeting please do not hesitate to call me (301) 492-7207.

Sincerely,

15/  
Harold R. Denton, Director  
Division of Site Safety and  
Environmental Analysis  
Office of Nuclear Reactor Regulation

Enclosure:  
AS stated

## CALIFORNIA COASTAL COMMISSION

631 HOWARD STREET, 4th FLOOR  
SAN FRANCISCO, CALIFORNIA 94105*Brown - action  
my reg*

March 13, 1978

Harold Denton  
Director of Site Safety and Environmental Analysis  
Nuclear Regulatory Commission  
Washington, D.C. 20014

Dear Mr. Denton:

The California Coastal Commission is required to evaluate and rank potential liquefied natural gas (LNG) terminal sites on the California coast and, by May 31, 1978, forward such ranking to the California Public Utilities Commission for a July 31 permit decision by that agency. We have retained 5 sites (out of 82 initially considered) for detailed study and final ranking. (see the preliminary and final staff reports adopted by the Commission on January 30, 1978).

Two of the five sites being considered are within 5 miles of existing nuclear power plants. The Rattlesnake Canyon site is approximately 4 miles south of the PG&E Diablo Canyon plant but is separated from it by rugged terrain. The Horno Canyon site on the Camp Pendleton Marine Base is approximately 5 miles south of the Southern California Edison/San Diego Gas and Electric Company's San Onofre plant (see the attached topographic maps). Both sites have many favorable characteristics for an LNG facility based upon land use, environmental, and feasibility considerations. It is conceivable that either site could be ranked first by the Coastal Commission.

We would appreciate the views of the Nuclear Regulatory Commission concerning the feasibility of locating an LNG facility capable of storing a legal maximum of 1.65 million barrels of LNG, eventually serviced by approximately 190 annual tanker trips, at either of these sites.

We are concerned about the safety questions raised by the proximity of the facilities and would like your comments to address probable safety requirements at each site. In this regard, we would benefit greatly from a discussion of the Nuclear Regulatory Commission's experiences with the Calvert Cliffs and Hope Creek generating plants, which are located in close proximity to LNG facilities and LNG tanker routes. Suggested conditions for the safe construction and operation of an LNG terminal at both locations would also be extremely helpful. Any implications the location of a nearby LNG facility might have on the operating licensing process for the nuclear plants and the time and expense involved would be relevant to our analysis. Finally, any comments on the

Mr. Harold Denton  
March 13, 1978  
Page 2

3. feasibility of a sea water exchange system between LNG and nuclear facilities at each site would be welcome.

Thank you for your cooperation. If more detailed information is required, do not hesitate to request it from us.

Very truly yours,

*Pat Weinstein*

*John Bratten*

JCS  
PAT, WEINSTEIN  
Onshore LNG Project Manager

415-543-8555

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AUG 8 1977

Ms. Suzanne Reed  
Senior Energy Advisor  
Office of Planning and Research  
1400 Tenth Street  
Sacramento, California 95814

Dear Ms. Reed:

Thank you for your July 25, 1977 letter to Dr. Norman Eisenberg concerning the licensing and regulation of Liquefied Natural Gas (LNG) facilities. Although the Nuclear Regulatory Commission (NRC) is not responsible for licensing and regulating LNG facilities, as part of our responsibilities under the Atomic Energy Act of 1954, as amended, and the National Environmental Policy Act (NEPA), we review all Environmental Impact Statements (EISs) prepared by the Federal Power Commission (FPC) pursuant to their responsibilities under the Natural Gas Act and the NEPA.

In general, our reviews are limited to those areas for which NRC has special expertise or jurisdiction by law. Specifically our reviews are directed to impacts of the proposed action relative to the radiological health and safety of the public and possible impacts on facilities licensed by or subject to licensing by NRC. I understand that Ben Harless discussed in somewhat greater detail our procedures for reviewing EISs prepared by other Federal agencies during his telephone conversation with you on August 3, 1977.

As Mr. Harless mentioned, we also received a letter from Ms. Nancy J. Aurich of the California Office of Planning and Research (COPR) requesting NRC to furnish certain technical assistance and review participation in the preparation of an Environmental Impact Report for a LNG terminal to be sited in Santa Barbara County, California. A copy of our response to that letter is enclosed.

We would of course be pleased to review any Environmental Impact Reports prepared by COPR for LNG facilities and provide comments to the State

Ms. Suzanne Reed

- 2 -

AUG 8 1977

within the scope of our reviews of EISs prepared for the FPC on similar facilities.

Sincerely,

Harold R. Denton, Director  
Division of Site Safety and  
Environmental Analysis  
Office of Nuclear Reactor Regulation

Enclosure:  
As stated



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

AUG 3 1977

Ms. Nancy J. Aurich  
Project Administration Assistant  
Office of Planning and Research  
1400 Tenth Street  
Sacramento, Ca 95814

Dear Ms. Aurich:

Your letter of June 13, 1977 requests the Nuclear Regulatory Commission to furnish certain technical assistance and review participation in the preparation of an Environmental Impact Report for an LNG terminal to be sited in Santa Barbara County, California. We would be pleased to exchange scientific and technical information to assist in the review of the proposed Point Conception LNG terminal. This exchange of scientific and technical information should prove to be of specific benefit to both our regulatory programs. Mr. Harold R. Denton, Director, Division of Site Safety and Environmental Analysis, will serve as the NRC contact on this matter. Members of his Division are familiar with technical matters related to LNG projects. Mr. Denton's telephone number is (301) 492-7207.

For your information there are other coordinated activities between representatives of the State of California and the Nuclear Regulatory Commission. Specifically, Mr. Robert Ryan, Director, Office of State Programs is working with the Energy Resources Conservation and Development Commission toward an agreement on matters of concurrent responsibility and jurisdiction for the siting of nuclear plants. In addition, Mr. Harold Denton is working with Mr. Frank Hahn, Administrative Director of the Energy Resources Conservation and Development Commission on similar matters, but related specifically to the San Diego Gas and Electric Company's Sundesert Nuclear Project.

Sincerely,

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

Lee V. Gossick  
Executive Director for Operations

# Memorandum

To : State and Federal LNG Task Force Contacts

Date : July 25, 1977  
(916) 322-4245

From : Governor's Office

Office of Planning and Research



Suzanne Reed, Senior Energy Advisor

Subject: OFFSHORE LIQUEFIED NATURAL GAS FACILITY SITING

The Office of Planning and Research is examining the procedures that would be involved in issuing a permit for an offshore Liquefied Natural Gas (LNG) facility. To facilitate this study, I would like to know what role under existing law your agency would perform if a permit for such a facility was sought and what new authority might be required to enable full licensing and regulation of such a facility.

An offshore LNG receiving facility could fall into one of the following categories:

1. An LNG receiving storage and regasification facility constructed in state-controlled waters adjacent to a natural island with a pipeline across federal waters, then state waters to the shore.
2. An LNG receiving storage and regasification facility built in federally-controlled waters, with a pipeline crossing state waters to the shore.
3. An LNG receiving, storage, and regasification facility located on a natural island with a trestle extending into state waters and a pipeline crossing federal waters, then state waters to shore.

The offshore facilities referenced above might be either fixed to the ocean bottom with sub-sea storage, floating with floating storage, or fixed with surface storage.

I would appreciate receiving your analysis of what permits, comments, or approvals must be secured from your agency under these offshore facility siting situations at your earliest possible convenience. In your reply, please include:

1. an estimate of how long approval will take;
2. a list of any reports the applicant must file with your agency;
3. a brief description of the decision-making process; and
4. references to the statutes authorizing your agency's action.

I would also appreciate any other pertinent information you would care to supply. Thank you for your attention to this request.



GOVERNOR'S OFFICE  
OFFICE OF PLANNING AND RESEARCH  
1400 TENTH STREET  
SACRAMENTO 95814

RONALD G. BROWN JR.  
GOVERNOR

June 13, 1977

General Lee V. Gossick  
Executive Director  
Nuclear Regulatory Commission  
5650 Nickelson Lane  
Rockville, MD 20852

Dear General Gossick:

In August, 1976, the County of Santa Barbara Office of Environmental Quality (OEQ) requested California State agency participation in an Environmental Impact Report (EIR) to be prepared in response to a proposal by Western LNG Terminal Company to site an LNG terminal at Point Conception, Santa Barbara County, California. The requirements of the County are for assistance from the State in addressing LNG safety and systems reliability and vessel traffic issues.

In accordance with a Memorandum of Understanding (MOU) with Santa Barbara, the Governor's Office of Planning and Research is coordinating State and Federal agency involvement in this project and is performing the necessary contractual management functions to accomplish analysis of the issues described above.

OPR envisions an active role for Federal agencies in this project and has secured technical assistance and review participation from the FEA, the Federal Maritime Administration, the Department of the Navy and U.S. Coast Guard, the FPC, NASA, and others. We are particularly interested in the participation of the Nuclear Regulatory Commission in regard to the seismic safety and sabotage issues that will be studied as a part of this project.

Please advise us of the name of a representative of your Commission who we may contact in regard to the above issues. I have discussed this request with Dr. Norman Eisenberg, of the Transportation and Standards Branch, who advised me to get in touch with you.

Thank you for your attention in this matter, and I will look forward to contacting you in the near future.

Sincerely,

Nancy J. Aurich  
Project Administration Assistant

NJA:nb

Encl.



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

MAY 2 1977

Robert L. Solomon  
Chief, Policy and Program Evaluation Office  
Energy Resources Conservation and  
Development Commission  
1111 Howe Avenue, MS30  
Sacramento, California 95825

Dear Rob,

For your information I am enclosing a Federal Register Notice on LNG Safety Standards dated April 21, 1977. I've not yet had a chance to review it.

I received your April 11, 1977 letter but have not yet received the responses to the request for proposals.

Brian K. Grimes, Chief  
Environmental Evaluation Branch  
Division of Operating Reactors  
Office of Nuclear Reactor Regulation

Enclosure:  
As stated

**ENERGY RESOURCES CONSERVATION  
AND DEVELOPMENT COMMISSION**1111 HOWE AVENUE, MS 30  
SACRAMENTO, CALIFORNIA 95825

(916) 322-2021



April 11, 1977

Mr. Brian Grimes  
Chief, Environmental Evaluation Branch  
United States Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Brian:

I appreciated the opportunity to meet with you and Bill again when I was in Washington.

The state's review of the proposed LNG terminals continues, while the outlook for new legislation that would reorganize the LNG siting function remains uncertain. Therefore we are simply trying to pre-position as much of the analytical work, especially on safety, as we can.

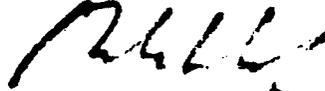
As we discussed in Washington, I am enclosing a copy of the contractor task statement on the safety portions of the Point Conception Environmental Impact Report. We will have responses to the request for proposals within about one week. We will forward directly to your office copies of the proposals on the safety analysis tasks; and, if you can designate the appropriate technical people to have an informal look at these responses, we can make a decision on the best way to get your input - perhaps by a conference call with our technical liaison, or better yet, an informal visit by yourself or a member of your staff. As agreed, this will be a strictly informal, "nonvoting" participation by NRC, and we'll take it step-by-step from there.

I am also enclosing some material regarding our position in the Pacific Indonesia LNG proceeding, where we have advocated a federal certificate condition requiring a "Final Safety Analysis Report" for the LNG facility. Aside from any future technical assistance that might be arranged, one of the areas where your office might be most helpful, again on an informal basis, would be in developing more specific and precise language for the actual permit condition. Since neither we nor the FPC have had any experience with a condition of this type, we would be very interested in your input as to how to develop this condition so that it would achieve the objectives described in the excerpts from my testimony before the FPC.

Mr. Brian Grimes  
April 11, 1977  
Page 2

I'll check with you in about two weeks, after you've had a chance to look over some of these materials.

Best regards,



ROBERT L. SOLOMON  
Chief, Policy and Program  
Evaluation Office

RLS:dh

Enclosures

Robert L. Solomon  
April 8, 1977

To: Randy Deutsch, California Public Utilities Commission

Re: FSAR Condition

California recommends that the Federal Power Commission, in its certificate of public convenience and necessity for the proposed LNG facility, establish a condition requiring a Final Safety Analysis Report (FSAR).

The FSAR condition described below is analogous in concept, but not necessarily in procedure, to the requirement for acceptance of an FSAR by the Nuclear Regulatory Commission (NRC) before a nuclear power plant may be granted an operating license. The need for a final, as distinct from a preliminary, safety analysis is basically the same for a liquefied natural gas facility as it is for a nuclear plant. The NRC is specifically required, under the original Atomic Energy Act, to implement a dual licensing procedure-- first issuing a construction permit, and then an operating license. In contrast, the FSAR condition proposed by California is in the nature of a certificate condition that would be established and relieved through appropriate administrative action by the FPC.

The certificate condition should set forth specific procedures and guidelines for implementation. The applicant would be responsible for providing necessary technical data and studies documenting final design and engineering, construction, testing, start-up and initial operation. In addition to general engineering and construction information, the applicant would be required to submit detailed information on critical safety-related systems and procedures that have not been available for review by the FPC as of the time when the project is certificated. This would include, but not necessarily be limited to, applicant's detailed information on marine operations (including information to be made available to the State, according to the applicant, in April 1977, and which has, accordingly, not been available for FPC review on the record of the present case); additional data on testing, start-up, operating, maintenance, repair and overhaul procedures; plans for response to marine and land-based emergency conditions; and hazard evaluations for any significant design changes or specification of systems and/or components not finalized as of the time of certification of the project.

The FPC will be responsible for development of the actual Final Safety Analysis Report, which could be performed either by FPC staff, or by the FPC's technical agent or contractor(s). The development of the document would proceed concurrently with progress on design and construction of the project, to minimize the time required in the compilation of the FSAR, as well as providing an ongoing design audit and construction monitoring function.

There should be a procedure for time-limited review of the document (and perhaps periodic progress reports on an ongoing basis, to minimize time required for final review), and there should be provision for involvement of the state and/or other intervenors in the form of opportunity to comment within the appropriate review period, as on an EIS-supplement.

Final acceptance of the FSAR by the Federal Power Commission would be required before the plant could receive its first full cargo of LNG.



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

MAR 1 1977

MEMORANDUM FOR: Chairman Rowden  
Commissioner Gilinsky  
Commissioner Kennedy

THRU: Lee V. Gossick (Signed) Lee V. Gossick  
Executive Director for Operations

FROM: William J. Dircks  
Assistant Executive Director  
for Operations

SUBJECT: REQUEST FROM CALIFORNIA ENERGY RESOURCE COMMISSION  
FOR ASSISTANCE IN NON-NUCLEAR SAFETY REVIEWS

On Thursday, February 24, Brian Grimes of NRR and I met with Robert Solomon, Chief of Policy and Program Evaluation, for the California Energy Resources Conservation and Development (CERCDC). Solomon had requested the meeting in order to explore the feasibility of securing NRC assistance in the review of the health and safety aspects of a proposed LNG facility to be constructed in California.

The FPC is conducting proceedings relating to an LNG facility to be located in California. California officials represented by the Energy Commission have testified before the FPC and have expressed concern about the need for additional resources and measures to assure system safety in the post permitting stages. Such additional measures would include final design review, monitoring of construction and plans, monitoring of facility operation, and assurance of acceptable safety contingency planning.

California has requested that FPC should condition its certificate approvals to not allow the facility to operate until a final safety analysis report (FSAR) has been completed and accepted and it has been determined that the facility has been built in accordance with the terms and conditions of the FSAR. The FSAR process, which the Commission pointed out should be similar to the FSAR process used by the U. S. Nuclear Regulatory Commission, would entail detailed independent review of final design and construction, safety contingency planning and testing, and should extend through initial start-up.

The State Energy Commission feels that the technical know-how for the implementation of the envisioned FSAR process does not exist either at the State or local level or with the FPC. In the view of the State Commission, such expertise is well established and presently exists in NRC, the Department of Defense, and NASA.

What Solomon was seeking in his meeting with us was an indication of any willingness on the part of NRC to assist them in:

- Reviewing of the FSAR;
- Establishing technical conditions for approval of project;
- Monitoring and inspecting construction operations;
- Reviewing initial start-up operations.

The State estimates that the NRC involvement would require several technical man years of effort over a three-year period.

If NRC agreed to assist it, the State would like FPC to contract with NRC to carry out the work. If FPC refused, the State would contract directly with NRC.

We ended the meeting with our agreeing to refer the matter to the Commissioners. We warned Mr. Solomon that, in view of the unusual nature of the proposal, the probable legal difficulties, and the very stringent manpower constraints faced by NRC in carrying out its own nuclear program, it would be difficult to be optimistic about securing full-scale NRC support for the State in the endeavor.

Solomon said that in view of the timing of FPC actions on the project he would be calling within a week to see if anything could be worked out.

If the Commission wishes to pursue this matter any further, we will secure the necessary legal and resource analyses.

If the Commission wishes to provide some level of support to the State short of the full-scale effort laid out by Solomon, we will explore alternatives with him.

(Signed) William J. Dircks

William J. Dircks  
Assistant Executive Director  
for Operations

**Enclosure D**

**Testimony of Camp Pendleton Officials**



JOINT PUBLIC  
 HEARINGS OFFICE  
 LDC 1100  
 CAMP PENDLETON  
 CALIFORNIA 92045

Case No.  
 Note No.

NO FURTHER  
 PROMOTION CONTACT  
 BY JOINT PUBLIC  
 HEARINGS OFFICE  
 LDC No. 1100-2100/

**OFFICIAL PRESS RELEASE**

LNG POLICY STATEMENT

CAMP PENDLETON, Calif., May 15 — The following statement was made at a California Coastal Commission public hearing today at Los Angeles.

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I am Major General Carl W. Hoffman, U.S. Marine Corps, commanding general of the Marine Corps Base at Camp Pendleton, Calif. I am here representing the Commandant of the Marine Corps, and I will present his position and the position of the Secretary of the Navy on the proposed establishment of a liquified natural gas terminal at Camp Pendleton.

As you know, the Secretary of the Navy and the Commandant of the Marine Corps have stated that no site at Camp Pendleton is available for use as an LNG terminal. I will reiterate their reasons and urge you to reject the staff recommendation that the terminal be sited at Camp Pendleton.

## LNG POLICY STATEMENT

ADD 1-1-1-1

Camp Pendleton houses the major ground combat elements and a few of the air combat elements of the I Marine Amphibious Force or I MAF. This force consists of the 1st Marine Division, the 3d Marine Aircraft Wing and a number of associated combat and logistical commands — all maintained in a high state of combat readiness for immediate use anywhere in the world.

The camp itself is a prime training area for all these air and ground combat commands. It contains 38,000 acres of ranges on which all the air and ground weapons of the force — including supersonic jet aircraft — are regularly exercised. It also has the only beach areas in the Western United States on which I MAF can hone the amphibious assault responsibilities assigned to U. S. Marines by federal law.

Construction of an LNG terminal at Camp Pendleton would have such a severe impact on these facilities that the combat readiness of I MAF and associated elements of the U. S. Navy would be seriously — perhaps irreparably — degraded.

For example, we would have to terminate the training of large landing forces. The 9,000-foot pier and LNG tanker activity would prevent the deployment and maneuver of the naval forces necessary for large landing exercises. Even small unit training could not receive the aircraft support vital to the success of landing forces. The LNG terminals and LNG tankers are hazardous areas, and high performance aircraft cannot fly over them at low altitude without violating peacetime safety rules.

We would also lose the use of our aircraft bombing range. The only air corridor to this range passes right over the terminal site. This corridor was designed by the Federal Aviation Administration and the U. S. Navy, to meet specific requirements. It keeps aircraft away from the San Onofre Nuclear Power Plant, military and civilian housing areas and Camp Pendleton's ammunition storage areas. It is used by fully armed aircraft — that is, aircraft carrying clusters of 500-lb. bombs — which fly over the terminal site at low altitude and at speeds in excess of 400 knots.

Construction of the terminal would also seriously inhibit training with ground combat weapons. The terminal plans we have seen call for routing natural gas pipelines through the range impact areas. And, rather obviously, we would be unable to fire high explosive ammunition in any area which contained gas pipelines.

The routing of pipelines through training areas would also seriously inhibit training with tanks and other mechanized equipment.

LNG POLICY STATEMENT

ADD 2-2-2-2

It is also pertinent to note that the population density requirements associated with LNG terminals would force us to relocate a number of billeting areas assigned to troops of I MAF. The costs of these relocations have not been refined, but they would be no less than \$40 million — and they could be as high as \$75 million. This, as I understand it, is a cost which would have to be met by the company building the terminal — one which would be passed on to the purchasers of natural gas.

I also must point out that the Secretary of Defense recently directed the Department of the Navy to study the possible relocation and/or consolidation of a number of training activities. One of the proposals under study calls for moving the Marine Corps Recruit Depot at San Diego — and, possibly, the Marine Corps Recruit Depot at Parris Island, S. C. — to Camp Pendleton. If this is done, the most logical Camp Pendleton site for the depot or depots is an area south of the LNG terminal site and adjacent to existing recruit training areas. Doing this might put the areas far above the population density requirements.

Because of all the things I have just told you, I must urge the commission to reject the staff recommendation and omit Camp Pendleton from further consideration as a site for an LNG terminal.

There is one final point to make.

This nation can import natural gas — and many other needed commodities — because the seas are free. American sea power guarantees that.

U. S. Marines are a vital element of sea power.

Establishing an LNG terminal at Camp Pendleton would jeopardize the Marine Corps' ability to contribute to American sea power. We think that would be a foolish risk.

Thank you.

I AM CAPTAIN WAYNE COLLINS REPRESENTING THE WESTERN DIVISION, NAVAL FACILITIES ENGINEERING COMMAND, SAN BRUNO, CALIFORNIA. OUR COMMAND HAS REPRESENTED NAVY INSTALLATIONS IN CALIFORNIA IN MANY DISCUSSIONS INVOLVING THE STATE OF CALIFORNIA'S COASTAL MANAGEMENT PROGRAM THROUGHOUT THE LAST FEW YEARS. WE HAVE ALSO COORDINATED NAVY INTERESTS FOR SIMILAR PROGRAMS IN THE STATES OF WASHINGTON AND OREGON. WE ARE SERIOUSLY CONCERNED WITH YOUR STAFF'S RECOMMENDATIONS REGARDING THE PROSPECTIVE USE OF A SITE AT CAMP PENDLETON FOR A LNG TERMINAL. MY COMMENTS ARE RELATED TO THOSE OF GENERAL HOFFMAN'S, BUT MY COMMENTS DO NOT ADDRESS NAVY/MARINE CORPS MISSION INTERFACES DIRECTLY BUT RATHER PINPOINT OBJECTIONS OF A GENERAL PLANNING POINT POLICY/OF VIEW. WHILE THESE COMMENTS RELATE TO THE NAVY/MARINE CORPS SPECIFIC INTERESTS AT CAMP PENDLETON, THEY ALSO GO BEYOND DIRECT SPECIFICS OF THAT SITE.

THE FIRST SUBJECT DEALS WITH YOUR STAFF'S VIEW AS REGARDS PUBLIC SAFETY IN THIS ISSUE. THE STAFF SEEMS TO BE CONCERNED WITH SAFETY, AT LEAST IN SOME AREAS. ALLOW ME TO CITE SEVERAL QUOTES/SUMMARIES OF STATEMENTS IN THE STAFF REPORT DEALING WITH SAFETY:

- A. "THE SAFETY OF LNG OPERATIONS REMAINS UNCERTAIN."
- B. "THE SINGLE TERMINAL AUTHORIZED....IS TO BE LOCATED AT A SITE REMOTE FROM HUMAN POPULATION IN ORDER TO PROVIDE THE MAXIMUM POSSIBLE PROTECTION TO THE PUBLIC AGAINST THE POSSIBILITY OF ACCIDENT."
- C. "THE COMMISSION HAS SERIOUS CONCERNS ABOUT THE ADEQUACY OF MEASURES TO PREVENT AND TO COPE WITH LNG ACCIDENTS AND ABOUT THE RESEARCH UNDERTAKEN SO FAR TO PREDICT THE CONSEQUENCES OF LNG SPILLS, FIRES, AND VAPOR CLOUD DISPERSION."
- D. "....THE COMMISSION HAS REMOVED LAS VARAS FROM FURTHER CONSIDERATION AS A LNG TERMINAL SITE TO MINIMIZE RISKS TO PERSONS AND PROPERTY.... EVEN THOUGH THE COMMISSION'S OWN CONSULTANTS BELIEVE THAT DESIGN

E. 30263: (A) "NEW OR EXPANDED REFINERIES OR PETROCHEMICAL FACILITIES NOT OTHERWISE CONSISTENT WITH THE PROVISIONS OF THIS DIVISION SHALL BE PERMITTED IF....(5) THE FACILITIES IS SITED SO AS TO PROVIDE A SUFFICIENT BUFFER AREA TO MINIMIZE ADVERSE IMPACTS ON SURROUNDING PROPERTY."

IT APPEARS THAT THE CLEAR INTENT OF SECTION 3 OF THE CALIFORNIA COASTAL MANAGEMENT ACT IS TO MAKE SURE COASTAL DEVELOPMENTS NOT ONLY PROTECT PUBLIC ACCESS, RECREATION, MARINE ENVIRONMENT, ETC., BUT TO ALSO ENSURE THAT NEW HAZARDOUS INDUSTRIAL DEVELOPMENTS ARE PLANNED FULLY CONSIDERING PUBLIC SAFETY. DESPITE THIS OBVIOUS INTENT, THE STAFF REPORT SAYS: "SINCE THE SAFETY OF LNG TERMINAL AND TANKER OPERATIONS IS NOT WITHIN THE COMMISSION'S LEGISLATIVE JURISDICTION, ONLY LIMITED STUDY WAS MADE OF THESE SAFETY ISSUES." ADDITIONALLY, : "THE BASIS FOR SITE RANKING IS THE HEAVY WEIGHTING OF COASTAL ACT POLICIES ON RECREATION, PUBLIC ACCESS, PROTECTION OF NATURAL RESOURCES, AND MINIMIZING ADVERSE DEVELOPMENT IMPACTS....LESS WEIGHT HAS BEEN GIVEN TO THE COASTAL ACT POLICIES PROVIDING FOR CONSIDERATION OF TERMINAL COST AND SAFETY DIFFERENCES AT THE SITES."

THESE LAST TWO STATEMENTS CLEARLY CONFLICT WITH THE INTENT OF CHAPTER 3 OF THE CALIFORNIA COASTAL MANAGEMENT ACT AND STAFF'S OWN WORDS QUOTED EARLIER VOICING CONCERN OVER SAFETY ISSUES AND THE OUTHRIGHT DISMISSAL OF AT LEAST ONE SITE DUE SOLELY TO SAFETY CONSIDERATIONS. CLEARLY ANY MAJOR LNG TERMINAL RANKING EFFORT BY THE STATE WHICH DOES NOT FULLY INCLUDE <sup>ALL</sup> ASPECTS OF PUBLIC SAFETY IS LITTLE MORE THAN AN INTERESTING ACADEMIC EXERCISE. THE ISSUE OF PUBLIC SAFETY MUST BE A MAJOR, AND WE WOULD SUGGEST THE PRIME, CONSIDERATION <sup>UPON WHICH</sup> BEFORE A FINAL STATE DECISION ON SITING IS MADE ~~MADE~~ <sup>BASED</sup>.

IF, IN FACT, YOU FEEL THAT YOUR RANKING CHARTER DOES NOT PERMIT <sup>FULL</sup> CONSIDERATION <sup>^</sup> ~~OF~~ OF PUBLIC SAFETY ISSUES, THEN THIS LIMITATION MUST BE FULLY DISCLOSED

TO THE PUBLIC THROUGH THE MEDIA AND THE OTHER CONSIDERATIONS REGARDING PUBLIC SAFETY ARE NOT APPROPRIATE IN YOUR REPORT - SUCH AS THE DISMISSAL OF ONE OR MORE SITES FOR SAFETY REASONS. IF SAFETY IS A CONSIDERATION IN YOUR FINDINGS, THEN YOU MUST THOROUGHLY EXPLORE ALL ASPECTS OF THE SAFETY ISSUE, NOT JUST THE ONES WHICH ARE MOST FAVORABLE TO A PARTICULAR POINT OF VIEW OR WHICH MIGHT BE MOST EASILY UNDERSTOOD. <sup>WE BELIEVE</sup> THE OPERATIONAL HAZARDS AT CAMP PENDLETON, <sup>FROM THE LNG INTERFACE ARE</sup> ~~WE BELIEVE ARE~~ MORE SEVERE FROM A PROBABILITY POINT OF VIEW THAN SEISMIC <sup>RISKS,</sup> <sup>^</sup> CONSIDERING THE PROPOSED SITING OF A TRESTLE AND TANKER BERTH IN THE TRACK OF NAVAL SHIPS ON MANEUVERS, AND SITING OF THE TERMINAL WHERE IT WOULD BE REGULARLY OVERFLOWN BY ARMED HIGH PERFORMANCE AIRCRAFT AT LOW ALTITUDE IN RESTRICTED AIR SPACE. YOU CANNOT PICK AND CHOOSE THE SAFETY ASPECTS YOU CONSIDER AS THE ONES BEST FITTING EITHER THE ANSWER YOU WANT OR THE ONES YOU BEST UNDERSTAND. YOU MUST LOOK AT THE SAFETY QUESTION CAREFULLY AND COMPLETELY, OR TELL THE WORLD THAT YOUR RANKING HAS NO CONSIDERATIONS REGARDING THE QUESTION OF PUBLIC SAFETY WITHIN IT, BUT IS LIMITED ONLY TO CONSIDERATIONS OF AN ENVIRONMENTAL <sup>CHARACTER.</sup> ~~NATURE~~

AS AN ADDED PARENTHETICAL COMMENT ON SAFETY, WE STILL <sup>DO NOT</sup> ~~DO NOT~~ UNDERSTAND THE STATE'S POPULATION LESPITE RESTRICTIONS, WHICH ARE CONCERNED ONLY WITH PERMANENT RESIDENTS AND WORKERS NEAR A LNG TERMINAL. WHEN YOU CONSIDER, (1) THAT INTERSTATE 5 IS ABOUT AS CLOSE AS YOU CAN GET TO THE SITE WITHOUT BEING ON IT, (2) AND THE STATE'S PERMANENT POPULATION DENSITY RESTRICTION IS ABOUT 27 PEOPLE LIVING OR WORKING WITHIN ONE MILE OF THE SITE, AND (3) THAT THE STAFF REPORTS THE PEAK DENSITY ON INTERSTATE 5 IN THE VICINITY OF HORNO CANYON TO BE 7,080 PEOPLE PER MILE, IT IS DIFFICULT FOR US TO UNDERSTAND THE RECOMMENDATION THAT THIS IS THE BEST SITE IN CALIFORNIA FOR THIS FACILITY. THE SAFETY ISSUE SHOULD CENTER ON REDUCING THE TOTAL NUMBER OF POTENTIAL CASUALTIES RESULTING FROM THE MAXIMUM CREDIBLE ACCIDENT, NOT WHETHER THEY LIVE OR WORK IN THE AREA ON A REGULAR BASIS. PEOPLE ARE PEOPLE, WHETHER THEY ARE TRANSIENT OR NOT.

I WOULD LIKE TO RAISE ONE LAST QUESTION OF A DIFFERENT NATURE. THIS ENTIRE  
RANKING ISSUE WITH WHICH/ARE EMBROILED IS BEING CARRIED OUT UNDER THE JURISDICTION  
OF THE STATE'S COASTAL MANAGEMENT PROGRM, WHICH, IN TURN, IS UNDER THE JURISDICTIONAL  
UMBRELLA OF THE FEDERAL COASTAL MANAGEMENT ACT. I AM CERTAIN YOU ARE AWARE OF THE  
FOLLOWING LANGUAGE IN THE FEDERAL COASTAL ZONE MANAGEMENT ACT: "EXCLUDED FROM  
THE COASTAL ZONE ARE LANDS THE USE OF WHICH IS BY LAW SUBJECT SOLELY TO THE  
DISCRETION OF OR WHICH IS HELD IN TRUST BY THE FEDERAL GOVERNMENT." OBVIOUSLY,  
NEITHER CAMP PENDLETON, NOR ANY OF THE OTHER NAVY/MARINE CORPS PROPERTY IN  
CALIFORNIA, IS LOCATED WITHIN THE STATE OF CALIFORNIA'S COASTAL ZONE. THE  
AUTHORITY OF THIS COASTAL ZONE COMMISSION TO PUBLICLY CONSIDER FUTURE DEVELOPMENT  
ON THIS NON-EXCESS FEDERAL PROPERTY TO THE EXTENT OF INCLUDING THE SITE IN A  
PUBLIC RANKING LIST ALONG WITH OTHER SITES WHICH ARE UNDER THE COMMISSION'S  
JURISDICTION, AND USING RANKING CRITERIA CONTAINED IN THE STATE'S COASTAL  
MANAGEMENT LEGISLATION, IS QUESTIONED.

THANK YOU FOR PERMITTING THE TIME FOR THESE COMMENTS.