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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING THE PROXIMITY OF COVE POINT LNG FACILITY

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS NOS. 1 AND 2

DOCKETS NOS. 50-317 AND 50-318

1.0 Introduction

On March 13, 1978,[14] we issued an interim Safety Evaluation (SE) that analyzed the short term effects on the Calvert Cliffs Nuclear Power Plant (CCNPP) of Liquefied Natural Gas (LNG) carrier accidents at or near the Cove Point Offshore Facility (CPOF) operated by Columbia LNG Corporation. This interim SE covered the arrival of up to six LNG carriers in approximately three months. Due to liquefication problems at the Algeria plant, the LNG carrier arrival schedule has slipped. The sixth ship is now expected to arrive sometime after July 1, 1978.

This SE addresses the long term hazard associated with the arrival of LNG carriers at a rate consistent with the CPOF design capacity.

2.0 History

The NRC staff began its review of this subject in the summer of 1975. At that time it was believed the Cove Point LNG Terminal would begin operation in late fall of 1977. In response to our request,[1] Baltimore Gas and

Electric Company (BG&E or the licensee) submitted an analysis of the consequences of several selected LNG accidents in March, 1976.[2,3] These were reviewed by us and the results reported in Supplement 5 to the Calvert Cliffs SER,[4] in August 1976. This evaluation concluded that the consequences of the LNG accidents postulated in BG&E's submittal would not adversely affect the safety of the nuclear power plants. The evaluation noted, however, that "It was assumed in the applicant's analysis that such massive failure (of an LNG tanker) could occur no closer than 9 kilometers from the Calvert Cliffs site, and that LNG tankers would not approach closer than 5.6 kilometers to the site." We required that BG&E take further steps to assure the safety of the plants. Those requirements appeared as paragraph 2.C.(3) of license DPR-53 (Unit No. 1),[7] and paragraph 2.C.4 of license DPR-69 (Unit No. 2)[5], which are as follows:

"Liquefied Natural Gas (LNG) Traffic at Cove Point Terminal

The licensee shall provide one of the following items to the Commission 60 days prior to the initiation of LNG ship traffic at the Cove Point LNG Receiving Terminal:

a. An analysis to show that the probability of an accident that could affect plant safety due to an LNG tanker approaching closer to the plant than the distances assumed in the safety analyses (discussed in Supplement No. 5 to the Safety Evaluation Report issued August 10, 1976) is acceptably small, as defined in Section 2.2.3 of NUREG-75/087; or

b. A commitment from the appropriate U. S. Coast Guard Port Authority that administrative limits will be imposed to prevent LNG traffic from approaching Calvert Cliffs Nuclear Plant closer than the distances assumed in the above-referenced analyses.

In addition, the licensee shall establish a mechanism whereby it will be promptly notified by the U.S. Coast Guard of abnormally dangerous occurrences involving LNG traffic in the vicinity of the Cove Point LNG Receiving Terminal."

BG&E provided an LNG Hazards Study[6] in accordance with part a. of the above license condition. In response to NRC requests for additional information[9,12], BG&E provided further analyses[10,13] in which BG&E concluded that the probability of an accident affecting CCNPP safety is acceptably small and meets the NRC Standard Review Plan guidelines.

3.0 Discussion and Evaluation

3.1 Character of the Hazard

Should the Calvert Cliffs nuclear plant be severely damaged as a result of the ignition of gas evolved from an LNG spill, a significant release of radioactivity might result. However, only a small number of postulated scenarios involving the LNG operations could even theoretically produce such a result. Potential hazards to the Calvert Cliffs facility could result only from a large spill of LNG onto water from a major tanker accident. Other scenarios, such as breaks in a transfer pipe or failure of

land tanks, have been examined and found not to present a hazard to the facility because the rate of gas evolution would be slow enough to assure that dispersal of LNG into the air would occur and a hazardous gas cloud could not reach the plant. Ignition of the flammable cloud from a very large spill would not present a potential hazard to the facility unless the flammable gas were within or among the facility structures at the time of ignition. This is because the vital areas of the plant are protected by concrete structures and radiant heat or overpressures which might result from a deflagration of the cloud near the plant would not likely result in damage to vital equipment.

The small class of spills which could adversely affect the plant is made even smaller by the fact that the cloud must remain unignited while it leaves the ship and transits to the plant. Nearly all impacts or internal ship events large enough to cause a major LNG release would involve fire or ignition sources from electrical equipment. In our analysis we conservatively assumed that only 90% of such cases would involve an ignition source at the time of release. Any hazard to the nuclear facility would be eliminated by ignition at the ship.

3.2 Review of Licensee's Submittals

In BG&E's submittals[6,10,13] they state that the probability of an LNG accident adversely affecting the safety of the CCNPP in any future year is on the order of 10^{-7}. This result is represented by BG&E as being an adequate measure of inherently low probability, such that further provisions to prevent or mitigate the consequences of LNG accidents from affecting the CCNPP are not required.

Provisions to mitigate LNG accident consequences at CCNPP which the licensee has documented include the installation of private telephone communications between the control rooms at the power station and the LNG terminal, and efforts to render the terminal management sensitive to the safety requirements of the nuclear facility.

BG&E's argument rests heavily upon there being an extremely low likelihood of a major LNG accident off the Calvert County shore. Other factors in the argument, namely that LNG spills are likely to be ignitied at the accident scene and the likelihood that wind conditions at the time of the accident would be such as to blow gas from the accident to the plant are estimated to have a joint probability of 1.9%. The bulk of their argument, therefore, lies in the inherent low likelihood that an accident of great magnitude will occur in the vicinity of or north of the Cove Point Offshore Facility.

BG&E has forwarded two arguments that such an accident is of very low likelihood:

1) Accidents at that location are no more likely than accidents anywhere else in the Chesapeake Bay. Under this assumption, the probability of a given tanker visit having a relevant accident is the product of the average ship accident rate times the ratio of areas of the waters within 9 km of the plant to the total navigable area of the bay. This method of estimation is considered by us to be non-conservative because very little of the navigable areas of the bay is expected ever to have an LNG tanker upon it. Were this

method to be properly applied, the area susceptible to an LNG tanker accident would be a path, perhaps 100 meters wide by 250 kms long, through which each tanker would pass in going from the Capes to Cove Point. This would yield a much smaller navigable area at risk than the 5000 km^2 used by BG&E.

2) Accidents in the vicinity of CPO. have a likelihood equivalent to that computed for New York harbor in an earlier LNG licensing study, multiplied by the ratio of overall marine accidents and expected traffic ratio between the two bodies of water. This argument is problematic, since the original estimation for New York harbor was unsuccessful in justifying its purpose, and since there are differences between the proposed traffic in New York and that at Cove Point other than the two factors used. While it is tempting to suppose that ship traffic is more dangerous in Raritan Bay and Arthur Kill off New York City's shore than it is in the Chesapeake Bay, it is also true that proposed supervision of the New York City traffic was far more rigid than that presently expected in the Chesapeake. In brief, the BG&E analysis does not adequately support their conclusions that the LNG traffic would be safer at Cove Point than New York City, or that the safety would have been as great in New York City as suggested by the study cited.

In summary, since we do not fully accept the assumptions used by BG&E in their analysis, we have performed our own independent analysis which is discussed in the following sections of this evaluation.

3.3 Independent Staff Analysis

3.3.1 Hazard Distances

We have considered several hazard models in an attempt to quantify the potential hazard to CCNPP from a large, unignited LNG spill at the CPOF. None of these models has been verified by experiment due to the difficulty of conducting experiments of spills of this postulated size and of scaling the results of experiments of small spills to predict the results of a large spill. As a result, the various models predict a wide range of potential hazard distances under the same meteorological conditions and predict different trends for hazard distances for high wind speeds.

The Gaussian plume models, which predict increasing hazard distances with poor ambient dispersion conditions, contain some physical contradictions which are discussed briefly in Appendix C to SER Supplement No. 5[4] and in greater detail in the Coast Guard report CG-M-09-77, "Predictability of LNG Vapor Dispersion from Catastrophic Spills onto Water," dated April 1977. As a result of these contradictions and the prediction of other models which do not have the same contradictions, we believe that the maximum range of distances over which severe consequences from an LNG carrier spill are possible is significantly less than estimated in the NRC Hope Creek hearings.[17]

Requirements on LNG carrier movements in the Chesapeake Bay and other ship traffic in the vicinity of the terminal are documented in the Chesapeake Bay LNG Oplan[11] which has the force of law. The Coast Guard has also agreed to require the LNG carrier traffic to be conducted in such a manner as to minimize risk to the CCNPP[15,16]. These rules (Enclosure 1) are designed to protect the plant not only during routine LNG traffic, but also in the event of potential accidents and malfunctions and the rapid advent of severe weather.

3.3.2 Assessment of Hazard

The above discussion indicates that a risk remains, although projected LNG spill tests and proposed improvements in Coast Guard vessel control systems will reduce these uncertainties and the risk to the CCNPP.

In our interim SE[14] of the likelihood of the hazard to CCNPP, we estimated that the likelihood of an unignited cloud reaching the facility was significantly less than one in one million for as many as ten dockages and perhaps less than one in ten million. This SE considers up to 200 dockages per year.

As the result of further review, we have concluded that some factors assumed in our interim SE may have been overly conservative. In particular, the frequency of major collisions at the dock is expected to be substantially lower than estimated in the March 13, 1978 SE because of the Coast

Guard restrictions on all traffic near the terminal whenever an LNG carrier is docked there and on available tugs during LNG carrier approaches and departures.

Other potential conservatisms in the estimates (reference 14) of the likelihood of a major release of LNG, include the applicability of general U.S. tanker accident statistics to the El Paso LNG carriers; the assumption that each serious accident leads to an instantaneous spill; and the assumption that a large LNG spill has one chance in ten of not igniting at the ship.

However, events over which we have no control may tend to reduce the level of conservatism incorporated in the estimates. For example, Coast Guard restrictions on other traffic in the vicinity of the CPOF may be ineffective under the very conditions which may make collisions more likely (heavy fog). Also, LNG carriers of lesser capacity but poorer design than the El Paso LNG carriers may be employed at the terminal over the life of CPOF. We have, therefore, not been able to quantify the lower probability with high confidence. Furthermore, although the U. S. Coast Guard has agreed to restrict laden LNG carrier traffic to distances of at least 5 km from the CCNPP site and to adopt, with the effect of regulation, certain other LNG carrier practices as given in the enclosure to this SE, they are bound by law to act in the manner they deem safe in the event of unusual circumstances such as adverse weather or LNG carrier malfunction. These actions may not always fall within the assumptions we have used in our estimate of the likelihood of a hazard. The U.S. Coast Guard has agreed to notify NRC of changes to its regulations and the LNG carrier practices which may affect CCNPP in as timely a manner

as possible to permit NRC response, but unforeseen circumstances may require the Captain of the Port (COTP) to make decisions on an immediate basis which directly conflict with the NRC staff's view of safety relative to CCNPP. We understand that shallow draft trials may be authorized by the Coast Guard with "unladen" LNG vessels carrying up to 4000 cubic meters of LNG in the vicinity of the CCNPP. Such trials could present a hazard to the facility should they result in a spill of the ship's contents within 2 to 3 km of the nuclear facility. We have this matter under review and have requested the Coast Guard to reconsider their use of the waters off CCNPP for this purpose.

Although it is difficult to quantify the contribution that these Coast Guard provisions will make to the reduction of accident probabilities, we conclude that it will be sufficient so that the likelihood of a hazard to the CCNPP from an LNG spill in transit or at the dock at CPOF is within the current NRC staff guidelines as described in Standard Review Plan 2.2.3.

In our interim evaluation we stated that anchorages much closer than 3 km could present a substantially higher hazard a. any unignited plume released would be much more likely to reach the nuclear facility. As discussed in our interim evaluation all areas less than about 2 km and most areas less than 3km are not feasible anchorage locations because of shallow water near the plant. We have discussed this matter with the Coast Guard and have obtained their agreement to assure that laden LNG carriers will

not be allowed to approach closer to the CCNPP than is necessary and will be required to approach the Cove Point facility by the most direct route that can be safely executed. The Coast Guard has assured us that this will effectively prevent anchorages north of the terminal and will assure that anchorages are greater than about 5km under foreseeable conditions. Under emergency conditions, the LNG carriers will attempt to maneuver so as not to be upwind of the nuclear plant or north of the terminal. We conclude that these conditions will provide reasonable assurance that anchorages near the plant will not occur.

However, unknown factors associated with operation of the LNG carriers, the behavior of a large LNG spill and the likelihood of the notification of an event are of sufficient concern that additional measures by the licensee are prudent to assure that the response to a potential or actual spill of LNG in the vicinity of the CCNPP will be appropriate.

Meetings were held on May 30, 1978, with the licensee to discuss practicable measures which would increase our confidence in the detection of an unignited cloud of LNG. The objective of these measures is to improve assurance of CCNPP being aware of an impending problem so that they may take appropriate emergency actions.

We conclude that the development of contingency plans is a prudent step which will add substantial confidence that the response to a potential or actual spill of LNG in the vicinity of the CCNPP is appropriate. The details of the contingency plan are given on page 13. The licensee has been requested and has agreed to submit the LNG contingency plan within 90 days.

4.0 Summary

We have concluded that, although the likelihood of an "instantaneous" LNG spill is very low, the BG&E staff should be prepared to effectively respond to conditions resulting from an LNG spill at or near CPOF. Therefore, we have asked for and BG&E has agreed to provide a contingency plan within 90 days of the date of these amendments. The LNG Contingency Plan will describe the steps to be taken to protect the facility from a serious LNG spill; including but not limited to: (a) description of the potential hazard, (b) prescribed use of the committed telephone line between CCNPP and CPOF control rooms, including routine verification of operability, and details of the communications with the U. S. Coast Guard, (c) detailed procedure for determining the extent of the hazard, (d) directions for response necessary to protect the plant, such as control of ventilation systems, use of contained air systems and criteria for shutdown of operating units, (e) communication procedures of BG&E as required with Coast Guard, NRC, Maryland State, and local responsible representatives including telephone numbers, (f) provisions for obtaining rapid response from offsite BG&E personnel capable of assisting in plant shutdown in a post-fire situation or providing assurance of the protection for on site personnel and equipment, and (g) appropriate training requirements. Development of the Contingency Plan will include confirmation of the feasibility of remote detection of unignited spills and, when determined feasible, provision of a schedule for installation of an appropriate device. A

description will also be provided of what additional provisions will be made to: (a) shutdown both units safely and (b) maintain an ultimate heat sink. Include a schedule for implementation of the provisions of the contingency plan. Requirements for updating the contingency plan to reflect current LNG traffic characteristics will be developed during review of the plan.

5.0 Environmental Consideration

We have determined that this evaluation does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the action is insignificant from the standpoint of environmental impact and pursuant to 10 CFR §51.5(d)(4) that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared.

6.0 Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the evaluation does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the action does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the action will not be inimical to the common defense and security or to the health and safety of the public.

Dated: June 13, 1978

REFERENCES

1. NRC request for additional information concerning the LNG terminal at Cove Point, O. D. Parr to J. W. Gore, December 5, 1975.

2. BG&E advises that the LNG investigation will be delayed, J. W. Gore to O. D. Parr, December 23, 1975.

3. BG&E submittal of Wesson and Associates report on investigation and literature survey to establish the hazard implication of LNG spills at the Columbia LNG Corporation, J.W. Gore to O.D. Parr, March 15, 1976.

4. NRC supplement No. 5 to the SER for CCNPP Units Nos. 1 and 2, August 10, 1976.

5. NRC issues license for CCNPP Unit No. 2-includes requirement for BG&E to provide probability analysis or Coast Guard administrative LNG carrier limits, August 13, 1976.

6. BG&E submittal of LNG hazards study, J.W. Gore to K. Kniel, December 31, 1976.

7. NRC Amendment No. 20 for CCNPP Unit No. 1 - includes same requirement on LNG carriers as the Unit No. 2 license, D. L. Ziemann to A. E. Lundvall, February 11, 1977.

8. BG&E points out that they have met the license condition, A. E. Lundvall to D. K. Davis, October 19, 1977.

9. NRC request for additional information on LNG hazard, D. K. Davis to A. E. Lundvall, November 9, 1977.

10. BG&E provides additional information on LNG hazard and correspondence with the Coast Guard and Columbia LNG Corporation, A. E. Lundvall to D. K. Davis, December 12, 1977.

11. Maryland State provides information on the LNG carrier "dry run" and a copy of the Coast Guard LNG Oplan, S. M. Long to E. L. Conner, February 17, 1978.

12. NRC request for additional information on LNG traffic, R. W. Reid to A. E. Lundvall, February 22, 1978.

13. BG&E provides additional information on LNG traffic, A. E. Lundvall to R. W. Reid, March 9, 1978.

14. NRC issues interim SE on potential risks to CCNPP from LNG ship traffic, R. W. Reid, to A. E. Lundvall, March 13, 1978.

15. Letter, B. Grimes USNRC, to Captain K. Schumacher, U. S. Coast Guard, May 31, 1978.

16. Letter, Captain K. Schumacher, U. S. Coast Guard to B. Grimes USNRC, June 8, 1978.

17. Letter, R. L. Mittl, Public Electric and Gas Services to A. Giambusso, September 30, 1974.