UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO LIQUEFIED NATURAL GAS HAZARDS ANALYSIS

BALTIMORE GAS AND ELECTRIC COMPANY

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

DOCKET NOS: 50-317, 50-318, AND 72-8

1.0 BACKGROUND

By letters dated June 7, 1993 and May 31, 1995, Baltimore Gas and Electric Company (BGE or the licensee) submitted an updated analysis of the potential hazards to the Calvert Cliffs Nuclear Plant (CCNPP) site which includes two nuclear power reactor systems (units) and an Independent Spent Fuel Storage Installation (ISFSI), as the result of resuming the operation of the Cove Point Liquified Natural Gas (LNG) Terminal. The LNG Hazards Analysis was prepared by Arthur D. Little, Inc., and was co-sponsored by the State of Maryland's Department of Natural Resources. The LNG terminal is located at Cove Point, Maryland, which is approximately 3.5 miles south-southeast of the CCNPP. The LNG terminal will be operated by the Cove Point LNG Limited Partnership and is currently scheduled to resume operation in mid-September.

The LNG terminal at Cove Point initially assumed operation in 1978; however, the facility discontinued operation in 1980. Prior to the initial operation of the LNG terminal, the licensee performed a probabilistic and deterministic hazards analysis of the possible hazards to the CCNPP which was reviewed and approved by the NRC staff in its Safety Evaluation (SE) dated June 13, 1978. Columbia LNG Corporation decided to resume operation of the LNG terminal and on February 26, 1993, applied to the Federal Energy Regulatory Commission for restart approval to initiate operation in the fall of 1994. This necessitated the licensee to prepare an updated hazards analysis to account for the changes which have occurred since its last hazard analysis was performed.

On November 3, 1993, Columbia LNG Corporation withdrew its original application and filed a new application, under a limited partnership called Cove Point LNG Company which was later changed to Cove Point LNG Limited Partnership. The new application downsized the liquefaction system from 20.0 millions cubic feet per day to 15.0 million cubic feet per day, abandoned the recommissioning of the offshore facility needed to import LNG by ship, and also abandoned the plans for installing two additional 600,000 barrel storage tanks. Based on the present application, the Cove Point LNG Terminal will

Enclosure

provide winter peaking services by liquefying natural gas from the existing gas pipeline and storing it during the summer period. The current licensee's hazard analysis covers operations which will not be performed based on the present application. However, the licensee requested that the NRC review the hazard analysis, which was based on operation of the LNG terminal as envisioned in the initial application, to assure that the NRC staff's SE will remain valid in case the Cove Point LNG Limited Partnership decides to resurrect the initial plans to increase the liquefaction system, import LNG by ship, or to expand the storage capacity in the future.

As noted above, the updated hazards analysis is applicable to both of the units and the ISFSI located on the CCNPP site. In the updated hazard analysis, the licensee evaluated risks corresponding to seven postulated accident scenarios. These seven scenarios included the four considered in the initial hazards analysis and were updated to include all credible accidents which could occur at the LNG terminal or in the vicinity of the CCNPP site and which might have a safety significant impact on the units or the ISFSI. The risks of damage to the units or the ISFSI were determined by considering likelihood of occurrence of individual accidents, resulting in LNG release, and the consequences to safety at the CCNPP site if the released gas ignited. The consequences of accidents caused by the ignition of LNG were calculated using deterministic analysis which assumed release of LNG during a postulated accident, its transport towards the CCNPP site, and its ignition at the closest approach of the gas cloud to the CCNPP site. The calculation of release, transport, and energy release by explosion was determined using two computer codes; U.S. Environmental Protection Agency's DAGADIS and Arthur D. Little's SuperChems.

The following accidents at the LNG terminal, which include the four considered in the initial LNG hazards analysis, were postulated:

- Accident during LNG tanker unloading operation consisting of breakage of all four 16-in. unloading arms, 32-in. transfer line, or failure of booster pump's suction drum.
- Catastrophic failure of 375,000-barrel LNG storage tank.
- Catastrophic failure of 600,000-barrel storage tank.
- Release of LNG from one 25,000-cubic meters cargo tank on board of a tanker caused by its collision with another vessel.
- Fire/Explosion aboard a laden LNG tanker while the tanker is approaching the unloading platform.
- Fire/Explosion aboard a laden LNG tanker while the tanker is docked at the terminal.
- Failure of the 36-in. natural gas transmission pipeline.

The probabilities of occurrence of these LNG spills varied from 2.7×10^{-6}/year to 4.8×10^{-4}/year. However, the probability of a vapor cloud actually being blown toward the CCNPP site and igniting could be considerably lower.

The consequences of LNG ignition and resulting explosion were evaluated by the licensee by determining the closest distance from the CCNPP site where either an explosion generated overpressure of 3-psi could exist, or the concentration of natural gas would be equal to one-half of its lower flammability limit, whichever would be closest to the CCNPP site. This is defined as the maximum hazards distance. The licensee considered that below one-half of flammability limit there is no chance of gas ignition, even assuming the existence of pockets of gas with higher concentration. It also concluded that, even if ignition occurs at the gas flammability limit, the 3-psi overpressure will occur far enough from the CCNPP site not to cause any damage impacting the safety of the units or the ISFSI.

The maximum hazards distance (closest distance) to the CCNPP site at which the overpressure of 3-psi could occur is 0.2 miles. This could occur when LNG is released during a tanker collision. The hazard distances corresponding to other postulated accidents are much larger. The licensee has shown that even at 0.2 mile distance, the 3-psi overpressure will not produce any significant damaging effects or impact on safety at the CCNPP site. In addition, the estimated probability of occurrence of this event is 4×10^{-8}/year, which is a very unlikely event.

Considering the risks based on both probabilistic and deterministic analyses, the licensee concluded that the operation of the Cove Point LNG Terminal will not present any undue hazards to the CCNPP site.

2.0 EVALUATION

The licensee considered two types of criteria in determining risks to the CCNPP site from the postulated accidents occurring at the Cove Point LNG terminal and resulting in releases of LNG or high pressure natural gas: (1) probability of occurrence of accidental release of LNG or high pressure natural gas, and (2) the consequences produced when the released gas ignites.

The licensee evaluated criterion 1 using probabilistic analyses and assuming, as initiating events, failures of different components at either the LNG storage site, the natural gas transmission pipeline, or on board the ships transporting LNG. It evaluated criterion 2 by calculating the effects caused by energy release from the ignited LNG.

2.1 Probability of Accidental Release of LNG or High Pressure Natural Gas

The licensee's evaluation was based on the information from several well known sources, including Coast Guard, American Gas Association, Electric Power Research Institute, American Institute of Chemical Engineers, European Gas Pipeline Data Group and the reports issued by the NRC. Of the total seven scenarios evaluated, two include cases where hurricanes and tornados are

either present or absent. These scenarios include a release during LNG tanker unloading, failure of two different LNG storage tanks, collision of an LNG tanker with other vessels, fire or explosion aboard a LNG tanker, fire or explosion at a loading dock, and underground gas pipeline failure. The licensee estimated the frequencies of occurrence of these accident scenarios.

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," (SRP) Section 2.2.3, provides the acceptance criteria for risk. These are when the expected rate of occurrence of potential exposures in excess of the 10 CFR Part 100 guidelines is approximately $1x10^{-7}$/year if calculated realistically, or $1x10^{-6}$/year if calculated conservatively and combined with reasonable qualitative arguments that the realistic frequency can be shown to be lower.

The licensee's approach to evaluating the risk was to estimate the frequency of occurrence of postulated accident scenarios and to estimate the potential consequences of each scenario by calculating a maximum hazard distance (as previously discussed). This approach is to demonstrate, for a scenario which has a maximum hazard distance very close to the CCNPP site, that the scenario's annual frequency is acceptably low. Thus, if a scenario's annual frequency is in the $1x10^{-6}$/year range or lower and safety measures are taken that would reduce the frequency further, then the SRP, Section 2.2.3 criteria are met. In addition, if the maximum hazard distance for a scenario is far enough away from the plant not to be a significant hazard, then the SRP, Section 2.2.3, criteria are also met.

The bounding scenario determined to have a maximum hazard distance close to the CCNPP site was the release of LNG from one 25,000-cubic meters cargo tank on board of a tanker caused by its collision with another vessel. This scenario's estimated frequency is the product of the following:
1) probability of a spill per year in the vicinity of the closest point of approach to CCNPP site, 2) the fraction of LNG that is released and not immediately ignited, 3) the percentage of time that the wind would be blowing in the direction of CCNPP site, and 4) the probability of ignition and explosion of the release prior to reaching its maximum size. The frequency calculation assumed 136 LNG ships/year transiting the Chesapeake Bay. The licensee determined that the frequency for this scenario to be approximately $4x10^{-8}$/year.

The licensee's estimated frequency for this bounding scenario is consistent with the NRC staff's conclusion in its June 13, 1978, SE which approved the initial hazards analysis relating to the impact that the operation of the Cove Point LNG Terminal would have on safety at the CCNPP site. The NRC staff's independent analysis concluded that the estimated frequency for this scenario was in the low $1x10^{-6}$/year range. The NRC staff also concluded that safety measures must be established such as Coast Guard restrictions on traffic and contingency plans in order to meet the risk acceptance criteria of the SRP, Section 2.2.3. These conclusions are still applicable. However, since the current plans for operating the Cove Point LNG Terminal does not include importing LNG by ship, the use of Coast Guard restrictions on traffic or

contingency plans are not necessary at this time. The NRC staff will request that the licensee inform the NRC if the shipping of LNG will be resumed and to identify the additional actions that will be taken, such as Coast Guard restrictions or other contingencies.

The other scenarios do not have a maximum hazard distance close to the CCNPP site. The maximum hazard distances are far enough away from the CCNPP site not to pose a significant hazard. Thus, even if any of the seven scenarios occurred, the potential for a radioactive release at the CCNPP site is highly unlikely. Variability is expected in these scenario frequencies. However, the NRC staff has determined that the maximum hazard distances are not close enough to the plant to have a significant impact. Thus, the probability of occurrence of radioactive fission products released from the CCNPP site due to any of these scenarios is within the risk acceptance criteria of the SRP, Section 2.2.3.

The NRC staff has determined that the licensee's analysis is comprehensive, the methodology used is appropriate, the supporting data are relevant, and that conservative assumptions were used. The NRC staff further believes that the results of the analysis are best estimates and are verifiable.

2.2 Consequence Produced by Ignited Natural Gas

Natural gas could be released accidentally either in a liquefied form as LNG or as a high-pressure gas. Released LNG will produce a spill which would gradually pickup heat from the environment and evaporate forming a gas cloud. The licensee assumed that a spill could occur on land or water, depending where the accident occurs. The natural gas, either released in a gaseous form from the transmission pipeline or evaporated from a LNG spill, will move from the point of release by atmospheric dispersion and by wind. The less stable the atmospheric conditions are, the faster the gas cloud will disperse, and the chance that a high concentration gas cloud will reach the vicinity of the CCNPP site is less. Similarly, a lower gas concentration at the CCNPP site will be achieved if the wind is not blowing directly towards the site. Ignition of the gas can occur anywhere along the path of the gas cloud as long as its concentration stays above the lower flammability limit.

The maximum calculated hazard distance may result either from vapor cloud explosion or from flammability hazard (which is conventionally defined as a distance to a point where gas concentration has reached one-half of its lower flammability limit). The licensee conservatively used the larger of the two because it would result in the longest distance from the source of the release and, therefore, the hazard would be at the nearest point to the CCNPP site.

For the case of a vapor cloud explosion, the licensee made an assumption that the gas will ignite at its lower flammability limits. This is a conservative assumption because the explosion would be at the shortest distance from the CCNPP site, assuming that the gas moves towards the site. The licensee defined the maximum hazard distance as a sum of the distances from the source of the gas release to its lower flammability limit and from the lower

flammability limit to the point where the overpressure reaches 3-psi value. An exception was made for the LNG release due to fire/explosion aboard the tanker during its approach to the unloading platform or while docked at the platform. In these cases, it was assumed that ignition will occur at the point of release and the maximum hazard distance was defined as a distance between the point of LNG release and the area where 3-psi overpressure would exist.

The 3-psi overpressure was considered by the licensee to constitute a value at which gas explosion would not cause damage to the safety-related structures located at the CCNPP site including the ISFSI. The NRC staff disagreed with the licensee's assumption on this point. The NRC staff considered that, although most structures at the site would withstand this overpressure without undergoing any significant damage, it may cause some damage to the turbine building where some of the safety-related systems are located. The licensee responded to the NRC staff's concern by indicating that 3-psi overpressure occurs at about 0.2 miles from the CCNPP site. Since this overpressure attenuates as it moves towards the site, its actual value at the CCNPP site is significantly lower. Also, as shown in the Updated Final Safety Analysis Report for the CCNPP, the turbine building contains only portions of two safety-related systems which are the auxiliary feedwater system pumps and a saltwater system piping and valve configuration. The auxiliary feed pumps are protected by a Class 1 structure located within the turbine building and the saltwater piping and valve configuration is located about 33 feet below the ground level of the turbine building. The Class 1 structure for the pumps and the location of the piping and valves ensure that they will not be adversely affected by the pressure to which the turbine building could be subjected to by exploding gas.

Evaluating flammability hazards using one-half of the lower flammability limit for determining maximum distances where ignition of gas could occur is a conservative assumption since this concentration precludes such ignition from occurring, even with non-uniform gas concentrations in the gas cloud. Also, the use of this limit for estimating the dispersion exclusion zone for flammable gases is specified by the Department of Transportation (DOT) in 49 CFR Part 193.

The licensee calculated release, transport, and deflagration/explosion of the natural gas using two computer programs: DEGADIS and SuperChems. DEGADIS is a program for calculating dispersion of heavier-than-air gases. It was developed by the University of Arkansas for the U.S. Environmental Protection Agency. SuperChems is a program developed by Arthur D. Little. The program is a comprehensive consequence modeling package for hazard analysis. It is capable of modeling source term for LNG or high pressure natural gas, its dispersion in the atmosphere, and deflagrations or explosions after its ignition.

The licensee used these computer codes to predict maximum hazard distances for the postulated accident scenarios. Release of LNG from a damaged tanker, terminal storage facility, or a discharge of high pressure natural gas from a

rupture in the 36-inch diameter transmission pipe was determined by the SuperChems program using the appropriate parameters to represent the postulated damage. The licensee also used this program to determine natural gas emission from a pool of released LNG. The output from the SuperChems program served as input in the DEGADIS program for determining atmospheric dispersion of the gas and the distances to lower flammability limit or to one-half of the lower flammability limit.

In calculating transport of natural gas throughout the atmosphere, the licensee was using atmospheric conditions existing at the CCNPP site. It conservatively assumed Pasquill atmospheric stabilities of "D" and "F" which correspond to more stable conditions than those actually existing at the site. The more stable atmospheric conditions will produce less dispersion of a gas cloud and will result in higher natural gas concentrations near the CCNPP site. Similarly, mean wind speeds of 2 and 5 meters/second, used with "D" and "F" Pasquill atmospheric stabilities, respectively, represented a conservative estimation of the actual meteorological conditions. The same conservative approach was used for other parameters which were used as inputs to the DEGADIS program.

Since natural gas consists mostly of methane, physical properties of this gas were used in evaluating its transport characteristics. However, the addition of other higher order hydrocarbons makes natural gas much more prone to deflagrations/explosions. This was taken into account by the licensee.

The licensee determined the consequences produced by the ignited natural gas using the outputs from the DEGADIS program as inputs to the SuperChems program. In most cases, it was assumed that natural gas will be ignited after reaching its lower flammability limit. This concentration was used, therefore, in calculating overpressures. An exception existed, as previously noted, for the cases where, due to fire/explosion aboard the tanker, the resulting turbulence would bring the concentration within the flammability range and the gas would ignite at the release point.

The flammable cloud is assumed to be hemispherical, homogeneous, and centrally ignited. The shock waves generating overpressure were caused by expansion of the cloud due to energy addition from burning gas. The licensee assumed 160 meters/second for the velocity at which flame propagated within the burning gas.

The licensee also considered hazard zones caused by thermal radiation from pool fires. However, hazard zones corresponding to a limiting thermal flux of 5 kW/m^2 were smaller than those estimated for explosion hazards.

The NRC staff has reviewed licensee's methodology for estimating overpressures generated by explosion of natural gas released in gaseous or liquefied form. Both computer programs, used by the licensee, are well recognized programs used in the past in many similar applications. The NRC staff had an opportunity to become familiar with the technical bases for the DEGADIS

program and the licensee provided a detailed description of the SuperChems program. Both of these programs have been validated with experimental data.

The NRC staff has determined that, with proper inputs, both of these programs are able to provide meaningful estimates of the consequences produced by deflagration/explosion of natural gas released during the postulated accidents. A review of the input data convinced the NRC staff that the licensee employed the predictive programs in a manner ensuring that the resulting predictions of the consequences to the CCNPP site from the postulated accidents that could result due to the operation of the Cove Point LNG Terminal are conservative. This conservatism is reflected in the calculated hazard zones determined for the different postulated accidents.

2.3 Evaluation of Risks to Calvert Cliffs Site

The risks to the CCNPP site were determined by combining the probabilities of occurrence of a LNG spill or the release of high pressure natural gas with the consequences produced by its ignition/explosion. The risks were determined for all the postulated accidents and the acceptability of the risk is based on the acceptance criteria of the SRP, Section 2.2.3, as discussed above. The NRC staff's evaluation is presented below:

- The estimated frequency of an accident causing LNG release during tanker unloading operation at the terminal was determined to be 2.8×10^{-5}/year. Determination of the maximum hazard distance, in the event the spilled gas ignites, was based on gas flammability consideration, since this criterion gives the largest hazard distance. The corresponding distance of the hazard zone to the CCNPP site is 0.6 miles. This is considered to be a sufficiently large distance for the ignited gas and will have no significant effect on safety at the CCNPP site.

  Considering the low estimated frequency of the event and the insignificant damage to the site structures, if the event occurs, the NRC staff considers risk to the CCNPP site from this accident to be acceptably low.

- The estimated frequency of catastrophic failure of one 375,000-barrel storage tank at the terminal was determined to be 1.2×10^{-4}/year. Since there are four of these tanks, the estimated failure frequency is 4.8×10^{-4}/year when natural events such as hurricanes and tornadoes are also considered. These frequencies will increase by 50 percent to 7.2×10^{-4}/year if two additional 600,000-barrel storage tanks, which maybe added in a future expansion of the LNG terminal, are included. Determination of the maximum hazard distance, when the released gas ignites, was based on the 3-psi overpressure criterion. The hazard distances for catastrophic failure of a 375,000-barrel or 600,000-barrel tanks are very similar. The licensee calculated that the hazard zone will stretch to distances of 3.3 and 3.4 miles from the plant for 375,000-barrel and 600,000-barrel tanks, respectively.

The difference is due to the slightly better tank and dike design of the 600,000-barrel tanks. At these distances no damage to any CCNPP site structures will occur, since the overpressure will decay to a negligibly low value.

Because of a low expected frequency of the event and insignificant consequences, if this event occurs, the NRC staff considers the risk to the CCNPP site acceptably low.

- The estimated frequency of LNG release when a tanker collides with another vessel, while at the closest point to the plant or while it approaches loading platform, was determined by the licensee to be 1.4×10^{-5}/year. The spilled LNG was assumed to spread over the water, evaporate and the resulting gas cloud to move towards the CCNPP site. The hazard zone for ignited gas, based on the 3-psi overpressure criterion, was predicted under worst atmospheric conditions to extend 0.2 miles from the plant. Although the overpressure at the CCNPP site would be lower than 3-psi, it still may cause some damaging effects to the turbine building. As previously noted, the turbine building itself is not a safety related structure, but it contains portions of two safety-related systems: the auxiliary feedwater system pumps and a salt water system piping and valve configuration. The auxiliary feedwater pumps are protected by a Class 1 structure within the turbine building and the saltwater system piping and valve configuration is located at a lower elevation in the turbine building where the overpressure is not expected to cause damage to these components. Also, the occurrence of such an overpressure, when considering that the probability of gas ignition and wind direction towards the CCNPP site, is 4×10^{-8}/year.

  Considering the low estimated frequency of the event and the consequences, based on the risk acceptance criteria of the SRP, Section 2.3.3, the NRC staff has determined that the risk to the CCNPP site is acceptably low.

- The estimated frequency of LNG release from a tanker during an onboard fire/explosion was determined by the licensee to be 2.7×10^{-6}/year, when it occurs while the tanker is approaching the unloading platform, and 5.4×10^{-4}/year while it is docked. The hazard distance for the ignited gas was based on 3-psi overpressure criterion, but it was assumed that the gas ignites immediately after its release. The corresponding hazard zones were 2.6 and 2.9 miles from the CCNPP site for the tankers approaching the unloading platform and while docked, respectively. At these distances the overpressure at the CCNPP site is too low to cause any significant damage.

  Considering the relatively low estimated frequency of the event and negligible consequences, if ignition of the gas takes place, the NRC

staff has determined that the risk to the CCNPP site is acceptably low.

- The licensee has determined the occurrence of the rupture of the 36-inch diameter transmission pipeline carrying natural gas from the terminal to be 1.9×10^{-5}/year. When it occurs, the natural gas will be released at the rate of approximately 1.16×10^{4} cubic feet/second. Assuming that the resulting gas cloud moves towards the CCNPP site and ignites at its lowest flammability limits, the 3-psi overpressure will occur at 1.5 miles from the site. At this distance, the actual overpressure to which the CCNPP site will be exposed will be too low to cause any damage.

  Taking into consideration the low estimated frequency of the event and negligible consequences when it occurs, the NRC staff finds the risk to the CCNPP site acceptably low.

2.4 Specific Safety Concerns

In addition to providing an evaluation of the seven postulated accident scenarios detailed above, the licensee addressed several specific safety concerns related to the operation of the LNG terminal and its potential impact on the ISFSI. These concerns were expressed by the Maryland Safe Energy Coalition in its letter dated July 27, 1993. The Maryland Safe Energy Coalition filed a petition dated December 21, 1992, requesting that a proceeding be initiated pursuant to 10 CFR 2.202 regarding the ISFSI at the CCNPP site. The request was denied in a "Director's Decision Under 10 CFR 2.206," which was sent to the Petitioners by letter dated August 16, 1993. We indicated in the Director's Decision that the concerns expressed in the July 27, 1993, letter would be addressed during the NRC staff's review of the updated LNG analysis. These concerns have been addressed by the licensee in its May 31, 1995, letter as follows:

- Explosion or fire in one storage tank can damage other storage tanks and cause release of total 1.5×10^{6} barrels of LNG.

Explosion or fire of the LNG, released from a damaged tank, which could cause other tanks to fail will ignite the released LNG at the point of release. Therefore, its explosion/deflagration will occur at a considerable distance from the CCNPP site. The licensee has estimated that 3-psi overpressure, caused by exploding gas, will occur approximately 1.5 miles from the point of ignition and 2.1 mile from the CCNPP site. At this distance no significant damage at the CCNPP site will occur.

The staff concurs with the licensee's analysis. As previously noted in Sections 2.1 and 2.2 of this SE, if the maximum hazards distance is far enough away that there is no significant impact on the CCNPP site, then the criteria of the SRP, Section 2.2.3, are met.

- Explosion of LNG released from a storage tank can cause local fires, including ignition of the forest surrounding the ISFSI. Burning trees hurled by explosion may damage the ISFSI vaults.

Forest fires can be started only by land based accidents which are limited to a failure of the transmission pipeline and accidents at the site of the LNG terminal. Since gas released from the transmission pipeline would start forest fires only 0.1 miles away from the point of release (1.5 miles from the CCNPP site), it will not have any appreciably effect on safety at the CCNPP site, unless the fire starts advancing towards the plant. However, the licensee has determined that this event has an expected frequency below 6.7×10^{-7}/year which, according to NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examinations Of External Events (IPEEE) for Severe Accident Vulnerabilities," published in June 1991, is an acceptably low hazard frequency for external event consideration. The accidents at the LNG terminal have hazard distances of 0.3 miles which is well within the boundaries of the terminal. Since the Cove Point Terminal meets the DOT requirements for thermal and flammable vapor dispersion exclusion zone, as specified in 49 CFR 193.2057 and 193.2059, respectively, it is highly unlikely that any incident within the terminal will result in a forest fire which could endanger the CCNPP site, including the ISFSI.

The staff concurs with the licensee's analysis for fires initiated at the LNG terminal for the same reasons stated for the previous concern. The NRC staff also concurs with the licensee's analysis that a fire due to a failure of the natural gas pipeline will not have a significant impact on the CCNPP site. This conclusion is consistent with that reached in the NRC staff's SE, dated November 1992, supporting the ISFSI's Materials License No. SNM-2505 (Docket No. 72-8) in which the NRC staff determine that adequate protection against external fire hazards had been provided.

- Leaking 375,000-barrel storage tank can generate gas cloud which could explode at the CCNPP site.

The licensee's analysis of the release of LNG after a catastrophic failure of a storage tanks indicated that the closest distance to the CCNPP site, where 3-psi overpressure will be generated by exploding gas, is 3.3 miles. No damage to the CCNPP site is possible at this distance as previously discussed in this evaluation.

The staff has determined that the accident caused by leaking gas from the storage tank is bounded by the licensee's analysis as previously discussed in this SE.

- "Neutral" atmospheric stability conditions and wind speeds used in the licensee's analysis may not be necessarily the most conservative.

The licensee, in its analysis, used the most conservative values for atmospheric stability and wind speed for the vicinity of the CCNPP site. The

staff has determined, as previously discussed in this SE, that the licensee's gas dispersion analyses is acceptable.

- Damage to the CCNPP plant may be caused by explosion of LNG released from more than one 25,000 m^3 cargo tanks.

In its analysis, the licensee's considered total spill of LNG from only one cargo tank due to a tanker collision because this has been found acceptable for risk analysis for LNG shipping by Federal and State agencies. Release of LNG from more than one cargo tank would require damage from particularly severe collisions. Such a collision would require a high-speed, close-to-beam impact by the colliding ship moving at a relatively high speed. Because of the type of vessels used for carrying LNG on Chesapeake Bay and transit speeds limited to the 10 to 12 knot range, such collisions are very improbable. The licensee believes that the estimated likelihood of LNG release from more than one cargo tank would be two orders of magnitude lower then the likelihood of release from a single tank.

The NRC staff has determined that basing the analysis on the failure of one cargo tank is acceptable because the expected frequency of the failure of more than one cargo tank would be much lower than the likelihood of a release from the failure of a single tank, thus, the criteria of SRP, Section 2.2.3, are met.

- The gas cloud of released LNG from collided ships could move towards the CCNPP plant and ignite close to the plant.

This accident was analyzed by the licensee using computer simulations. It was found that, although the gas could approach the CCNPP site, it becomes diffused in air as it moves towards the CCNPP site. By the time it reaches the CCNPP site, the concentration of natural gas is too low to cause an explosion.

The NRC staff has determined that the licensee's analysis is acceptable as previously discussed in this SE.

- Explosion of LNG released from all four on-shore tanks could be caused by a sabotage.

The Cove Point terminal has a very good security system. It is located in 108-acre fenced area with the industrial terminal occupying only 77 acres in the middle. The entire site is comprised of 1,017 acres; thus, a buffer area of 940 acres exists to exclude potential intruders. The facility meets the DOT requirement (49 CFR 193, Subpart J) for security systems applicable to protective enclosures for various parts of the facility, security monitoring for each protective enclosure, security communication, security lighting system, alternative power for security lighting, and detailed security procedures which limit access to the facility.

The NRC staff finds that all these safety precautions make acts of industrial sabotage extremely improbable and, therefore, the resultant risk to the CCNPP site is acceptably low.

3.0 SUMMARY

The NRC staff reviewed the licensee's evaluations of the hazards to the CCNPP, including the ISFSI, caused by the presence of the LNG terminal at Cove Point. As detailed above, the hazards were defined as the risks to the CCNPP site from the seven accident scenarios which were postulated to occur as the result of the operation of the Cove Point LNG Terminal. These seven scenarios covered the most credible accidents. The risks were evaluated by calculating the estimated frequency of occurrence of individual events resulting in release of natural gas in gaseous or liquefied form, and the consequences to the CCNPP site if the released gas is ignited. The results of the licensee's analysis indicated that, in all these accident scenarios, the risk always remained within acceptable limits. The bases and methodologies used by the licensee in its calculations of the estimated frequency of occurrence and the consequences of gas fire/explosion are appropriate, the supporting data is relevant, and conservative assumptions were used. The licensee has also adequately addressed the concerns identified in the Maryland Safe Energy Coalition's letter, dated July 27, 1993.

4.0 CONCLUSIONS

The NRC staff has determined that the CCNPP design will continue to meet the requirements of General Design Criterion (GDC) 3, as it applies to fire protection of the structures, systems and components important to safety and GDC 4, as it applies to the design of structures, systems and components important to safety which will be able to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

The NRC staff has also determined that the ISFSI's design for protection against environmental conditions and natural phenomena continues to meet the requirements of 10 CFR Part 72, as detailed in the NRC staff's SE dated November 1992, which supported the Part 72 License.

Therefore, the NRC staff concludes that the safe operation of the CCNPP, including the ISFSI, will not be jeopardized by the operation of the LNG terminal at Cove Point. However, the licensee should inform the NRC if shipping of LNG is resumed in the future and identify the additional actions it will take as previously discussed in this evaluation.

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Date: August 31, 1995

August 31, 1995

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SUBJECT: LIQUEFIED NATURAL GAS HAZARDS ANALYSIS - CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2, AND THE INDEPENDENT SPENT FUEL STORAGE INSTALLATION

Dear Mr. Ochs:

Enclosed for your information is the NRC staff's Safety Evaluation (SE) relating to the updated hazard analysis for the liquefied natural gas (LNG) terminal located at Cove Point, Maryland. The LNG hazards analysis was co-sponsored by the State of Maryland's Department of Natural Resources.

Baltimore Gas and Electric Company evaluated the possible hazards that the Calvert Cliffs Nuclear Power Plant (CCNPP) site, which includes the Independent Spent Fuel Storage Installation (ISFSI), could be subjected due to the operation of the LNG terminal at Cove Point. In addition, the concerns expressed in your letter dated July 27, 1993, are also addressed in the SE. The Cove Point LNG Terminal is currently scheduled to reopen in mid September.

As the result of its review, the NRC staff has concluded that the safe operation of the CCNPP and the ISFSI will not be jeopardized by the operation of the LNG terminal at Cove Point.

Sincerely,

Original signed by:
Ledyard B. Marsh, Director
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-317, 50-318
and 72-8

Enclosures: Transmittal Letter and
LNG Hazards Analysis SE

cc w/encls: See next page

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