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Federal Energy Regulatory Commission
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RE**: Comments on Draft Environmental Impact Statement/Environmental Impact Report ("EIS/EIR") for the Long Beach LNG Import Project**

FERC Docket No. CP04-58-000, et al./POLB Application No, HDP 03-079

Dear Ms. Salas and Mr. Kanter:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement/Environmental Impact Report ("EIS/EIR") for the Long Beach LNG Import Project. Sound Energy Solutions ("SES") proposes to construct and operate a liquefied natural gas ("LNG") receiving terminal and associated facilities in the Port of Long Beach. The project includes: (a) an LNG ship berth and unloading facility at Pier T capable of receiving LNG tankers ranging in capacity from 95,000-145,000 cubic meters; (b) two 160,000 cubic meter LNG storage tanks surrounded by a security wall; (c) an onshore re-gasification facility; (d) an LNG trailer truck loading facility and small LNG storage tank; (e) a 2.3-mile long, 36-inch-diamter pipeline to transport natural gas from the LNG terminal to the existing SoCal Gas system; and (f) a 4.6-mile long, 10-inch diameter pipeline to transport C_2 from the LNG terminal to the existing ConocoPhillips' Los Angeles Refinery Carson Plant.

This project requires certification by the Coastal Commission of an amendment to the Port of Long Beach Master Plan. The Port of Long Beach must submit a Port Master Plan Amendment to the Coastal Commission after it certifies under the California Environmental Quality Act a project-specific EIR. In reviewing the amendment request, the Coastal Commission will analyze the proposed project's environmental effects and evaluate if the proposed siting of the LNG facility within the Port is consistent with the Coastal Act's Chapter 3 and Chapter 8 coastal resource protection and use policies. See Cal. Pub. Res. Code §§ 30200-30265.5, 30700-30721.

If the Coastal Commission certifies the Port Master Plan Amendment, the Port then has the authority to grant SES a harbor district permit for the proposed development. However, Port approval of a harbor district permit for an energy facility, including an LNG terminal, can be appealed to the Coastal Commission. The SES proposal will also require a permit from the Federal Energy Regulatory Commission ("FERC"). That permit is subject to federal consistency review by the Coastal Commission.

The Coastal Commission staff has focused its review of the Draft EIS/EIR on issue areas central to the Coastal Commission's evaluation of the project. The Coastal Commission staff has serious concerns about the adequacy of the EIS/EIR, especially with the respect to the document's analysis of public safety and risk. We strongly believe these inadequacies warrant recirculation of the EIS/EIR. Separately, we also provide comments on the Draft Port Master Plan Amendment.

Draft EIS/EIR Comments

Safety and Risk Assessment

The Coastal Commission must evaluate the potential safety risks of hazardous industrial developments. Coastal Act Section 30250(b) states, "Where feasible, new hazardous industrial development shall be located away from developed areas."

1. On September 7, 2005, the California Energy Commission submitted to the FERC a Safety Advisory Report on the proposed SES LNG terminal. The California Energy Commission, with input from other state and local government agencies (e.g., California Air Resources Board, California Coastal Commission, California Public Utilities Commission, and City of Long Beach), prepared the Safety Advisory Report pursuant to Section 311(d) of the Energy Policy Act of 2005. Section 311(d) allows states with a pending onshore LNG terminal application to identify safety issues and concerns regarding the terminal in an advisory report filed with the FERC. The FERC must respond specifically to the issues raised in the advisory report. Some of the issues and concerns raised in the Safety Advisory Report are not addressed in the Draft EIS/EIR. We note, for example, that the Coastal Act, the Energy Policy Act of 2005, and the 1979 amendments to the Natural Gas Pipeline Safety Act encourage *remote* siting of LNG facilities to the maximum extent feasible. This issue, as well as other safety concerns identified in the Safety Advisory Report but not addressed in the Draft EIS/EIR, should be evaluated in a revised EIS/EIR.

2. Overall, the analysis of public safety in the Draft EIS/EIR is inadequate; it fails to disclose worst-case impacts as required by the CEQA. The approach in the reliability and safety analysis is essentially qualitative with no quantitative significance criteria or comparison of potential impacts to any measurable level of risk. The reliability and safety section also intentionally excludes any analysis of large, credible accidents that would have the potential to adversely affect the public, even though the Port's consultant, Quest Consultants, provided both accident frequency and consequence modeling results that clearly support a finding of significant risk, even using the EIS/EIR qualitative significance criteria.

Catastrophic events, such as an earthquake-induced storage tank failure or terrorist attack, are identified in the Draft EIS/EIR as credible events that would clearly "…result in a substantial increase in the potential for incidents that would cause serious injury or death to members of the public." Therefore, these events should be considered potentially significant impacts, and additional mitigation measures and/or alternatives should be considered. Similarly, these large credible events would also likely affect Fire Department facilities within the port, thus substantially diminishing the level of fire services available during an emergency. Again, catastrophic events should be considered a potentially significant impact requiring consideration of additional mitigation and/or alternatives.

The significance criteria presented in Section 4.11.1 do not provide any quantitative measures that can be used to determine the potential significance of accidental releases from the proposed LNG import terminal. Without any quantitative measure, the evaluation of potential impacts is meaningless. The Draft EIS/EIR analysis should be revised to include standard risk analysis methodologies, such as the "Guidelines for Chemical Process Quantitative Risk Analysis" prepared by the American Institute of Chemical Engineers. The Port's Risk Management Plan release frequencies, which are not included in the significance criteria, are correctly applied, but do not meet the worst-case analysis requirements of the CEQA. By excluding all large credible events, the EIS/EIR precludes meaningful public disclosure, review, and comment on the accidents that would have the greatest impact on public safety.

The Draft EIS/EIR notes that "[t]he FERC staff does not agree with analyzing worst-case, high-consequence, low-probability events without accounting for the beneficial effect of preventive or mitigation measures as part of a risk management process." As a result, many of the credible worst-case high consequences calculated in the Hazards Analysis prepared by Quest Consultants are not considered credible events by the FERC. Using this approach in combination with the significance criteria in the EIR, one could also conclude that there would be no significant impact associated with other hazardous facilities, such as nuclear power plants. By excluding all high consequence events, even those with probabilities considered credible by agencies such as the Nuclear Regulatory Commission, the analysis is guaranteed to result in all impacts being considered less than significant.

Thus, no valid conclusion can be reached regarding the project's potential impacts on public safety when a majority of release scenarios are summarily dismissed from any serious analysis. In the absence of a quantitative risk analysis or thorough evaluation of all credible events, any conclusions related to public safety are highly qualitative and speculative. CEQA Guidelines 15002(a) clearly state the purposes of the CEQA are to: (a) Inform governmental decision-makers and the public about the potential, significant environmental effects of proposed activities; (b) Identify the ways that environmental damage can be avoided or significantly reduced; (c) Prevent significant, avoidable damage to the environment by requiring changes in projects through use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible; and (d) Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

Thus, the CEQA requires the Port to fully disclose potential environmental effects associated with the proposed project, identify mitigation measures to avoid or lessen potential impacts, and to disclose this information to the public. Compliance with the CEQA can only be met through a thorough examination of all credible events that are identified in the Quest Consultants Hazards Analysis Report (Draft EIS/EIR Appendix F).

3. The Draft EIS/EIR evaluation of LNG spills into sumps/impoundments incorrectly uses the SOURCE5 and DEGADIS models to simulate these complex releases. In cases such as this, the FEM3A model, which uses computational fluid dynamics, should be used to evaluate exclusion zones for a hypothetical spill within a typical dike/tank configuration. The SES analysis (Page 4-142, 2nd paragraph), asserts that all vapor from a spill would be contained within the security barrier. This assertion should be removed from the document. The assumption that LNG vapor would be contained within the security barrier is not realistic and has no place in the safety analysis.

4. Portions of the Waterway Suitability Assessment that are not security sensitive should be included in a revised EIS/EIR. This information is critical to the safe operation of the LNG terminal and warrants public review.

5. The Draft EIS/EIR fails to provide any information or analysis on the consequences of an accidental release from the onshore natural gas or ethane pipelines. While some anecdotal information is provided on failure rates and historical fatalities associated with natural gas pipeline accidents, the Draft EIS/EIR ignores site-specific issues such as seismic events, liquefaction, and local demographics. The EIS/EIR should be revised to provide a quantitative analysis of pipeline risk associated with the project. This would include an expansion of the pipeline failure rate analysis, a consequence analysis, and estimates of population exposure, injuries and fatalities. Given the serious nature of this potential public safety impact, the EIS/EIR should be re-circulated to allow for public review.

6. The project's natural gas and ethane pipeline will pass through or adjacent to highly populated areas. The Draft EIS/EIR presents a discussion of natural gas and ethane pipeline failure rates, but does not evaluate consequences associated with a pipeline failure. To be able to make an informed decision related to pipeline risk, design and mitigation, the EIS/EIR should be revised to include a consequence and risk analysis of these pipelines.

7. SES proposes to accept LNG from a wide variety of sources. As proposed, the project LNG marine terminal would accept LNG that contains higher fractions of heavier hydrocarbons (i.e., ethane and propane). LNG with heavier hydrocarbons is known as "hot" LNG due to the higher energy content of the heavier hydrocarbons. The Draft EIS/EIR fails to evaluate potential consequences and risk associated with handling hot LNG. The EIS/EIR should be revised to evaluate the increased risk of vapor cloud explosions associated with hot LNG.

8. Following hydrocarbon separation, SES plans to store and transport natural gas liquids ("NGLs"). The project will include two NGL storage tanks. The Draft EIS/EIR does not contain an analysis of potential hazards associated with NGL storage and transportation. Therefore, the EIS/EIR should be revised to include a risk analysis of all NGL hazards, including the potential risk of an NGL storage tank "BLEVE" (i.e., boiling liquid expanding vapor explosion).

9. Truck transportation of LNG is an important component of the project. The Draft EIS/EIR contains a discussion of LNG truck accident rates and measures that have been taken at the Distrigas Terminal in Everett, Massachusetts to reduce truck accident rates. Unfortunately, the EIS/EIR analysis stops there and does not provide any evaluation of LNG trucking consequences and risk. Since this is not a trivial component of this project, the EIS/EIR should be revised to include a thorough transportation risk analysis of LNG trucking.

10. In section 4.11.10.1 of the Draft EIS/EIR, the Port describes the Los Angeles County Fire Department probability definitions and correctly identifies events with a probability of greater than 1.0×10^{-6}/year (one in one million years) as a credible event. The Port Risk Management Plan's term "probable" is used for a possible event; the Risk Management Plan requires that only the worst probable events be assessed. Therefore, the Port excludes all credible events with a probability of 1.0×10^{-4}/year (once in a 10,000 year period) as improbable, which includes virtually all major credible releases. This definition is inconsistent with the CEQA and the NEPA, which require an analysis of worst-case events, which, in this case, would include all credible events. It is clear from the Quest Consultants Hazards Analysis that several credible events with probabilities between 1.0×10^{-4}/year (once in a 10,000 year period) and 1.0×10^{-6}/year (one in one million years) would have a substantial effect on public safety. The CEQA and the NEPA therefore require that an accidental release of LNG be identified as a potentially significant impact.

    To address potentially significant public safety impacts, the EIS/EIR should be revised to evaluate potential impacts associated with all credible events. Since a worst-case evaluation of credible events would likely result the identification of a potentially significant impact to public safety, the EIS/EIR should identify all feasible mitigation measures that could reduce potential impacts to a less than significant level.

    To address the potential significance of accidental releases from the proposed LNG terminal, Marine Research Specials ("MRS") prepared for the Coastal Commission a quantitative risk analysis ("QRA") to estimate the project's public safety risk. The QRA is included as Attachment A. In preparing the QRA for the proposed project, MRS used information contained in the Draft EIS/EIR. The analyses prepared by the FERC, the Port and Quest Consultants formed the basis for the QRA analysis. The QRA includes a discussion of the methodologies used in its preparation and identifies areas where the analysis differs from the FERC/Port/Quest' analyses. Specific evaluations in the QRA include:

    - Acceptable Risk
    - Receptors

- Failure Frequencies
- Consequence Analysis
- Risk Analysis

The results of the EIS/EIR failure rate and consequence analysis are combined to develop FN curves (plots of frequency (F) versus the number of fatalities (N)), using risk analysis software. FN curves are commonly called risk profiles and represent societal risk. In calculating the risk profiles, MRS prepared a two-dimensional computer map of the facility, pipelines, and surrounding area. The population distribution and probabilities of ignition are specified across the area of the map; and the likelihood of an individual fatality occurrence is calculated at each grid location on the map.

Figures 6 and 7 in Attachment A (pages 29-30) provide the results of the QRA in terms of societal risk. The FN curve is compared to a range of acceptability criteria, most specifically the criteria developed in the Netherlands and adopted by Santa Barbara County. In virtually all cases, the societal risk associated with the project would be considered intolerable in the absence of additional safety mitigation. To provide a more thorough analysis of project risk, including the evaluation of the risk associated with all credible events, the FERC and the Port should incorporate the results of the QRA in a revised EIS/EIR.

11. Attachment 2 of the report prepared by MRS contains NFPA 59A and 49 CFR 193 Summary Checklists that can be used to demonstrate compliance with applicable Federal codes and standards. A review of these checklists indicates that the project would not comply with some of the exclusion zone requirements of NFPA 59A. In addition, the Draft EIS/EIR does not contain enough design information to determine if the project is consistent with the requirements of NFPA 59A and 49 CFR 193. While much of this detailed information is well beyond the scope of CEQA and NEPA, the fact that the project does not currently meet some elements of these standards raises the concern that there could be other project design deficiencies. In order to address compliance with NFPA 59A and 49 CFR 193, the EIS/EIR should, at a minimum, state that the project design meets or exceeds the NFPA 59A and 49 CFR 193 requirements. If possible, the EIS/EIR should include completed NFPA 59A and 49 CFR 193 Summary Checklists.

Oil Spills

12. The Draft EIS/EIR is missing: (a) a risk and hazards analysis of a reasonable worst case fuel oil spill from the LNG vessels; and (b) the oil spill prevention and response measures that would be used to mitigate a reasonable worst case spill. The LNG tankers pose a risk of fuel oil spills. The Project Description for the LNG vessels (Section 2.1.2, page 2-10) indicates that bunker fuel oil will be used in the LNG vessel’s propulsion systems when it enters port. Although the Marine Safety Section (4.11.7, page 4-148) provides an analysis and discussion of the risks of an LNG spill from a vessel accident, the analysis does not provide any discussion for the risk of fuel oil spills from the LNG vessels.

Because the LNG vessels will transit State waters, the California State Vessel Contingency Plan and Certificate of Financial Responsibility regulations (California Code of Regulations Title 14 Section 815-820 and Sections 791-797), require SES and the LNG vessel owners/operators to prepare a detailed non-tank vessel contingency plan. That contingency plan must include a reasonable worst case oil spill scenario, trajectory analysis, identification of resources at risk, and a summary of a vessel's prevention and response measures to protect resources in the event of a reasonable worst case oil spill. The Commission staff recognizes that a detailed oil spill contingency plan may not be available at the Final EIS/EIR stage due to the fact that the exact type of LNG vessel that will be used may not be known until the later design phases for the LNG terminal and facility. However, it is possible for the Final EIS/EIR to provide a conceptual vessel oil spill risk analysis and contingency plan.

To conduct a complete analysis under Coastal Act Section 30232, please provide the following information in a revised EIS/EIR.

- Scenario and volume of reasonable worst-case oil spill from the largest fuel oil tank on the vessel.
- On-water oil spill trajectories for 2, 6, 24, 36, and 60-hour timeframes, as applicable for the duration of the worst case spill scenario.
- Identification of marine and shoreline resources at risk of impact within 2, 6, 24, 36, and 60-hour timeframes, as appropriate for the duration of the worst-case spill scenario. This should include identification of federal and California endangered or threatened species.
- Analysis of SES's ability to respond to a reasonable worst-case spill for 2, 6, 24, 36, and 60-hour timeframes.
- Identification of response equipment and personnel that can be at the spill site within 2 hours of an oil spill event.
- Evidence of contracts with California certified oil spill response organization that can effectively respond, contain and clean-up a worst case oil spill within Port of Long Beach and California waters.
- Description of the general oil spill prevention, containment and response equipment available onboard the LNG vessels.

As additional guidance for the above information, we recommend using the California State Marine Facilities Contingency Plan and Certificate of Financial Responsibility regulations (CCR Title 14 Sections 815-820 and 791-797) to reduce duplication of effort and ensure consistency with those regulations.

Marine Resources/Water Quality

13. The Draft EIS/EIR states on page 4-37 that during each unloading operation the LNG ship will bring on ballast water (about 8-18 million gallons per unloading event, depending on the size of the ship (1-2 billion gallons per year)) and retain this ballast water until after the LNG ship departs the harbor. How far offshore will the ship discharge the ballast water? Please describe the anticipated temperature difference between the discharged ballast water and the surrounding seawater and what effects this difference is likely to have on the nearby

biological community. Describe the effects of the biomass (i.e., dead plankton, other marine organisms) that would be discharged with the ballast water.

At what depth and velocity will ballast water be drawn? In a revised EIS/EIR, please evaluate if taking on ballast water will cause mortality to marine organisms (the Draft EIS/EIR for the Cabrillo Port Project, for example, assumed 100% mortality to marine organisms due to ballast water exchanges). In addition, evaluate the significance of impacts to ichthyoplankton and Essential Fish Habitat. The adverse environmental effects associated with this type of seawater use will vary depending on site characteristics (e.g., location, depth, interaction with currents, etc.) and the makeup of the community of marine organisms in the area. Please characterize the species and densities of marine organisms in the area of the proposed project that could be entrained or impinged. This characterization should include diurnal and seasonal variations in the specific makeup of the locally affected biological community. Are the ships' intake pipes designed to minimize entrainment (e.g., use of mesh screens)?

14. The Draft EIS/EIR states on Page 4-36:

Ship traffic and various construction or maintenance activities create a relatively "noisy" underwater environment within Long Beach Harbor. Research suggests that some marine organisms exhibit avoidance behaviors in response to noise from ships engines (International Council for the Exploration of the Sea, 1995). As such, project vessels (LNG ships, tugs, construction barges) operating within Long Beach Harbor could create sounds that lead to responses in fish. Additionally, specific construction activities (e.g., driving sheet piles) could also generate sound pressure waves that potential kill, injure, or cause a behavioral change in fish in the immediate vicinity of the construction activities (NOAA Fisheries, 2003). Given the abundance of fish in the harbor despite continuous maritime activity, marine organisms found in the project area have generally adapted to these "noisy" conditions. Accordingly, the impacts of construction on fish populations are considered insignificant.

The above quote from the Draft EIS/EIR acknowledges that construction and operation activities can generate underwater sound pressure levels that cause injury, death, or behavioral changes in fish. However, without offering any supporting evidence, the Draft EIS/EIR concludes that since there is an abundance of fish in the harbor, the fish have adapted and any impacts are insignificant. There is no scientific basis offered in the EIS/EIR for this conclusion. In fact, much remains to be learned about the effects of intense noise events on fish and other marine life (especially marine mammals). A revised EIS/EIR should acknowledge this uncertainty and provide additional detailed analysis of the potential effects of construction and operation activities on fish and marine mammals. At a minimum, please address the following:

a. Identify specifically project-related construction and operation activities that generate underwater sound (e.g., pile-driving, dredging, LNG vessel transits).

b. Estimate the sound pressure level[1] and frequency[2] of each activity identified under (a).

c. Evaluate if the estimated levels of underwater sound may cause injury or disturbance to marine mammals. (The issue of noise thresholds is controversial. NOAA Fisheries currently defines Level A Harassment (death or injury) occurring at a received level of 180 dB and Level B Harassment (disruption) occurring at a received level of 160 dB and 120 dB for continuous sound. The Coastal Commission believes that ample evidence exists that sound levels of 140 dB can cause behavioral responses.)

d. Based on the conclusions of (c), model the estimated marine mammal "impact zone" (distance to expected received sound levels).

e. Based on the conclusions of (d), will sound generated by the project be likely to adversely affect marine mammals? If so, what measures can be implemented to avoid or reduce these harmful effects (e.g., establishment of marine mammal safety zones, marine mammal monitoring, passive acoustic monitoring)?

   What measures can be implemented to reduce impacts to fish (e.g., use of bubble curtains)?

15. The Draft EIS/EIR fails to provide a comprehensive discussion of potential deleterious impacts to marine water quality and marine biota that could result from increased turbidity caused by dredging and other construction activities in and near surface waters. The Draft EIS/EIR acknowledges, "*…in-water activities would temporarily resuspend sediments in the water column, which could cause turbidity. An increase in sediment and turbidity levels could adversely affect water quality and aquatic organisms. Resuspension of contaminated sediments could also impact marine organisms in the area. Resuspension of contaminated sediments could also impact marine organisms in the area.*" [pg ES-6; 4-22]. However, the Draft EIS/EIR uses imprecise TSS (total suspended solid) concentrations as part of the basis for determining that impacts to marine resources would be less than significant. "*As described in section 4.3.3.2, previous studies conducted in 1999 and 2000 during dredging activities at the Pier T Marine Terminal adjacent to the proposed project site found no indication that TSS values within 300 feet of the dredge sites were significantly elevated during dredging activities (MBC, 2001a and 2001b)…Therefore, the overall impact of dredging associated with the proposed project on marine organisms would be less than significant.* [pg. 4-36]

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[1] Sound pressure level is typically expressed as decibels referenced to a specific pressure – usually one micro Pascal.
[2] The primary concerns raised in the past decade about the effects of noise on the marine environment have been related to low frequency (i.e., less than 1 kHz) and mid-frequency (i.e., 1-10 kHz) sound. High frequency sounds (i.e., greater than 10 kHz) with anthropogenic sources in the marine environment include: (1) fish finding sonar, which operates in the 18-200 kHz region (of which there are thousands deployed world-wide and many off the California coast); (2) depth sounding sonar, with operating frequencies often at 12 kHz (most ships transiting California use this type of sonar); (3) bottom profilers, which range from 400 Hz to 30 kHz; (4) side scan sonar (50-500 Hz); and (5) navigation transponders (7-60 kHz). These types of equipment are fairly commonly used in coastal waters and their sounds attenuate rapidly in the marine environment

TSS measurements in discrete water samples do not provide quantitative support for this conclusion. TSS concentrations are usually determined by filtration of discrete water samples. Unless particulate loads are heavy, or very large water samples are collected, TSS measurements are imprecise. Specifically, TSS measurements are not as sensitive or reliable as transmissivity measurements for detecting changes in suspended particulate loads. Transmissivity measurements apparently contradict conclusions concerning dredging-induced turbidity. "*Dredging affected light transmission at monitoring stations within 300 feet of the dredging operations. Substantial decreases in light transmission in the water column were often observed and were likely the result of sediments disturbed during dredging (dredge plume).*" [pg. 4-26]

Given these contradictory conclusions, a revised EIS/EIR should provide a more quantitative analysis of the extent and duration of potential turbidity impacts. The duration over which disturbed or dredged sediments would remain suspended can be estimated using available grain-size measurements to compute settlement rates. The spatial extent of impacts can then be determined by combining estimated settlement rates with estimates of tidal flow velocities. If the turbidity plume is likely to represent an exception to narrative standards in the California Ocean Plan, the Regional Basin Plan, or the Regional Water Quality Control Board's Waste Discharge Requirements, then the EIS/EIR should require additional mitigation. This may include monitoring of the dredge plume using transmissometers (not discrete TSS measurements) and limiting dredging activities during periods of peak tidal flow. Dispersion of suspended sediments is of concern because of known contamination, although the extent and origin of the contamination is not clear from the statements in the Draft EIS/EIR. "*The five metals detected throughout the dredge surveys (arsenic, copper, lead, selenium, and zinc) were also detected during the pre-dredge survey. The other analytes detected during the surveys (polychlorinated aromatic hydrocarbons) were found at very low concentrations, close to detection limits.*" [pg. 4-26]. This statement seems to imply that sediments contaminated by trace-metals and PAHs were resuspended by the dredging operations. The EIS/EIR needs to clarify whether the contaminant concentrations were measured in bulk-sediments samples, sediment elutriate/porewater, or within the water column. It also needs to clearly describe the implications of the measurements in terms of potential impacts from the spread of contaminants into the water column from dredging activities.

16. The Draft EIS/EIR fails to provide sufficient monitoring to prevent an uncontrolled accidental release (frac-out) of drilling fluid during horizontal directional drilling ("HDD"). "*Depending on the subsurface conditions along the drill paths, it is possible that some of the drilling fluid could be inadvertently released into the Cerritos Channel during the drilling operation.*" [pg. 4-29]. The Draft EIS/EIR dismisses the significance of potential impacts from frac-outs with a statement concerning differences in the behavior of drilling particulates in the marine environment. "*Unlike a fresh water environment, the high salt concentration in sea water would result in rapid flocculation of the solid particles in any drilling fluid released into the channel. The flocculated particles would settle to the channel bottom quite rapidly, resulting in negligible dispersal of the drilling fluid in the water column down current of the site where the fluid is released*" [pg. 4-26]. This is contrary to experience monitoring marine frac-outs during

HDD along the California coast. Because the drilling fluid is higher in temperature than ambient seawater, and drilling fluids form low-density flocs, they tend to remain suspended in the water column where they can be transported over large distances.

The Draft EIS/EIR also minimizes the risk of impacts to marine resources from frac-outs by relying on ineffective monitoring procedures described in the HDD plan. "*SES prepared an HDD Plan (see Appendix C) to minimize impacts associated with an inadvertent release of drilling fluid. The HDD Plan includes a description of … monitoring procedures*" [pg. 4-29]. Although not explicitly stated in the HDD plan, the proposed frac-out monitoring procedure appears to be based on visual observation and measurement of mud loss. However, past HDD projects have demonstrated these methods are ineffective. The signature of discharged drilling fluid is often not visible on the water surface. Similarly, measurement of changes in mud volume or pressure is not an accurate, sensitive, or timely method for tracking mud loss to the environment. Drilling fluid is constantly added during the drilling process to fill the increased bore volume. Also, unknown quantities of mud are lost to the to the subsurface formation. Tracking discharge-related changes in the continuously changing mud volume is extraordinarily difficult in practice.

The HDD plan for frac-out monitoring should be modified to require the use of Rhodamine dye measurements. The procedure involves adding fluorescent dye to the mud tanks onshore. An in-situ fluorometer is placed in the Cerritos channel, downstream (depending on the tide) of the drill bit location. This method is capable of rapidly detecting extremely small, sub-ppb concentrations of drilling fluid released into the channel. It has proven successful at limiting the volume of drill-mud releases to the marine environment during HDD frac-outs.

17. The Draft EIS/EIR fails to address whether *Caulerpa taxifolia* could be present at the construction site and, if so, it fails to describe mitigation measures that could prevent its spread during construction activities. The highly invasive alga *Caulerpa taxifolia* poses a substantial threat to marine ecosystems in southern California because it can rapidly spread if disturbed. It has been observed in harbors to the south. The EIS/EIR needs to provide an assessment of its potential occurrence in the area of the proposed construction. The assessment may require a field survey by a marine biologist certified by either NOAA Fisheries or California Department of Fish and Game under the *Caulerpa taxifolia* Control Protocol. If found, eradication and surveillance efforts need to be conducted before construction activities begin.

Geology

18. Technical documentation for the seismic studies, including source earthquakes, assumptions, and probabilistic seismic hazard analysis are not provided. Instead, the user is referred to the FERC website. Although these materials may be on the FERC website, they are difficult to locate and download. This type of information normally is provided in the technical appendices of an EIS/EIR for a project of this type. Without review of these materials it is impossible to determine whether the assumed peak ground accelerations of 0.44g for the Operating Basis Earthquake, 0.88g for the Safe Shutdown Earthquake, and 0.52g for the Port of Long Beach's Contingency Level Earthquake are appropriate. We note that the USGS

PGA look up page (http://eqint.cr.usgs.gov/eq-men/html/lookup-2002-interp.html) returns a value of 0.43g for a return period equivalent to the OBE and CLE at the site. Similarly, the California Seismic Hazards Mapping program (see http://gmw.consrv.ca.gov/shmp/download/evalrpt/longb_eval.pdf) interpolates a Peak Ground Acceleration of 0.48g for a point very near the site. However, both of these values are for "firm rock" sites. On the fill at Terminal T it might be expected that much higher ground accelerations would be achieved. Neither the USGS or the SHMP provides an estimated Peak Ground Acceleration with return periods corresponding to the Safe Shutdown Earthquake (1% probability of exceedence in 50 years), but the USGS does provide a value for the smaller event corresponding to a 2% probability in 50 years: 0.88g. Because this is for a smaller event than the Safe Shutdown Earthquake and is for a firm rock site, it is surprising that the Peak Ground Acceleration matches the calculated SSE ground motion. Without details of how these Peak Ground Accelerations for the SSE, OBE, and CLE were calculated, it is not possible to evaluate whether the assumed values adequately address the seismic hazard (ground shaking) at the site.

19. The hazard posed by surface rupture similarly is difficult to evaluate. The Draft EIS/EIR relies on published on-shore geologic maps and one unpublished study not provided in the Draft EIS/EIR (URS, 2003b) to conclude that there is no evidence of faults that intersect the surface in or near the project site. The active Palos Verdes fault and the probably active Thums- Huntington Beach fault pass within a few miles of the site. Although it is unlikely that rupture along the main traces of either fault would affect the facility by surface rupture, no detailed fault study demonstrating the absence of active spurs from either of these faults is provided. For a critical facility of this type, the Coastal Commission expects seismic reflection profiling and/or multibeam bathymetry to be performed to evaluate the surface fault rupture hazard.

20. The Draft EIS/EIR recognizes that the fill materials at Terminal T would likely be subject to liquefaction during a severe seismic event. Further, lateral spreading and settlement are likely due to the mass of the LNG storage tanks and the inadequacy of the existing terminal shoreline structures. The Draft EIS/EIR states that this hazard will be mitigated by rebuilding the shoreline structures and by extending foundation systems beneath the major facilities. However, the depth to non-liquefiable materials is not provided, nor are calculations demonstrating the adequacy of the re-engineered shoreline structures to resist lateral movement. Please provide this information in a revised EIS/EIR.

21. The Draft EIS/EIR relies on Synolakis (2003) for estimates of the 100- and 500-year tsunami runup, and on Borrero et al. (2005) as a model for landslide-derived tsunami. Neither of these references, however, was intended to adequately portray the tsunami hazard for land use planning purposes. These are instead hazard assessments for illustrative purposes. For example, the submarine landslide modeled in Borrero et al (2005) is only one of numerous possible tsunamigenic slope failures in the area, and this particular event was not intended to be worst-case or even representative. A detailed tsunami hazards evaluation should be undertaken and provided in a revised EIS/EIR.

In the Coastal Commission staff's comment letter on the Notice of Intent to prepare this Draft EIS/EIR, we indicated the need for:

a. Historic information on wave conditions and flooding, including frequency of various wave and flooding conditions and extreme conditions that have been recorded or identified anecdotally. If site-specific information is not available, then extrapolate from information known from the general project area; and

b. Safe building elevations based on wave conditions, historic shoreline trends, and IPCC projections for changes in eustatic sea level, combined with local changes in higher high water or mean sea level. We have been unable to find this type of analysis in the Draft EIS/EIR.

22. As stated in Comment 16, the HDD monitoring and spill contingency plan is inadequate. The plan should include, at a minimum:

    a) Project Description
    b) Training Program
    c) Monitoring Program
    d) Worst Case Scenario Evaluation
    e) Equipment to be on site (or nearby)
    f) Agency notification (call down list)
    g) MSDS sheets for all materials

    Specifically, the monitoring program should contain procedures for testing for waters of the Cerritos Channel to determine whether drilling muds are being released. These procedures should make use of a fluorescent dye tracer in the drilling muds, and involve a sampling program while drilling is underway.

23. The Draft EIS/EIR recognizes that a potential project impact is the release of petroleum products to waters of the Port of Long Beach if a submerged pipeline is broken during HDD operations. This impact is to be mitigated by "agency staffs" recommending to their respective decision-makers that the following measures be included as a specific condition of any approvals issued by FERC and the Port: "*SES shall revise its HDD plan to describe the procedures that would be followed if an existing submerged pipe is encountered during the HDD operations*." This is inadequate mitigation; the time to modify the HDD plan is during the revisions of the EIS/EIR, not as a condition of agency approval.

Air Quality

24. Page 4-100, Table 4.9.2-1. More recent air quality data are available (for 2002-2004) for the area. State standards for PM_{10} and $PM_{2.5}$ for 2002-2004 are exceeded in the area. Please update the data in a revised EIS/EIR.

25. Page 4-111. The Draft EIS/EIR estimates the peak construction workforce to be 404 persons. However, in the Updated Air Quality Impact Analysis Information, Docket No. CP04-58-000 (April 4, 2005), SES states that the construction peak work force would be 500 persons. If an incorrect lower number is used in the Draft EIS/EIR's calculations, offsite commuting emissions are underestimated, and, potentially, construction machinery emissions are underestimated as well. A revised EIS/EIR should clarify this issue.

26. Pages 4-109 and 4-115. The Draft EIS/EIR contains only summary tables for the project air emissions. There are no detailed air quality assumptions, emissions sources (e.g., what type and how many construction machinery pieces would be used), emission factors for the equipment, calculations, etc. (e.g., in a form of a technical appendix), which is surprising for a relatively complex project that consists of many different types of construction and operational equipment. The SES Application and subsequent revisions to the air quality analysis (FERC Docket No. CP04-58) contain detailed calculations and emissions summary for the project; however, there are many revisions and subsequent revisions of the air quality calculations and analysis contained in Docket No. CP04-58, making it almost impossible to verify the emission estimates in the EIS/EIR. All emission calculations and assumptions should be included in a revised EIS/EIR.

27. Page 4-111. Because construction emissions would be significant, all possible mitigation measures should be explored. We propose to add the following measures typically used by the AQMD to further mitigate the emissions from construction:
    -- *Require that all the construction equipment with combustion engines be maintained according to the manufacturer's specifications.*
    - *Consolidate truck deliveries to the construction site and waste removal from the site, as much as feasible.*

28. We propose putting a specific time limit on the following measure proposed at the 3rd bullet on page 4-111:
    --*Prohibit truck and other equipment with combustion engines idling in excess of 2 minutes (page 11-13 AQMD CEQA Air Quality Handbook).*

29. To reduce emissions of diesel particulate and hydrocarbons, the following mitigation measure should be included:
    - *All heavy diesel equipment shall be retrofitted to use oxidizing soot catalysts.*

30. Page 4-114. The project description lists two technologies that could be used for the engines on the LNG ships (p. 2-12): steam engines and diesel-electric engines. The steam engines typically use both boil-off LNG and fuel oil as fuel to generate steam. The diesel-electric engines either (1) use boil-off LNG with partial diesel pilot injection or (2) use diesel fuel only to generate electricity to propel the ship and re-liquefy the boil-off LNG. The project description states (Section 2.1.2, p. 2-12), "*Several large diesel electric-powered LNG ships are currently under construction.*" The diesel-electric engines produce different emissions as compared to the LNG- and fuel oil-powered steam engines that are currently used on most LNG ships. The analysis of emissions from operations does not address the difference in

emissions if all-diesel-powered ships are used in the future, and how that would affect the operational emissions inventory of the project. Thus, the Draft EIS/EIR contains no analysis or statement as to which type of engines would produce "worst-case" emissions scenario that is required to be analyzed under the CEQA.

31. The available literature specifies that the new dual-powered (LNG and diesel) electric engines produce lower emissions than the currently used diesel-only electric engines and the dual powered steam engines (LNG Journal 2004; High Technology Finland 2005). Use of this new technology could be incorporated as a mitigation measure.

32. It is not clear from the project description if SES prefers dual-powered over diesel-only electric engines. The LNG ships are the single highest contributor to the project emissions from operations, and any change in the emissions from the ships would significantly affect the total emissions from operations. Thus, a more detailed evaluation of how emissions would change if ships with diesel-electric-powered engines are used instead of ships with the LNG/oil-powered steam engines should be included in a revised EIS/EIR.

33. In Tables 4.9.5-1 and 4.9.5-2, footnote "c" states that the assumption for emissions calculations are that the ships use LNG boil-off gas plus a minor quantity of residual fuel No. 6 during hotelling. Although SES is committed to maximize use of boil-off LNG as fuel during hotelling, these may not be the worst-case emissions because SES may also use diesel-electric powered LNG carriers (which do not use boil-off gas as fuel). If emissions from diesel-electric powered ships are not controlled, NO_x and SO_x emissions could be higher than what is currently estimated in the air quality section. Therefore, the EIS/EIR should be revised to provide a worst-case estimate of ship hotelling emissions.

34. Page 4-114, second to last paragraph. The air quality section does not specifically identify or quantify the AQMD-required emission offset package. For a complete emissions summary of the project, emission offsets should be listed and quantified in the air quality section (e.g., as part of Tables 4.5.9-1 and –2). At a minimum, the EIS/EIR should reference the SES-submitted emission offset package documents (FERC Docket No. CP04-58).

35. Page 4-114, second to last paragraph and Tables 4.9.5-1 and 4.9.5-2. The two tables contain water heater emission estimates that include BACT. It is not clear if the other emission estimates listed include BACT. This should be stated specifically, with the mitigation efficiency (e.g., in %) quantified, because it is unclear which emissions will be offset or mitigated, and how that reduces the overall emissions inventory of the project.

36. Pages 4-113—4-115. The highest source of NO_x, PM_{10}, $PM_{2.5}$, and SO_x emissions from LNG terminal operations is emissions during the LNG ships' hotelling at the berth. SES states that the emissions from hotelling and non-propulsion emissions from the LNG ships would be offset (Revision to Report 9 of April 4, 2005, footnote 5 to Revised Table 9-15, FERC Docket No. CP04-58). To ensure this measure is enforceable, we propose the following mitigation measure be added to the EIS/EIR:

- Require that emissions from the LNG ships hotelling are fully offset (this measure will provide 44% reduction in each NO_x and SO_x emissions, 35% reduction in each PM_{10} and $PM_{2.5}$ emissions, and 33% reduction in CO emissions).

- Require that non-propulsion emissions from the LNG ships be fully offset.

37. The SES-proposed measures for reducing operational emissions from LNG ships are listed in the air quality section of the Draft EIS/EIR as one bulleted item on page 4-116. However, some of these measures address only emissions of one pollutant or even would worsen emissions of other pollutants. For instance, bio diesel fuels typically increase NO_x emissions (EPA 2002); selective catalytic reduction ("SCR") reduces only NO_x emissions. A more detailed and specific approach is needed to mitigate emissions from LNG ships.

38. 3rd bullet on page 4-116. The SES-proposed mitigation measure to use emission reduction technology on the LNG ships during hotelling is not specific. Therefore, it is not possible to quantify the emissions reductions that could be achieved by implementation of this measure. Estimated emissions of No_x and So_x are significantly higher than the AQMD CEQA thresholds. Therefore, these two pollutants should be targeted for reduction (see below). SCR engine emissions reduction technology is available on the market for ocean-going ships (Wärtsilä 2004). It can be retrofitted onto the existing ship engines. NO_x emission reductions of 75-96% are achievable. The EIS/EIR should be revised to include an evaluation of the feasibility of retrofitting project-related LNG ships with SCR.

39. The proposed regulations from the CARB (CARB 2005) would require (if adopted) use of fuel in the ships' auxiliary engines of not higher than 0.5% sulfur (bunker fuel now typically contains 4.5% of sulfur). MARPOL Annex VI (MARPOL 1997) contains provisions allowing special "SO_x Emission Control Areas" to be established with more stringent control on sulfur emissions. In these areas, the sulfur content of fuel oil used on board ships must not exceed 1.5%. Use of low sulfur fuels can achieve 75-96% reduction in SO_x emissions. The Port of Long Beach evaluated the effectiveness of using low sulfur fuels and positively identified marine gas oil (MGO) as a viable alternative fuel for fuelling ships during hotelling (Environ 2004). Therefore, the use of low sulfur fuels should be incorporated as a mitigation measure in the EIS/EIR.

40. We suggest the following additional mitigation measures as a means of reducing NO_x and SO_x emissions:

    - Require that Selective Catalytic Reduction (SCR) technology be used on the exhaust of all project-dedicated LNG ships with steam turbine engines. (This measure will provide reduction of NOx from LNG ships by 85-95%, reduction of NOx from the project overall by up to 70%.)

    - Require that SES ensure that all project-dedicated LNG ships use low sulfur marine gas oil or equivalent low sulfur fuel while hotelling or moving within the CEQA boundary (27 nautical miles from shore. (This measure will provide reduction of SO_x from LNG ships by up to 90%, and PM up to 80%).

41. Table 4.9.7-2. The reference to sensitive receptor numbers in the Table notes is not clear (e.g., Receptor No. 1751, No. 515, No. 443, No. 514). The EIS/EIR should be revised to include the list of receptors and all supporting analyses.

42. Page 4-117, 2nd paragraph after Table. The reasoning behind why SES "also conducted a dispersion modeling analysis of NO_x, CO, PM_{10}, $PM_{2.5}$, and SO_2 emissions from the project as a whole" is not explained, although it is probably related to the applicability of Regulation XX (RECLAIM) to the project. Also, please explain why Table 4.9.5-4 does not include the criteria from AQMD Rule 2005 (Regulation XX), specifically thresholds of 20 $\mu g/m^3$ for 1-hr NO_x concentration and 1 $\mu g/m^3$ for Annual Mean NO_x concentration (Appendix A in Rule 2005). The applicability of Rule 2005 is not adequately explained in the air quality section, although this Rule seems to apply in that SES would be required to offset the hotelling emissions and non-propulsion emissions from ships - see section b) (C) (i) and (ii).

Commercial and Recreational Fishing

43. The Draft EIS/EIR states on Pages 4-89 and 4-92 that since "high density" commercial fishing does not occur within the approaches to the POLB or within the Port limits there will be no impacts on the commercial fishing industry. How do you define "high density" commercial fishing? Does *any* commercial or recreational fishing occur within the approaches to the POLB or within the Port boundaries? If so, please identify the types of fishing that occur in the project area (including CDFG fish blocks) and analyze how that the fishing activity may be affected (e.g., lost fishing opportunities) by LNG tanker traffic, etc. Please describe how commercial and recreational fishermen and recreational boaters will be notified in advance of LNG vessel traffic.

Traffic

44. The Draft EIS/EIR analyzes weekday traffic impacts. In a revised EIS/EIR, please address if the proposed project will affect weekend traffic.

Multicompany Use of Tanker Terminals

45. Coastal Act Section 30261 states, "Multicompany use of existing and new tanker facilities shall be encouraged to the maximum extent feasible and legally permissible, except where to do so would result in increased tanker operations and associated onshore development incompatible with the land use and environmental goals for the area." Please describe any FERC or other legal restrictions, if any, pertaining to "open access" or "managed access" of the proposed LNG terminal.

Project Alternatives

46. Overall, the analysis of alternatives is fundamentally flawed given the lack of a thorough analysis of several issue areas, especially in the area of public safety. Since the Draft EIS/EIR only identifies potentially significant impacts in the area of Air Quality, the Draft

EIS/EIR alternatives analysis does not provide a balanced analysis of alternatives that would benefit public safety.

As noted in the comments on the Safety and Reliability section, failure of the Draft EIS/EIR to fully evaluate credible events has a profound impact on the evaluation of alternatives. In addition, the Draft EIS/EIR notes that the proposed project does not even meet the FERC exclusion zone requirements, but dismisses this potential impact with a mitigation measure that may not be attainable and defers the identification to the Final EIS/EIR, at which time the public would not have an opportunity to comment. Had the EIS/EIR adequately evaluated potentially significant impacts to public safety, the conclusions of the alternatives analysis could be different.

47. The Draft EIS/EIR incorrectly interprets the CEQA requirements for project objectives and the analysis of alternatives. The CEQA states,

    "The alternatives shall be limited to ones that would avoid or substantially lessen any of the significant effect of the project. Of those alternatives, the EIR need examine in detail only the ones that the lead agency determines could feasibly attain most of the basic objectives of the project." (Section 15126.6(f))

    The key assumption is that an alternative meets the basic objectives of the project. The CEQA Guidelines further clarify that an alternative must be considered even if it would impede the attainment of project alternatives:

    "…the discussion of alternatives shall focus on alternatives to the project or its location which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly." (Section 15126.6(b))

    The Draft EIS/EIR correctly identifies the most basic objective of the project on Page 3-2, where it states:

    "…to provide a new supply of natural gas and LNG to southern California."

48. The Draft EIS/EIR incorrectly characterizes potential impacts to air quality that could occur under the No Action/No Project Alternative. Specifically Table 3.1-1 identifies potential air pollutant emissions from industrial boilers for natural gas, fuel oil, and coal, even though there are very few industrial boilers in California that could use any fuel other than natural gas. The information in this table further ignores specific fuel oil and natural gas specifications that are in place in California, especially as they relate to fuel sulfur content, as well as California-specific emission control technologies that would be required. This section of the EIS/EIR should be revised to accurately identify potential impacts to alternative fuels.

49. Draft EIS/EIR Section 3.2.1 states that SoCalGas is capable of receiving up to 1 billion standard cubic foot per day (Bscfd) of natural gas at its Salt Works Station in Long Beach. The EIS/EIR should also note that the SoCalGas transmission system can accept up to 3.875 Bscfd of interstate and local California supplies.

50. Draft EIS/EIR Section 3.2.1 states that a pipeline alternative would not meet the project goal of natural gas storage. This analysis and statement ignores that SoCalGas operates four storage fields that interconnect with its transmission system. These storage fields – Aliso Canyon, Honor Rancho, La Goleta, and Playa del Rey – are located near the primary load centers of the SoCalGas system. Together, they have a combined inventory capacity of 118.1 billion cubic feet (BCF), a combined firm injection capacity of 845 MMcfd, and a combined firm withdrawal capacity of 3,125 MMcfd. The injection capacity gas also can be expanded to meet local storage needs.

    SoCalGas designs its backbone transmission system to maintain a 15 % – 20 % annual average slack capacity relative to demand forecast under an average temperature/normal hydro condition. This slack capacity allows flexibility to purchase gas supplies at the most favorable time and location, which lowers gas costs and allows SoCalGas' customers to meet unexpected and temporary spikes in demand cost effectively. Given the extensive SoCalGas storage and distribution system that is in place, existing systems already provide a far larger storage capacity than would be achieved by the proposed project. Therefore, any alternative that can supply natural gas to the SoCalGas system would meet the SES project objective of LNG/natural gas storage. The EIS/EIR should be revised to reflect existing natural gas storage facilities and the ability of alternatives to meet the SES storage objective.

51. Two statements in the Draft EIS/EIR Section 3.2.1 are inaccurate and should be revised or clarified. First, the Draft EIS/EIR notes:

    > *"However, the significant trucking distances to California (600 to 900 miles) would limit the economic feasibility of using out-of-state facilities..."*

    This statement is inconsistent with the fact that LNG is currently trucked from a liquefaction plant in Topock, Arizona. It is currently economically feasible to import out-of-state LNG and there is no justification in the EIS/EIR to conclude otherwise for future economic conditions.

    The Draft EIS/EIR also makes an unsubstantiated and speculative statement related to the ability of out-of-state to meet future deliveries as follows:

    > *"These out-of-state facilities may also have existing contractual arrangements that would preclude them from being able to make the required deliveries."*

    In the absence of substantiated information related to the ability of out-of-state LNG suppliers to meet future demand, such claims should not be made in the EIS/EIR to dismiss an important alternative to one of the stated project components and objectives. The current importation of out-of-state LNG is meeting current demand of LNG vehicle fueling without the proposed project. The EIS/EIR should be revised to provide support for these inaccurate and unsubstantiated statements, or revise the analysis to reflect the facts as they relate to the importation of out-of-state LNG.

52. One component of the proposed project that has significant safety implications is related to the importation of "hot" LNG (i.e., LNG containing heavier hydrocarbons and a higher

energy content). The importation of hot LNG has implications for facility and public safety including the need to separate ethane and natural gas liquids ("NGLs") from the imported LNG, the onsite storage of NGLs, and the offsite transportation of ethane (C_2 pipeline). There are serious implications associated with accidental releases of hot LNG including the potential for unconfined vapor cloud explosions, and if spilled on water, greater rapid phase transition explosion hazards.

The importation of LNG that does not require any further separation (i.e., the importation of pipeline quality natural gas), would serve to reduce potential hazards associated with the NGL recovery system, NGL storage and the ethane (C_2) pipeline to the LARC). Also, hot LNG separation and combustion of NGLs also contribute to the project's operational emissions. The importation of pipeline quality LNG would reduce the project's overall emissions and lessen potential air quality impacts associated with the proposed project. An LNG import terminal and regasification facility using pipeline quality natural gas would be consistent with all other proposed LNG terminals in California, would be economically feasible, and would meet all of SES' stated objectives.

Therefore, the EIS/EIR should be revised to add an alternative for a traditional LNG facility that imports only pipeline quality natural gas, thus avoiding several public safety impacts that result from the handling, separation and transportation of hot LNG and its components, and reducing overall air quality impacts associated with the separation and combustion of heavier hydrocarbons. This alternative is economically feasible, meets all of the project's stated objectives and would avoid or lessen significant environmental impacts associated with the proposed project, thus representing a preferred alternative to the proposed project.

Recirculation of the EIS/EIR

Above, the Coastal Commission staff has identified numerous deficiencies in the Draft EIS/EIR that warrant remedial action. In some issue areas, such as Reliability and Safety, the Draft EIR is so fundamentally inadequate that we believe meaningful public review and comment were precluded. Numerous significant impacts are overlooked and at least one viable alternative is not evaluated that would meet all of the project's stated objectives and avoid or substantially lessen one or more significant impacts.

CEQA Guidelines Section 15088.5(a) states:

> *"A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. As used in this section, the term "information" can include changes in the project or environmental setting as well as additional data or other information."*

Significant new information requiring recirculation includes, for example, a disclosure showing that:

> *(1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.*

(2) A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance.
(3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the environmental impacts of the project, but the project's proponents decline to adopt it.
(4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded. (Mountain Lion Coalition v. Fish and Game Com. (1989) 214 Cal.App.3d 1043)

We believe all four conditions apply in this case and that a recirculation of the EIS/EIR is warranted.

Draft Port Master Plan Amendment

The environmental impact information and revised safety analysis we request above are needed for the Coastal Commission to evaluate fully consistency of the Port's proposed Port Master Plan ("PMP") Amendment with the Chapter 3 and 8 policies of the Coastal Act. In addition to the above inadequacies, the PMP Amendment needs to address the following:

1. The analysis of oil spill prevention and response required by Coastal Act Section 30232 should include an identification of: (a) the project's reasonable worst-case oil spill scenario (including an analysis of how the worst-case spill event was chosen); (b) oil spill prevention measures provided by the applicant or required by the Port; and (c) oil spill response equipment and procedures adequate to respond to the identified worst-case spill event.

2. In numerous places in the Draft PMP Amendment, the Port mistakenly states that the project does not require fill in coastal waters. Section 30108.2 of the Coastal Act defines "fill" as "earth or any other substance or material, including pilings placed for the purpose of erecting structures thereon, placed in a submerged area." Therefore, installation of new pilings, construction of an underwater rock buttress, and placement of any other substance or structure on the seafloor constitutes "fill" under the Coastal Act. Accordingly, please include, at a minimum, (a) an alternatives analysis that considers whether there are feasible, less environmentally damaging alternatives to the proposed fill, and (b) specific identification of mitigation measures either provided by SES or required by the Port or other agencies that would minimize any adverse environmental effects of fill. Please also address the requirements of Coastal Act Section 30706(a), (c), and (d).

3. With respect to dredging, the PMP Amendment should also include: (a) an analysis of whether there are feasible, less environmentally damaging alternatives to dredging, and (b) specific identification of mitigation measures provided by SES or required by the Port or other agencies that would minimize any adverse environmental effects of dredging.

4. The dredged material is to be used to create two boat slips. Has the Port already obtained an amendment to the PMP to allow for this upland fill? If not, the Port should to amend the PMP to allow for this disposal option.

5. The PMP Amendment should include an analysis of the project's consistency with the PMP's Hazards Design and Operational criteria.

6. Is the density of greater than 10 personnel/acre referenced in Figure 2 of the Risk Management Plan's Daytime-Weekday Personnel Density Map correct? Since this figure was based on a former land use, we question if the density figure might be outdated. If it is incorrect, the PMP Amendment should include a modification to the map and an analysis of the need to change the density.

7. Objective (a) of the PMP is to "separate hazardous cargo from non-compatible vulnerable resources." Please address how allowing this project at this location is consistent with this PMP objective.

Please contact me at (415) 904-5205 or at adettmer@coastal.ca.gov if you have any questions.

Sincerely,

Alison Dett

ALISON J. DETTMER
Manager
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SES Long Beach LNG Import Project

Quantitative Risk Analysis

A Critical Review of the SES Long Beach LNG Import Project EIS/R Reliability and Safety Analysis

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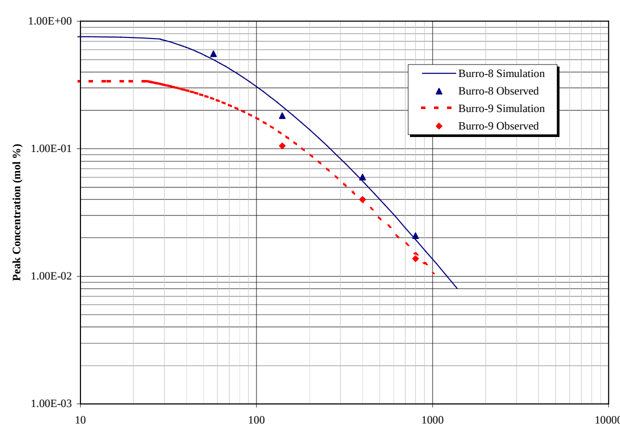

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December 2005

Attachment A
California Coastal Commission
December 8, 2005 Comments SES Draft EIR/EIS
Page 1 of 51

Table of Contents

Table/Figure		**Page**

1.0 Introduction

This analysis was undertaken in support of the California Coastal Commission's review of the proposed Sound Energy Solutions (SES) Long Beach Liquefied Natural Gas (LNG) Import Project. Our review of the Sound Energy Solutions (SES) Long Beach LNG Import Project EIS/R Reliability and Safety analysis is presented in this report. The review involved an evaluation of the adequacy of the EIS/R in terms of content and technical approach, and where necessary to evaluate potential impacts additional analyses were prepared. Out risk analysis is presented in the following sections:

1. Introduction (this section)
2. Definitions of Acceptable Risk
3. Public and Sensitive Receptors
4. Event Failure Frequencies
5. Consequence Analysis
6. Quantitative Risk Analysis
7. References

Attachments
1. Fault Tree Analysis
2. NFPA 59A and CFR 193 Checklist

Our specific comments on the Reliability and Safety section of the EIS/R, as well as other issue areas and topics have been submitted under separate cover.

Overall, the analysis of public risk was inadequate in the EIS/R. The approach in the reliability and safety analysis was essentially qualitative with no quantitative significance criteria or comparison of potential impacts to any measurable level of risk.

The EIS/R reliability and safety analysis also intentionally excluded any analysis of large, credible accidents that would have the potential to adversely affect the public, even though the Port's consultant (Quest Consultants) provided both accident frequency and consequence modeling results that would clearly support a finding of significant risk. Potential consequences associated with many project components, such as pipelines, natural gas liquids and LNG trucking, were also omitted from the EIS/R analysis, thus not providing full public disclosure.

Given the failure of the EIS/R to quantitatively evaluate public risk and to consider accident scenarios that would have the potential to adversely affect the surrounding population; a risk analysis was conducted to provide a quantitative estimate of the project's risk. The analysis presented here was prepared to quantitatively evaluate the risk associated with the proposed project. This analysis was conducted using as much of the EIS/R information as possible, especially in the area of event probability and consequences. The bulk of the information that represents the foundation of the quantitative risk analysis comes directly from the EIS/R, specifically Appendix F.

2.0 Acceptable Risk Criteria

Although FERC does not analyze high consequence, low probability events (EIS/R pg 4-128), risk criteria established by Santa Barbara County (and previously accepted by several California regulatory agencies), Europe, Hong Kong and Canada indicate that these events can contribute to public risk. It is important to examine the hazards associated with all aspects of the LNG import project to determine overall societal risk. Risk is defined as a combination of the frequency of an event, the probability that the released material will impact populations, and the consequences of these events on the populations. The end result would be a set of risk profiles, known as FN curves (plots of frequency versus fatalities).

The EIS/R begs the question: what is acceptable? The criteria established in the FERC document are vague in the sense that it only specifies that a risk is significant if it presents a "*substantial increase in the potential for incidents that would cause serious injury or death to members of the public*". The definition of substantial is not addressed.

Numerous risk criteria have been established by government agencies and private industry. Below is a discussion of various risk criteria in the US, Canada, Hong Kong and European countries. An FN curve for fatalities showing the various risk criteria is shown in Figure 1.

2.1 United States

The federal government has no specific risk based criteria. The Federal Clean Air Act and RMP define worst case zones which are used for emergency response planning, but nothing related to land use decisions.

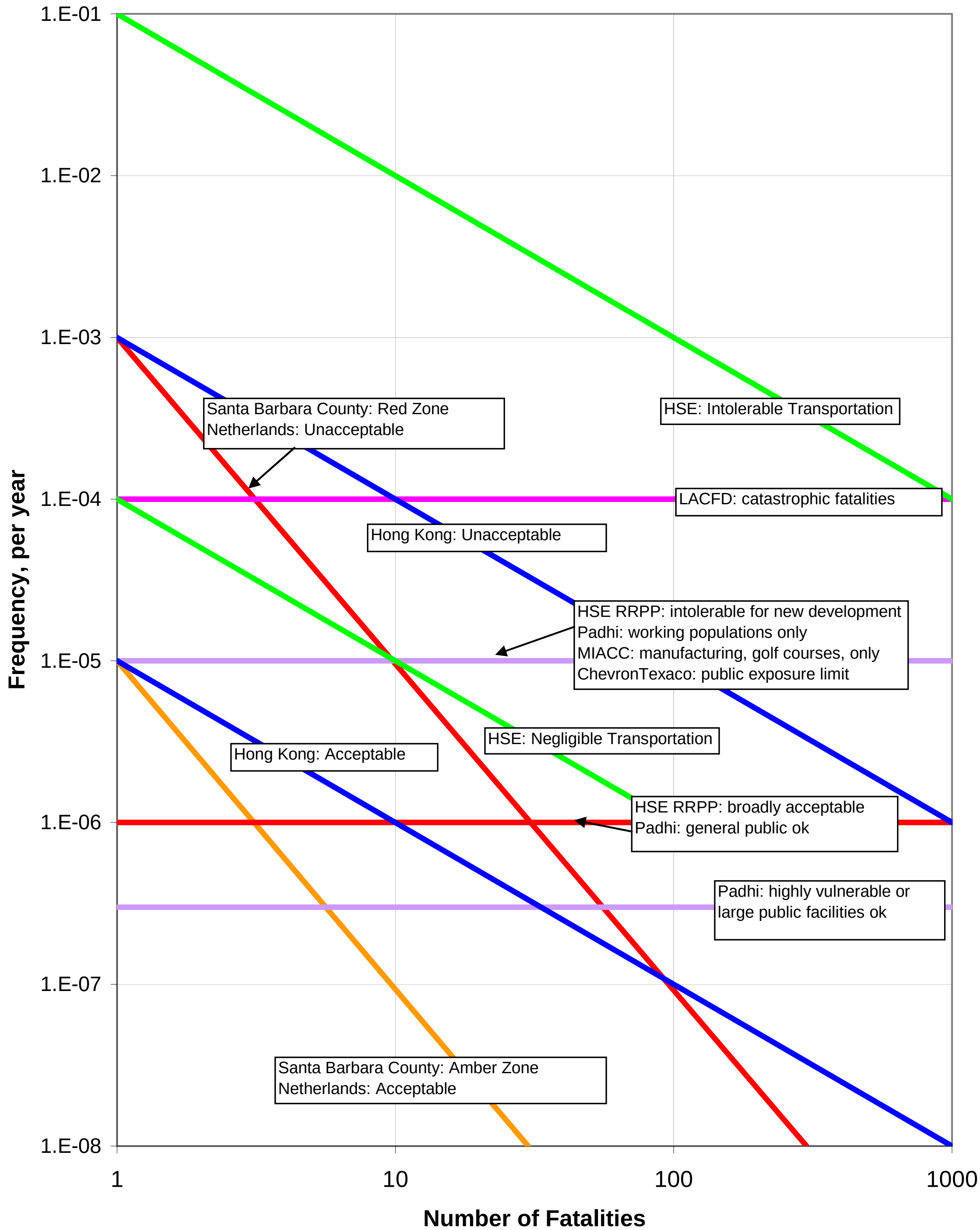
2.1.1 County of Los Angeles Fire Department, LACFD, 1991

LACFD defines criteria for significant risks associated with their RMPP program (LACFD, 1991), which has been superseded by the statewide CalARP program. It should be noted that the LACFD criteria do not meet the specific requirements of the California Environmental Quality Act (CEQA) for the evaluation of worst-case events.

2.1.2 County of Santa Barbara, Public Safety Thresholds

The County of Santa Barbara established public safety thresholds in 2000 addressing the types of development that would require detailed risk analysis and the thresholds which would define significance under the CEQA. The Santa Barbara thresholds are based on FN curves and define acceptable frequency as being a function of the number of persons affected (a sloped line on an FN curve). There are two lines based on land use type (red and amber). The Santa Barbara risk criteria are based on risk criteria adopted by the Netherlands and widely used throughout Europe. The criteria and zones are shown below.

Figure 1 Worldwide Risk Criteria



2.1.3 County of Santa Barbara – Safety Element Supplement

Under the County of Santa Barbara Safety Element, the following definitions are used to categorize public risk:

- Red Zone: unacceptable for all land uses.
- Amber zone: acceptable for urban development.
- Amber zone: unacceptable for highly sensitive land uses and high density residential.
- Green Zone: acceptable for all land uses.

2.2 Europe

Europe, particularly the UK and the Netherlands, have been developing risk criteria for a period of some 30 years. These are detailed in the report "Societal Risks", (Ball, 1998), and are summarized below.

In 1996, the European Union Council Directive on the control of major-accident hazards – the so-called Seveso II Directive – was adopted. Member States had up to two years to bring into force laws, regulations and administrative provisions to comply with the Directive. From 1999, the obligations of the Directive have become mandatory for industry as well as the public authorities of the Member States responsible for the implementation and enforcement of the Directive.

2.3 England's Health and Safety Executive, Reducing Risk, Protecting People

The UK has published a number of documents related to risk criteria and the levels considered acceptable have evolved since the 1970s. The HSE published "Tolerability of Risk Criteria" addresses some levels shown on Figure 1. Transportation risk is also addressed in by the HSE and those levels are also tabulated on Figure 1.

2.4 PADHI Levels (Planning Advice for Developments near Hazardous Installations)

The UK HSE also has published the PADHI levels report which details acceptable criteria. These levels are shown below and are also shown on Figure 1.

Sensitivity Levels

Sensitivity level	Description and Examples	Criteria
Level 1	Based on normal working population – parking areas, warehouses, non-retail, less than 100 occupants, minor transportation links	Ok in all zones $<1 \times 10^{-5}$
Level 2	Based on the general public - at home and involved in normal activities – residential units less than 40 per hectare, hotels, motels up to 100 beds, major transport links, retail less than 5000 m2, gatherings of less than 100 people	Ok in middle and outer zones only $<1 \times 10^{-6}$
Level 3	Based on vulnerable members of the public (children, those with mobility difficulties or those unable to recognize physical danger) – more than 100 beds, more than 40 units per hectare, more than 100 people outdoors, hospitals 24 hr care < 0.25 hectare, prisons	Ok in outer zone only $<3 \times 10^{-7}$
Level 4	Large examples of Level 3 and large outdoor examples of Level 2 – theme parks, stadiums, open air areas with more than 1000 people, hospitals >0.25 hectare, daycare larger than 1.4 hectare,	Not ok in any zone

Consultation Zones

Frequency	Zone	Description
$<1 \times 10^{-5}$	Inner zone	Receiving a “dangerous dose” or worse.
$<1 \times 10^{-6}$	Middle zone	Receiving a “dangerous dose” or worse.
$<3 \times 10^{-7}$	Outer Zone	Receiving a “dangerous dose” or worse. This criterion is appropriate for highly vulnerable or very large public facilities.

2.5 France

The criteria in France are related only to the “worst credible” consequences of accidents that are used to define the safety distances around hazardous establishments.

Zone distances are based on the distance which produces a 1% fatality rate (for the inner zone) and the distance to which irreversible health effects occur (for the outer zone). Inner zone areas do not allow additional development which could increase populations. The zone in between allows limited, low density development. All development is allowed beyond the outer zone.

Type of risks and facilities	Type of accident scenario
Risks linked to liquefied combustible gas facilities (fixed, semi-mobile or mobile)	**Scenario A :** BLEVE (Boiling Liquid Expanding Vapor Explosion) **Scenario B :** VCE (Vapour Cloud Explosion)
Risks linked to vessels containing liquefied or non-liquefied toxic gases where the containment is not designed to resist external damage or internal reactions of products	**Scenario C :** Total instantaneous loss of containment
Risks linked to vessels containing toxic gases where the containment is designed to resist external damage or internal reactions of products	**Scenario D :** Instantaneous rupture of the largest pipeline leading to the highest mass flow
Risks linked to large vessels containing flammable liquids	**Scenario E :** Fire in the largest tank Explosion of the gas phase for fixed roof tanks Fireball and projection of burning product due to boil-over
Risks linked to use or storage of explosives	**Scenario F :** Explosion of the largest mass of explosive present or explosion due to a reaction

2.6 Netherlands Policy

The Netherlands adopted specific risk criteria in the 1980s and updated in 1996. These levels are shown in Figure 1 and are based on three regions: an unacceptable region, a region where reductions are desired and an acceptable region. The Santa Barbara County policy is based on the Netherlands policy.

2.7 Canada

The Major Industrial Accidents Council of Canada (MIACC) was dissolved in the fall of 1999. Their risk criteria were based on frequency and land use types shown below.

Frequency level	Type of Zone	Allowed Land Uses
$>1 \times 10^{-4}$	Buffer zone	None
$>1 \times 10^{-5}$	Municipality transition zone	Manufacturing, open spaces, golf courses
$>1 \times 10^{-6}$	Municipality transition zone	Commercial, low density residential
$<1 \times 10^{-6}$		All other uses

2.8 Hong Kong

In response to the expansion and development of oil/LPG terminals in Tsing Yi Island, and the residential development nearby, the HK government developed specific risk criteria in 1988 and updated in 1993. These are shown on Figure 1.

2.9 Private Industry

Some private industries have developed approaches to risk analysis utilizing risk criteria. A number of LNG projects have been analyzed in various documents. These are listed below in Table 1 below. Most do not list specific risk criteria.

Table 1 Impacts Associated with other North American LNG Project Analysis

Project	Impact Scenario	Impact Distance	Frequency of Occurrence	Significance Criteria	Notes
Baja	LNG release	ND	Not significant	1 x10^{-3} fatality 1 x10^{-2} injuries	
BHP	Complete loss of all tank contents	1.6 miles	ND		
BHP	Vessel ramming, loss of one tank	1.3 miles 1.1 miles	6 x10^{-7} 1.1 x10^{-6}	Class I	
Cove Point	Design spill into containment area	1,752 feet to thermal 1600 btu 900’ for vapor		Contained with facility	24” line failure, 4.5 m/s wind, F stab,
Cove Point	Spill into water	2,250’ for an offshore spill		Contained with facility	Flange failure on a 16” line,
Freeport	LNG design spill	914’ to thermal 2,111 to vapor	ND	ND	28 mph, 32F for thermal, 4.5 m/s wind, F stab for vapor
Pelican	1-5m hole in ship tank	2.3-2.5 miles	ND	ND Large distance to populations (>3 miles)	1.5 m/s, F stab
Weavers Cove	Tank design spill	995’ thermal	ND	ND	15-26 mph, 15F
Weavers Cove	Tank design spill	Zero	ND	All vapor contained within dike area	4.5 m/s, F stab

3.0 Public and Sensitive Receptors

One of the critical issues associated with risk analysis is the identification of receptors, or locations where persons could be located and receive impacts from a spill or release of material. Receptors would include members of the public located in either public places or at places of employment not directly associated with the proposed project. The receptors associated with this project were identified and are listed in Table 2 and shown in Figure 2.

Table 2 Public and Sensitive Receptors

From	To Receptor	Distance, ft
Breakwater	Pier J	4,000
	Queen Mary and Carnival Cruise Line Terminal	10,200
	Fire Department Central Offices	12,300
	Long Beach City West	13,500
	City of Long Beach East	15,750
Equipment area	Naval Area parking lot and building	220
	Lumber shed area	580
	Lumber area offices	890
	Container transfer area	900
	Recycling area	1,200
	Pier T container storage	1,400
	Pier D Dock Area	2,300
	Pier E2 Dock Area	3,500
Tanks and Terminal	Lumber shed area	200
	Lumber area offices	800
	Recycling area	1,700
	Pier D loading area	2,200
	Pier E2 Container Area	2,500
	Pier T Dock area	2,780
	Pier E1 Dock area	2,780
	Pier E2 dock areas	2,900
	Nimitz Road	3,100
	Pier E1 Container Area	3,400
	Pier G dock areas	5,500
	Boat ramp and Restaurant area	6,000
	Fire Department Central Offices	6,400
	Coast Long Beach hotel	6,900
	Long Beach Hilton	7,900
	City of Long Beach West	8,860
	Harbor restaurants	9,200
	Queen Mary and Carnival Cruise Line Terminal	9,400

Figure 2 POLB LNG Project Area Receptors

The Port of Long Beach documents indicates that up to 30,000 workers are employed at the POLB. This population is primarily associated with the offloading and movement of containerized cargo. Many of these workers could be exposed to spills of LNG and should be included in the risk analysis. The EIR does not address populations at the POLB facilities.

The GAO report to the Senate Subcommittee on Commerce during the Hazardous Liquid Pipeline Safety Act (HLPSA) of 1979, said "*Remote siting for [LNG] storage facilities should be required. The bill should prohibit the siting of any new, large hazardous commodity storage facility or the expansion, including additions to storage capacity or the expanded use, of an existing, large storage facility in or near densely populated areas*" and "*We believe remote siting is the primary factor in safety. Because of the inevitable uncertainties inherent in large-scale use of new technologies and the vulnerability of the facilities to natural phenomena and sabotage, the public can be best protected by placing these facilities away from densely populated areas.*"

Table 3.3.3-2 in the EIR report only addresses housing units within 1 mile. But consequence zones are larger than this. All receptors within the hazard zones identified in Appendix F should be identified, included business and occupied areas that could be affected by a spill.

Thermal radiation exclusion zone requirements from 49 CFR 193.2057 are summarized in Table 3 below. Additional requirements from NFPA 59A are also included in this table.

For flammable vapor exclusion zones, each LNG container and LNG transfer system must have a dispersion exclusion zone with a boundary described by the minimum dispersion distance computed in accordance with 49 CFR 193.2059. The following are prohibited in a dispersion exclusion zone unless it is an LNG facility of the operator:

(1) Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreation areas, or other places of public assembly.

(2) Buildings that are:
- (i) Used for residences;
- (ii) Occupied by 20 or more persons during normal use;
- (iii) Contain explosive, flammable, or toxic materials in hazardous quantities;
- (iv) Have exceptional value or contain objects of exceptional value based on historic uniqueness described in Federal, State, or local registers; or
- (v) Could result in additional hazard if exposed to a vapor-gas cloud.

The flammable vapor exclusion zones is defined as one half of the lower flammability limit (1/2 LFL).

The EIS/R report addresses only LFL distances, not ½ LFL distances, and does not address areas that could be occupied within these zones, including industrial areas within the POLB, that could have buildings and/or areas occupied by in excess of 20 persons.

Table 3 Thermal Radiation Exclusion Zone Requirements

Exclusion Zone Requirement - Offsite Target	**Btu/ft.^{2}-hour**	**W/m^2-s**
1. Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreation areas or other places of public assembly.	1,600	5,047
2. Buildings that are used for residences, or occupied by 20 or more persons during normal use.	1,600	5,047
3. Buildings made of cellulosic materials or are not fire resistant or do not provide durable shielding from thermal radiation that: (i) Have exceptional value, or contain objects of exceptional value based on historic uniqueness described in Federal, State, or local registers; (ii) Contain explosive, flammable, or toxic materials in hazardous quantities; or. (iii) Could result in additional hazard if exposed to high levels of thermal radiation	4,000	12,600
4. Structures that are fire resistant and provide durable shielding from thermal radiation that have the characteristics described in paragraphs (3)(i) through (3)(iii) above.	6,700	21,100
5. Public streets, highways, and mainlines of railroads	6,700	21,100
6. Other offsite structures, or if closer, the property line of the facility.	10,000	31,500
7. Structures outside the owner's property line in existence at the time of plant siting and used for purposes classified as Assembly, Educational, Health Care, Detention and Correction, or Residential.	3,000	9,464

4.0 Event Failure Frequencies

Event failure frequencies are summarized in the Quest analysis (EIS/R Appendix F). A separate, Fault Tree Analysis (FTA) was conducted as part of this study and the results are similar to the Quest frequencies. Fault Trees are located in Attachment 1 of this report. Below is a listing of estimated release frequencies both for this study and as developed by Quest. Differences in release frequencies are noted in the table.

Table 4 Release Frequencies

Scenario	Fault Tree Frequency	Quest Frequency	Notes
Ship: Rupture tanks or piping (with failure of ESD system) with spill onto water: at berth	4.7 x10^{-6}/yr	na	This scenario addresses collisions or allisons while the ship is at berth
Ship: collision/grounding with spill at breakwater	7.7 x10^{-6}/yr	1.0 x10^{-3} /yr	Quest estimate for grounding/collision. Not clear if Quest estimated probability of subsequent spill or only accident.
Rupture of storage tank and containment due to earthquake	6.6 x10^{-5}/yr	6.6 x10^{-5} /yr	As defined by Quest on page 4.9 as one in 15,000 years.
Rupture of storage tank due to other causes	5.8 x10^{-7}/yr	Na	Fault trees addresses releases due to spontaneous tank failures, subsidence, inner tank failures due to overpressure and rollover. Includes failure of outer tank but not barrier.
Equipment release	3.2 x10^{-5}/yr	2.3 x10^{-4} /yr	Equipment numbers and piping lengths were estimated for the fault trees. LNG equipment only. Fault trees assumed ESD failure.
Failure of ESD system	6.5 x10^{-3} /demand	Na	This addresses the failure of the ESD system due to faulty hydrocarbon sensors and malfunctioning safety valves and operator errors..

Although the assumption is made that there are no boilers (EIS/R pg 4-129), the hazard is still there with a small to medium sized LNG release and subsequent intake of LNG vapors into the vaporizers/hot water heaters, which can cause an explosion. This would be a scenario similar to the Algerian incident which caused substantial equipment damage due to a relatively small/medium sized leak. This scenario was included in the fault tree analysis and should be included in the EIS/R analysis.

In addition, for tank failures, the worldwide experience of LNG tanks at marine terminals is only on the order of 5,000 tank-years (World LNG Sourcebook). There is an additional approximately 3,000 tank years at storage facilities within the US (associated with gas pipeline utilities (EIA, 2003). As the estimated failure rate (catastrophic significant release) of standard, single walled, crude oil atmospheric tank is only once every 10,000 tank-years (Rijnmond), there is not enough operational history to establish that LNG tanks have a lower failure rate than normal, atmospheric tanks. (EIS/R Pg 4-148)

An additional scenario is included in the fault tree analysis addressing tank failures due to a range of other, metallurgical or operational causes. These causes include spontaneous failure of the inner tank wall, failure of the inner tank due to rollover or overpressure. Each of these scenarios is accompanied by an associated failure of the secondary tank. Due to the secondary tank, the frequency of these scenarios is low (10^{-7}/year).

The Quest analysis appropriately examines a number of low frequency events, such as earthquake induced tank failures. However, these events are not included in the main EIS/R document (EIS/R Tables' 4.11.10-2 and 3). Although the frequency is low, it is still a greater frequency than many risk criteria established by Santa Barbara County, Canada, Hong Kong and Europe as well as industry. The impacts of this scenario should be quantified and the numbers of persons affected by this event should be addressed to determine if the scenario presents a significant impact. (EIS/R Pg 4-184)

EIS/R Section 3.1.1 and Table 3-1 (Appendix F) seem to imply that failures could only occur in piping. However, the process would include vessels, valves, and flanges and, particularly, pumps (which have a high failure rate). This equipment has a related failure rate that would play into the event trees shown in EIS/R Figure 3-1. It is unclear if all of these equipment failures are included in EIS/R Table 3-1. If not, all equipment in these areas should be included. The fault trees prepared in this study include an estimate of vessels, piping lengths, pumps and valve counts in order to estimate the risks of spills from the equipment.

4.1 Earthquakes

Earthquake events are defined by Quest for an SSE at 2.0 $x10^{-4}$/yr and a complete tank failure at 6.7 $x10^{-5}$ (or once every 15,000 years). Although the report accurately describes the failure frequencies of equipment and estimates the hazard zones, it fails to bring together these, along with population densities, ignition frequencies and metrological data into a complete estimate of the facility risk. This risk level should then be compared to the acceptable risk criteria as established by local, regional, national and international standards.

As per EIS/R page 4-144, only the tanks are designed to withstand a SSE. Final design indicates that all structures besides the tanks are designed to withstand only an OBE. Therefore, it is assumed that the frequency of a pipe failure that could lead to a substantial release is the frequency of the SSE event. Therefore the earthquake event would double the equipment failure frequencies.

The USGS has conducted a theoretical analysis of an earthquake "scenario" of a 6.9m earthquake along the Newport-Inglewood fault. This "scenario" should be included in the EIS/R analysis. This scenario indicates a ground shaking of about 37% near the POLB. The USGS

Palos Verde scenario, also done by the USGS for a magnitude 7.1 earthquake along the PV fault, indicates acceleration values of close to 43% at the POLB.

The earthquake described which would cause a catastrophic release of LNG and “level Long Beach” would produce a peak acceleration of 1.14 g, as per the EIS/R description. According to the USGS, earthquakes producing ground accelerations in excess of 1.14g have occurred twice in the last 35 years in Southern California. Earthquakes that have produced this level of ground shaking include the Imperial earthquake in 1979 (1.73g), and the San Fernando earthquake in 1971 (1.25 g), both of which caused substantial damage but neither of which “leveled” the areas in which they occurred.

The security barrier, as mentioned on EIS/R pg 1-36, is not capable of withstanding a “tank failure” earthquake. Failure of the barrier wall in addition to the tanks significantly exacerbates the size of the vapor cloud as the LNG is allowed to reach the water. A single earthquake producing a tank failure is a single point failure to cause a catastrophic LNG release. The frequency of this event is listed at 6.7×10^{-5}/year, which is of high enough frequency to require planning and mitigation based on Santa Barbara County, Canada and European risk criteria.

4.2 Shipping Incidents

Although the history of LNG shipping shows that there has not been a significant release of cargo, the historical number of trips does not provide enough data to indicate whether the safety LNG transportation history exceeds that of standard oil and oil products transportation. For example, it is estimated that there have historically been between 30-35,000 LNG cargo trips. The major spill frequency for crude oil transportation is estimated to be once every 30-45,000 trips (MMS). Therefore, there have not been enough LNG cargo trips to establish an accident rate for LNG cargos (EIS/R pg 4-148). As there have been a number of “close calls” during this period (Lees, BHP, CH-IV) including:

- Spills of LNG on decks causing some deck damage (7 times),
- Tank over filling with releases (3 times),
- Stranded and groundings (8 times),
- Releases to inner barriers (4 times) and
- Ship collisions (12 times),

It is only a matter of time before there is a serious incident.

The USCG casualty database for the years 1997-2001 indicates that about 9.9% of groundings of tankers produce a pollution event. In general, about 19% of all tanker casualties produce pollution events. As the worldwide LNG vessel fleet has experienced only 8 groundings, it has not reached the point where we can say if the fleet has a lower level of pollution event conditional probability than the general worldwide tanker fleet. This does not take in to account the added protection of doubled hulled (although a percentage of the USCG casualty incidents may have had double hulls. The USCG data does not indicate this). Again, there is not enough historical data to make conclusion about the better safety record of LNG vessels. It is expected that grounding events would happen at the same frequency for LNG ships as for the worldwide general vessel fleet as the navigational strategies are the same.

While it is certainly expected that groundings with double hulled vessels would produce a lower probability of cargo loss, it is overly optimistic to assume that the probability of cargo losses from grounding is zero with double hulled vessels. The DOT recommends a 5% probability of loss given a grounding, verses 25% with a single hull. EIS/R Pg 4-160

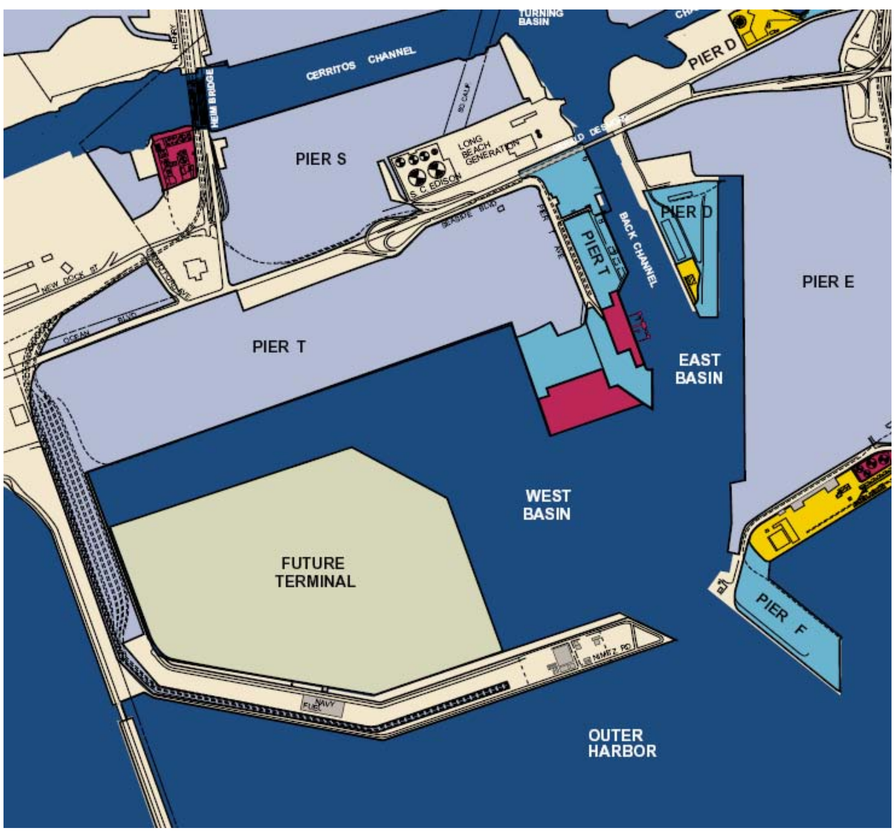
USCG data for the POLB and the POLA indicate that, between the years 1992-1998, there were 379 ship casualties within the ports, 25 of which were either allisions, collisions or groundings. This equated to a frequency of 3.3×10^{-4} ACG (allision/collision/grounding) per transit for deep draft vessels (>20'). Data compiled by the POLA and the POLB in the SES application indicate that, between the years, 2000-2002, there were 3 incidents where large vessels hit piers or docks, for a rate of 8.5×10^{-5} allisions/collisions per transit. For the LNG vessel rate of 124 per year, this would equate to once every 100 years. Although none of the collisions/allisions produce lasting damage or material releases, this is a high enough frequency to consider the scenario of allisons/collisions in the port area to be credible. This scenario was included in the fault tree analysis.

ACGs can and have occurred within the ports and should be included in the analysis. Speed limits within the inner port are stated as 6 knots, which some studies discussed in the EIS/R (Table 4.11.7-2) indicate is enough energy to cause catastrophic failure of the LNG vessel inner tanks (if vessel striking and groundings are comparable, which they most likely are). Also, there is the potential for vessel impacts within the breakwater and even within the middle harbor area. There is a significant container unloading area at Terminal Island directly in front of (to the west of) the proposed LNG berthing location where ships leaving or maneuvering could impact a berthed LNG vessel. Ships moving into the back channel under the Gerald Desmond Bridge could possibly impact a berthed LNG vessel with lack of steerage, etc. Also, ships berth immediately south of the proposed berthing location in the middle channel that could also impact the berthed location while departing their berths. See Figure 3 below. In addition, the POLB facilities plan indicates that an additional terminal may be build in the middle harbor which would increase traffic along a narrower corridor, thereby increasing the probability of an impact to a berthed LNG ship. See Figure 4 below. These scenarios should be included in the EIS/R analysis. Pg 4-174.

In September 2000, the Elba Island terminal was the site of a shipping accident. A 580-foot tanker filled with palm and coconut oil lost it's steering and slammed into the LNG terminal's dock, putting a 40-foot gash in the tanker and wrecking almost half of the dock. The terminal had no LNG ship present, because it was still in the process of restarting, but USCG officials agreed that the consequences could have been serious. The probability of an inner harbor release from an LNG ship should be included in the EIS/R and was include in this studies risk analysis.

Figure 3 Middle Harbor Area

Figure 4 Proposed Port of Long Beach Developments in the Project Vicinity



From POLB Facilities Master Plan

4.3 Ignition Probabilities

Although a vapor cloud would most likely ignite if it dispersed over the pier industries and the community, it could achieve significant dimensions before encountering an ignition source with sufficient energy to ignite it. The La Spezia, Italy venting of LNG vapor for a period of multiple hours did not ignite. There are examples in Lees, such as Flixborough, Mexico City and Pasadena, where vapor clouds were produced and traveled hundreds of meters through industrial plant areas before igniting.

If a release of LNG were to occur at night, when traffic levels are low and few ignition sources are active in the community, the vapor cloud could travel some distance before igniting (HSE, 2004). The areas to the east of the berth between the berth and populated areas on the north side of Queensway Bay would include pier E, F and R, Pico Ave and Queensway Bridge. There would most likely be numerous ignition sources in these areas, although none of them would be open flames, such as flares, or large, very hot surfaces, which are the two most energetic ignition sources. In addition, a release at the breakwater would have almost no ignition source between the release and the populated areas along the eastern City of Long Beach coastal areas.

The probability of ignition immediately upon release is not as high as LPG or gaseous methane, for example, due to the need to have the LNG vaporize first. Impact and friction energies are very short-lived and may not ignite at the release point as liquid is released first, which then draws energy from the environment in order to vaporize. As well, Lees and CCPS indicate that ignition at the release point for LPG and methane occurs in about 20-30% of cases; most releases encounter ignition sources away from the release point.

Conducting an analysis on the probability of ignition of a vapor cloud released at the tanks and under the influence of a westerly wind was conducted utilizing the land use types and facilities located between the facility and the City of Long Beach. This analysis was conducted using an event tree type of configuration shown below. The source of ignition probabilities is CCPS (CCPS, 1989) and the HSE (HSE, 2004).

Table 5 Ignition Probabilities Event Tree: Vapor Cloud Dispersion with Westerly Winds

Event	Individual Probability	Cumulative Probability	Reference and Notes
Initial Event	1.00		
Ignition at Source	0.25		Based on CCPS probability for a large natural gas release (0.25)
No ignition in this area	0.75		
Ignition at LNG facility	0.10		Ignition at facility based on the absence of ignition sources at the plant to the west of the tanks. Vaporization heaters located to the N of the tanks. HSE report, light industrial
No ignition in this area	0.90	0.68	
Ignition at Pier T area	0.25		Probability based on forest products area to W of facility, medium industrial .25 (HSE)
No ignition in this area	0.75	0.51	
Ignition at BP/Arco terminal	0.08		BP/Arco operating an estimated 30 days per year, 1.0 probability while operating
No ignition in this area	0.92	0.46	
Ignition at pier D, E, F, light industrial	0.47		Ignition at bulk cargo areas, estimated as multiple vehicle starts of 15 minutes per hr (at 0.2 each), smoking at 10 minutes per hr (p=1), plus misc probability associated with medium industrial 0.25 (HSE)
No ignition in this area	0.53	0.25	
Ignition along RR track and Pico Ave	0.41		Roadway ignition. CCPS indicates 0.06 per car for non-starting mode. Assume 200m of roadway affected by VC, ADT of 3000. Equates to about 1 car within VC. Train ignition estimated at 0.1. Medium industrial along RR tracks of 0.25
No ignition in this area	0.59	0.15	
Ignition along Queensway Bay	0.27		Parking area for water access, estimated assuming as 10 cars starting per hr at 30 sec each start. Medium industrial along waterfront areas (south side) of 0.25
No ignition	0.73	0.11	Probability of vapor cloud reaching north shore of Queensway Bay (City of Long Beach)

The estimated probability of a vapor cloud reaching the City of Long Beach is conservatively about 11%. As described in the HSE report "*Development of a Method for Determination of On-Site Ignition Probabilities*" (HSE, 2004), studies based on actual observed incidents indicates that the probability for a 2,000 meter distance vapor cloud to reach it's theoretical limit would be on the order of 1%. However, most of these incidents were releases in heavy industrial areas. The facility would not be located in a heavy industrial area (classified as large motors, high temperature surfaces and open flames). Risk models used by the HSE estimate the probability of reaching the maximum vapor cloud size at closer to 10% during nighttime (lower activity) and greater than 50% for urban areas (for the cloud size of 2,000 meters, or about 10^5 m^2). As the areas to the east of the facility are a combination of industrial (container unloading, BP/Arco pipeline intermittent operations) and rural areas (open space), and about 40% of the cloud area would be over water, the probability of achieving the maximum cloud dimension is conservatively estimated to be close to the 11% number above.

However, once the cloud enters the City areas, the density of automobiles and other ignition sources, estimated at 100 ignition sources every 500 meters of cloud length, would have a 99% probability of igniting the vapor cloud. This assumes an ignition probability of 0.06 per car, as per CCPS and HSE (CCPS, 1989 HSE, 2004). Therefore, the cloud is not anticipated to be able to enter the City area more than 500 meters.

The probability of a release at the breakwater reaching populated areas is assumed to be the probability of non-ignition from the initiating event shown above, or 75%. This is due to the lack of ignition sources between the breakwater and the City of Long Beach over open water.

Although the EIS/R indicates that the probability of a vapor cloud going any significant distance is negligible, the analysis conducted by Quest and presented in EIS/R Table 3-1 indicates that 60% of rupture equipment releases dissipate without finding an ignition source.

4.4 Fault Tree Analysis

The occurrence rates for human error and equipment failure used in the fault trees are based either on information reported in the literature, plant history, or on our own estimates which combine information supplied by the plant (operating procedures, personnel organization and experience, and design information) with information from other sources in the literature.

The estimated frequencies of the fault trees are given in Attachment 1. The information sources that have been used for estimating the frequencies are shown in the references section.

5.0 Consequence Analysis

The EIS/R uses a 10 minute, maximum flow rate to develop the containment sizing, as per NFPA 59A requirements. However, only a leak rate for exclusion zones is conducted. Historical failure frequencies indicate that ruptures from piping occur, and occur at a level that should be included in the risk assessment. Exclusion zones should be based on the 10 minute rupture at max flow. (EIS/R pg 4-138)

The marine transfer line design spill only assumes a spill from a 3" line. However, the marine line is a 16" line and there are 3 loading arms. Failure of the common header or failure of one of the loading arms, with subsequent failure of shutdown systems, could cause a 10 minute release from the loading system that would be substantially larger than a release from a 3" line. The maximum flow rate from the transfer system should be used for the design spill from the transfer system (a spill of 550,000 gallons, EIS/R pg 4-138 and 139). This is important as a spill in this area might be into the water, which could cause a RPT and/or more rapid vaporization of LNG than a spill onto land. In addition, the failure rate of shutdown systems is generally on the order of 10^{-2} as their function is based on the correct performance of detectors and valves, which can fail. (EIS/R pg 4-142)

It is unclear which scenarios were examined by Quest. For example, the use of water for gasification of the LNG could lead to a freezing of vaporization water due to loss of flow and subsequent expansion and failure of vaporizer equipment, RPT explosions could cause damage to LNG equipment and exacerbate a release scenario, smaller releases of LNG or methane or C_2 vapors could enter the intake of the water boilers and cause explosions, failure of the truck loading tank 3800 m^3 (23,901 bbl) or loading facility failures could cause medium sized releases of LNG.

In addition, not just design spills should be examined. Significant tank leakages, partial tank failures and total tank failures should be examined on a quantitative basis. Although NFPA does a good job requiring the design of the facility to meet tough industry standards, satisfaction of NFPA should not be viewed as a satisfying the issues associated with risk analysis and complying with the California Environmental Quality Act public disclosure requirements. Clearly, the issues addressed by NFPA, such as separation zones and hazard detection, are very important to minimizing the risks of an LNG facility. However, they do not supply a complete picture of the risk issues involved. All scenarios, including lower consequence, higher probability and high consequence, low probability events, should be examined and compiled into FN curves in order to quantify the risks.

Although Part 193 and NFPA specify met conditions to be used for LFL dispersion, CEQA does not define the conditions. The most conservative conditions should be used that regularly occur in the region. Historical met data indicates that conditions more stable than F/4.5 occur quite frequently. Meteorological data from Long Beach indicates that almost 25% of readings are between 1-2 meters/second and that calms occur almost 50% of the time. The use of 2 or 4.5 m/s wind speeds for a worst case in not appropriate. In addition, the prevailing wind is from the west, which places impacts directly towards the City of Long Beach. (EIS/R App F Pg 4-33)

The RMP assumes a worst case of 1.5 m/s wind speed. This wind speed should be used as a worst case for flammable vapor dispersion.

The impact zone of a large spill of LNG into the security barrier wall of 313 feet to ½ LFL seems very conservative. The same is true of 95,000 gallons spill causing ½ LFL impacts for only 230 feet (EIS/R pg 4-142).

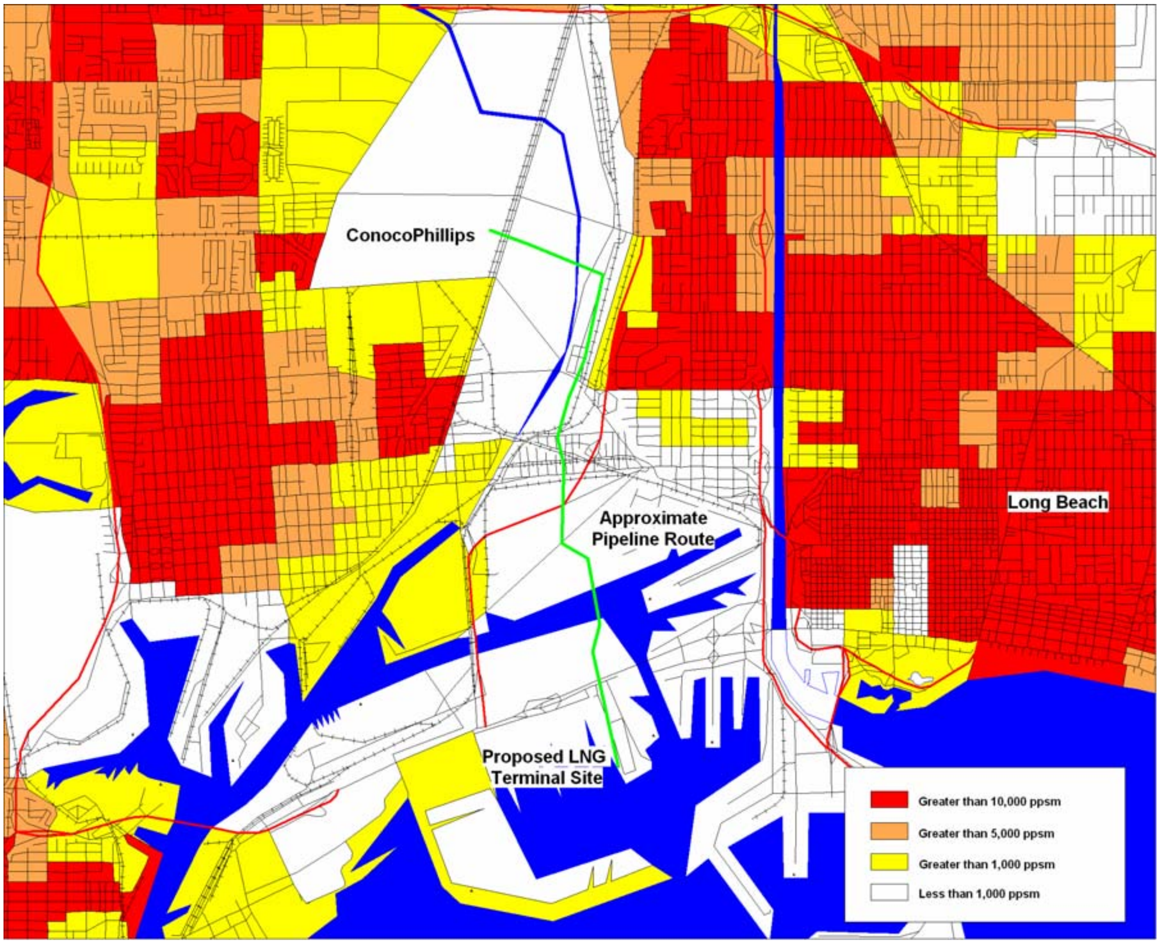
Although impact distances might be similar for similar sized spills of propane, for example, large, 165,000 m^3 ships of propane do not visit US ports. Other products, such as large bulk shipments of anhydrous ammonia, could also produce impact zones of 2-3 miles. However, bulk shipments of anhydrous ammonia into the Port of Stockton, for example, average around 15,000 m3, which is significantly smaller than the LNG cargo vessels. Impact zones (1/2 LFL) from a large gasoline spill would not be as large as 2-3 miles. (EIS/R Pg 4-162).

Pipeline impacts to public safety are a strong function of the area in which the pipeline passes. The nationwide rate listed in the document does not take into account that much of the 300,000 miles of pipelines in this country pass through unpopulated areas. A more detailed analysis should be conducted utilizing the failure rates and the population densities that the methane and C_2 pipeline will pass through. However, an examination of the proposed C_2 and gas pipeline route indicates that it is proposed to pass through primarily industrial areas with population density in the 100-200 person per sq mile range (relatively low density), and avoids the more heavily populated areas with population densities ranging in the 1,000s or above 10,000 ppsm (people per square mile), as areas to the east and west of the pipeline route are. These areas, including some schools (Cabrillo/Savannah/Reid High Schools, Hudson middle School), are within 1/4 mile of the proposed pipeline route (near Middle Road). See Figure 5 below showing population densities of the area. (EIS/R Pg 4-195)

A tsunami run-up height of 15 feet is estimate to occur every 500 years, or $5x10^{-2}$/yr. What would the effect of this type of tsunami have on the facilities if an LNG ship were in the process of unloading or even at the berth at that time? As this event is indicated as possibly producing significant ship damage, a release from the ship at berth should be examined, instead of at the breakwater and outside the harbor only. (EIS/R App F Pg 2-4 and 2-5). This analysis examines releases from the ship at the berth.

It is important to note that the RMP Comp program uses very conservative modeling estimates, which the modeling conducted in the EIS/R does not do. This is therefore not a fair comparison to chlorine exposures. The RMP Comp program estimates that the worst case impact zone for 42 million gallons of LNG, a single tank, would be in excess of 4 miles. (EIS/R Pg 3-10).

Figure 5 Pipeline Route and Population Densities



As is clear from the amount of energy expended to gasify the LNG, a release of LNG would require large amounts of energy to move into vapor form. The EIS/R indicates that there is enough energy in the air to vaporize almost 45,000 pounds of LNG (just the vapor portion shown in EIS/R Figure 4-1) in less than 35 seconds. Most likely, there would be a pool of LNG formed which would subsequently vaporize. The amount of energy required to vaporize this much LNG in such a short amount of time would exceed the energy content of very large volumes of air. Note that this is similar to the amount of energy that is produced by the vaporizers and water heaters in the process equipment for normal operations. The surrounding air does not contain enough energy to vaporize this much LNG so fast. (EIS/R App F Pg. 4-12).

The largest distance for thermal radiation from an equipment release is 600 feet, which could impact the tanks or the truck storage tank if the location (location F) is located along the southern half of the equipment area. (EIS/R Pg 5-3)

6.0 Quantitative Risk Analysis

Determining what events to include in a risk analysis should be based on acceptable risk criteria in the industry and by government agencies. Events on the order of 10^{-6}/yr, for example, although incredible, should be included if they produce numbers of fatalities in the 10s, 100s or 1000s. This would demonstrate the full spectrum of risk faced by the public. Events on the order of 10^{-6}/yr or 10^{-5}/yr that produce a single fatality are close to accepted levels of risk criteria. It is also important to quantify all scenarios at this level as the resulting risk is additive. The risk section below addresses these issues.

The scenarios described above, along with the estimated frequencies and the populations at the port and within the community, were compiled into FN curves (plots of frequency (F) versus the expected number of fatalities (N)). A number of assumptions were made. These are discussed below:

6.1 Populations

Population densities at the port facilities were assumed to be a single person for every 1,000 m^2 within dock/berth areas and a single person every 10,000 m^2 for container areas. Maximum populations at a dock were assumed to be 50 persons and within container areas, 10 persons. Specific buildings located close to the proposed equipment were given small populations numbers, such as 1-2 persons per building or area. These include the forest products dock area, the recycling yard area and the container receiving/shipping gates. Larger buildings, such as the Navy area to the north of the proposed site, were given larger populations. Populations were averaged over a 24 hour period.

Populations associated with public areas utilized census block data for the areas within the City of Long Beach. Areas such as the Fire Department headquarters, restaurants and hotels along Harbor Scenic Drive, the Queen Mary, the Carnival Cruise Lines Terminal, the Boat ramp area, Cesar Chavez Park and the Hilton Hotel were estimated based on typical facility populations.

6.2 Ignition Probabilities

Ignition probabilities are based on the analysis presented above for winds blowing from the west. For winds blowing a vapor cloud over the equipment areas (from the south), it was assumed that the cloud would be ignited. For releases from the breakwater area with winds from the S or SW, it was assumed that the only ignition source was the initiating event.

The ignition probability analysis assumes conservatively that a vapor cloud has an 11% chance of reaching the City of Long Beach. With an assumed penetration distance of 500 meters, and based on census data, this equates to a maximum exposed population (within a vapor cloud) of 2000 persons (in eastern Long Beach) and 1,500 persons (in western Long Beach).

6.3 Meteorological Conditions

The QRA utilized the SCAQMD Long Beach meteorological data with the following wind direction probabilities. Probabilities were broken into D stability (including A-D) and F stability (including stabilities E-F). These two stability classes represent daytime (d stability) and nighttime (F stability) conditions. Note that the prevailing wind is from the west.

Direction wind is from	D Stab Probability	F Stab Probability
NNE	0.0135	0.0403
NE	0.0230	0.0462
ENE	0.0232	0.0200
E	0.0302	0.0167
ESE	0.0183	0.0066
SE	0.0326	0.0109
SSE	0.0397	0.0076
S	0.0983	0.0058
SSW	0.0248	0.0032
SW	0.0189	0.0054
WSW	0.0423	0.0187
W	0.1347	0.1337
WNW	0.0116	0.0298
NW	0.0103	0.0200
NNW	0.0078	0.0197
N	0.0203	0.0658

6.4 Levels of Concern

Levels of concern that produced either fatalities or injuries are shown below.

Level of Concern	*Consequence Type*	*Probability of Occurrence (fraction of persons exposed to this level that suffer the consequence)*
Thermal 10 kW/m2	Fatality	0.10
Thermal 5 kW/m2	Injury	0.10
VCE LFL	Fatality	0.30
VCE 1/2 LFL	Injury	0.50

Exposure to a radiation intensity of 5 kW/m^2 would result in pain if the exposure period were to exceed 13 seconds or second degree burns after 40 seconds. Exposure to a radiation intensity of 10 kW/m^2 would result in pain (5 seconds) and second degree burns after short exposure periods (i.e., 14 seconds), and death after longer periods. The time required to reach the pain, 2nd degree burn or fatality thresholds were used to estimate radiation levels that would result in serious injury or fatality. Persons exposed to thermal radiation have the opportunity to move away from the hazard, unlike toxic hazards or overpressure effects or vapor cloud fires/explosions which are instantaneous. It was assumed in this analysis that some people not within the flame area would move away from the flame and to a safe location in less than 1 minute. An analysis of the distances to various radiation levels indicates that this is feasible in many cases. Therefore, a less than 1 minute exposure was used as the basis for determining the levels of concern. Exposure to a thermal radiation level of 10 kW/m^2 could result in a serious injury (at least 2^{nd} degree burns) if exposed for less than 1 minute, and it was therefore assumed that all persons exposed to 10 kw/m^2 would suffer serious injuries. Serious injuries would start to be realized at and above 5 kw/m^2. Exposure to a thermal radiation level in excess of 10 kW/m^2 would likely begin to generate fatalities if exposed for less than 1 minute.

The estimate for vapor cloud exposure assumes that any person outside exposed to the vapor cloud fire above the LFL would experience a fatality. It was assumed that 30% of the population is outdoors and would suffer 100% fatalities within the LFL. It was assumed that indoor populations would not suffer more than serious injury due to subsequent fire and damage. Persons outside and exposed to ½ LFL would realize serious injuries. Therefore, accounting for the persons inside, the probability of realizing a serious injury if exposed to ½ LFL was estimated at 50%.

6.5 FN Curves

The results of the EIS/R failure rate and consequence analysis have been combined to develop FN curves (plots of frequency (F) versus the expected number of fatalities (N)), using risk analysis software. These FN curves are commonly called risk profiles and represent societal risk. In calculating the risk profiles, a two-dimensional computer map of the facility, pipelines and surrounding area was prepared. The population distribution and probabilities of ignition were specified across the area of the map; and the likelihood of an individual fatality occurrence was calculated at each grid location on the map.

To develop a risk profile, many factors were considered. Each release scenario was evaluated for all wind directions, and for each combination of stability and wind speed. In any given direction of travel, it is necessary to consider the chances of having the particular wind stability class, the cloud igniting on-site, and the cloud igniting offsite at every downwind location on the map. Clearly, the maximum downwind distances for flammable vapor dispersion will only be attained if the vapor cloud reaches the maximum downwind distance and then ignites. The maximum downwind distances for flammable vapor dispersion will not be attained if the vapor cloud does ignite at the point of release or at any point along its travel path.

The approach for general calculations followed the steps listed below:

- Summarize meteorological data into representative wind direction, wind speed and stability conditions.

- Select an appropriate grid size, then construct a map using Cartesian coordinates of the site and surrounding area.

- Identify the ignition sources and enter the ignition probabilities on the Cartesian grid.

- Determine the population distribution, then enter the data on the Cartesian grid.
- Select the release events, along with the likelihood's of release, consequence data and release locations.
- Determine the likelihood and consequences of immediate ignition.
- Determine the likelihood and consequences of vapor cloud fires, jet fires and explosions as appropriate, for each weather condition.
- Determine the probability of ignition at each point along the path of a dispersing vapor cloud using an ignition algorithm.
- Select another release event and repeat the preceding three steps.
- Apply conditional probabilities of fatality given exposure, for each type of consequence (i.e., thermal exposure, explosion overpressure).
- Aggregate the likelihood of all probabilities of fatality at each location on the map for all the releases scenarios.
- Construct **N**umber of fatality-**F**requency (FN) curves by summing the number of fatalities for each event outcome and plotting the results against the frequency.

A risk profile is a graphical depiction of the cumulative frequency of incidents with various levels of unwanted or adverse impact. This study focused on fatalities, in the population near the LNG terminal and along the pipeline routes. To develop the risk profiles, the following information was examined:

- Frequency and size of releases,
- Hazard model outputs for releases,
- Atmospheric stability data and wind rose data to determine the probability of each set of weather conditions used in the hazard modeling,
- Population distribution data,
- Ignition source distributions (including traffic), and
- Impact criteria for each type of hazard to determine the chance of a fatality occurring given exposure to a specified hazard.

The FN curves for the proposed facility are shown in the following figures. Most established criteria, discussed above, are for fatalities and are shown on the fatality FN curve. The injury curve is also shown, along with the Santa Barbara County criteria, which addresses injuries.

The FN curves demonstrate that the fewer-fatality end of the curve, the area with less than 10-15 fatalities, is primarily driven by the equipment related releases and the catastrophic tank release due to an earthquake. Equipment related releases are releases from process piping, vessels, loading arms, etc, but not the tanks or the ships. The equipment related releases are estimated to occur more frequently than the catastrophic releases, and the impact zones for these releases are estimated to travel up to 1,700 feet for the vapor cloud, which is far enough to reach all of the port receptors in the Pier T immediate area. In addition, the thermal radiation levels could reach the former Navy areas to the immediate north of the equipment areas. The thermal radiation scenario has a higher probability of impacting a specific location than the vapor cloud scenario as it is less wind-dependant and would affect a circular area.

The catastrophic tank release due to an earthquake producing a vapor cloud or thermal radiation fire is also estimated to occur on the order of close to 10^{-4} (earthquake frequency of 0.67×10^{-4} per year) which also drives the risk of impact to nearby facilities and workers.

The higher-fatality end of the FN curve (greater than 15 fatalities) is due to the larger, catastrophic failures associated with tank failures (from earthquakes and other causes) and ship releases. These impacts occur closer to and within the City of Long Beach. The FN curve drops off in frequency due to the increasing probability of ignition associated with large vapor clouds and the numbers of ignition sources. Hazardous thermal radiation levels which could cause fatalities do not reach highly populated areas. Entry of the vapor cloud into highly populated areas, such as the City of Long Beach, is estimated to occur on the order of 10^{-7} and could produce close to 600 fatalities.

A catastrophic failure of an LNG ship at the breakwater could cause a vapor cloud that could reach the City of Long Beach east of the downtown area along the beach. As a worst case, it was assumed that a grounding or collision at the breakwater sufficient to breach a single tank would lead to a loss of all tanks on the LNG vessel.

By the criteria shown on the FN curves from the UK and Hong Kong discussed above, this would be considered a risk that falls into the middle region, which would imply a potentially significant impact requiring further mitigation. The Santa Barbara County criteria, certain UK studies and the Netherlands criteria would classify this as a significant, Class I impact.

The injury FN curve follows a similar logic as the fatality FN curve. The equipment releases produce thermal impacts of up to 20 injuries to other POLB employees in vicinity of the proposed project. The catastrophic tank failure produces injuries in the proposed project vicinity due to both vapor clouds and thermal fires.

The large scale releases associated with the tank failures and the ship releases produce up to 1,000 serious injuries within the City of Long Beach in the 10^{-7} range.

By the injury criteria shown on the FN curves from the County of Santa Barbara, this risk is considered to be in the amber region. This would be considered a significant Class I impact in the absence of additional mitigation.

Figure 6 POLB Proposed SES Long Beach LNG Facility Fatality FN Curves

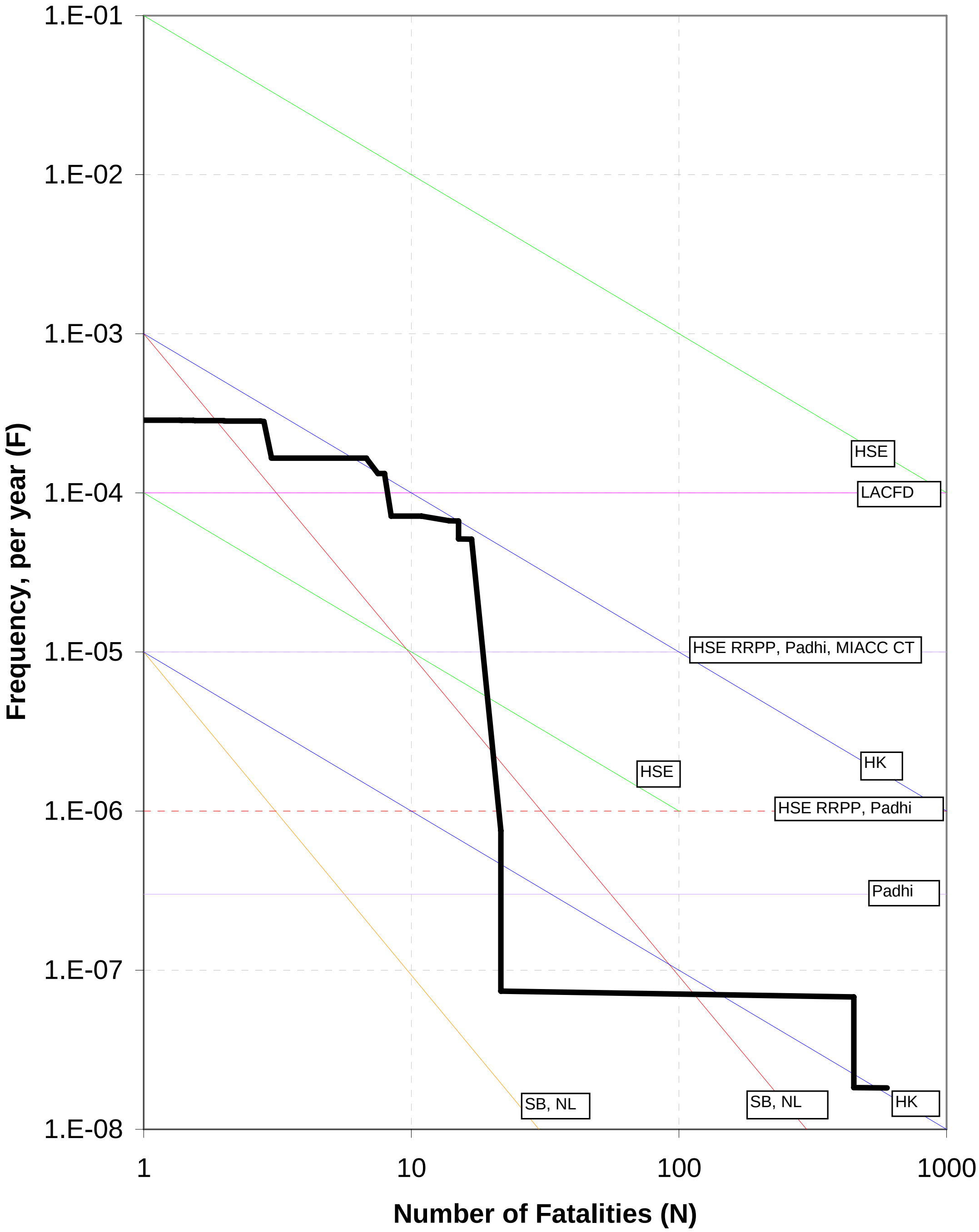
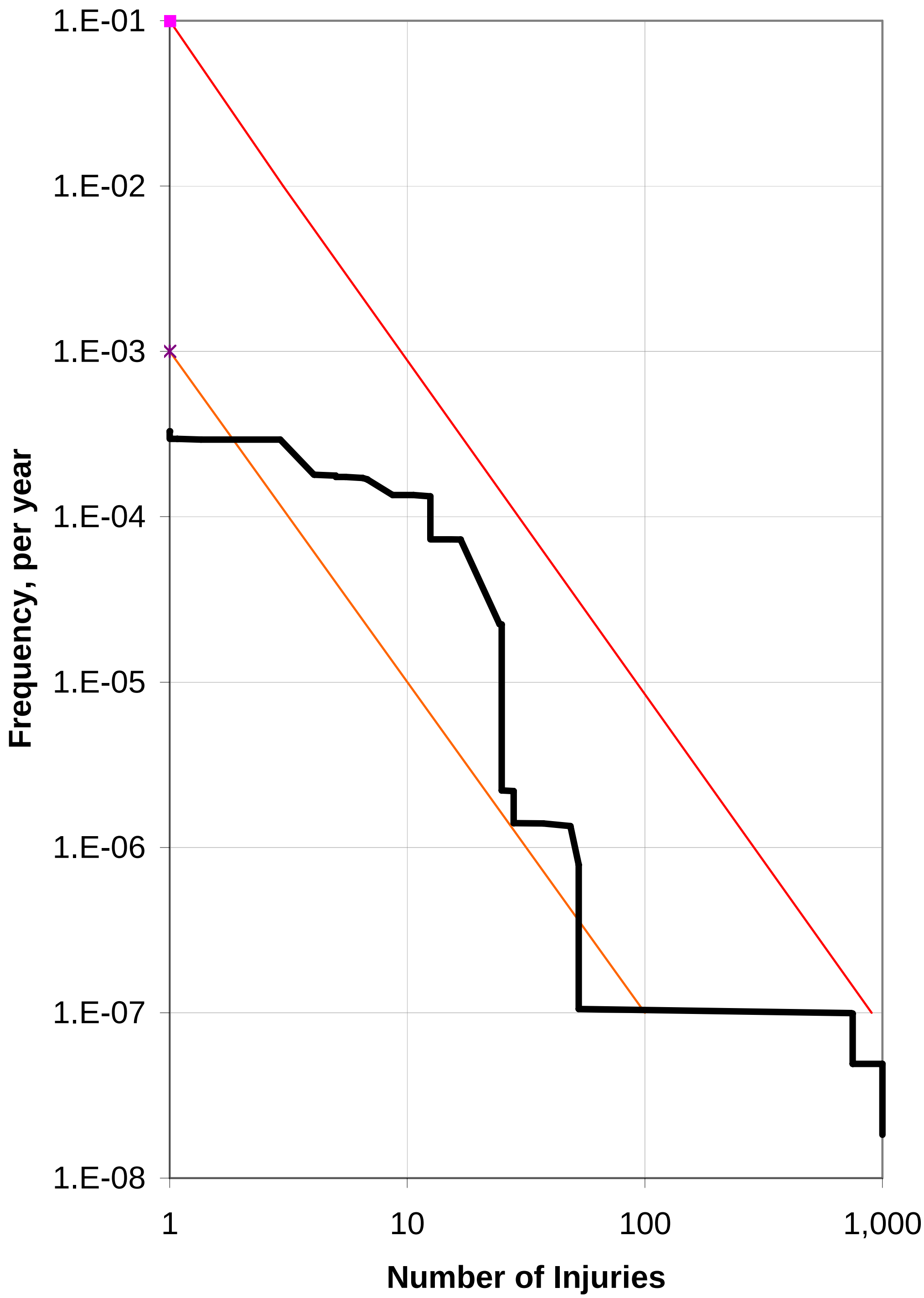


Figure 7 POLB Proposed SES Long Beach LNG Facility Injury FN Curves



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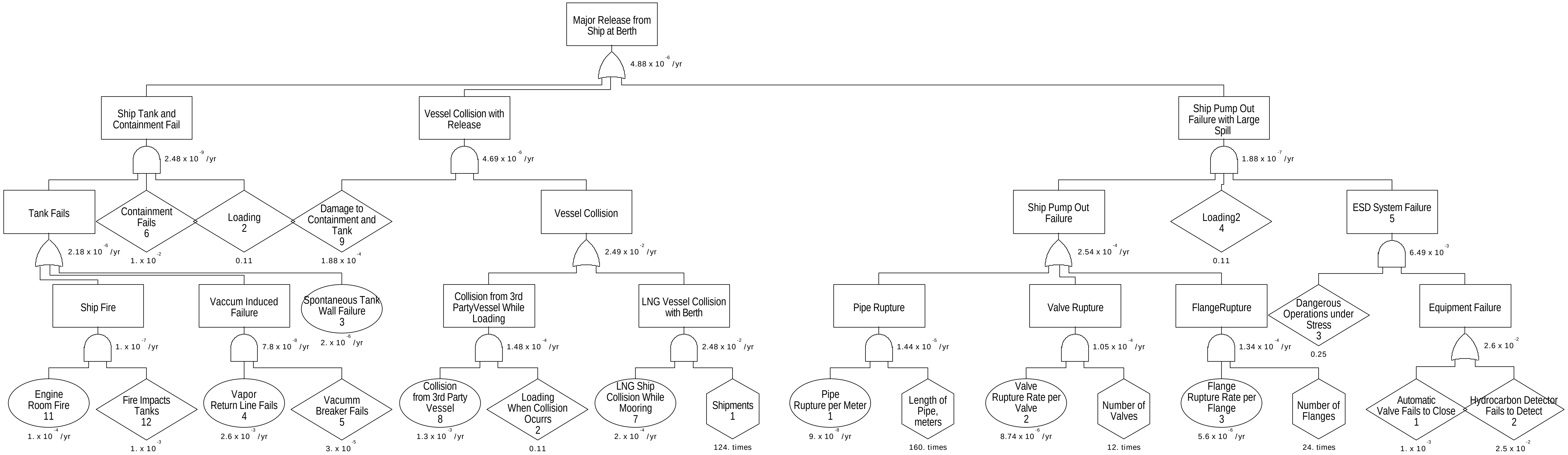
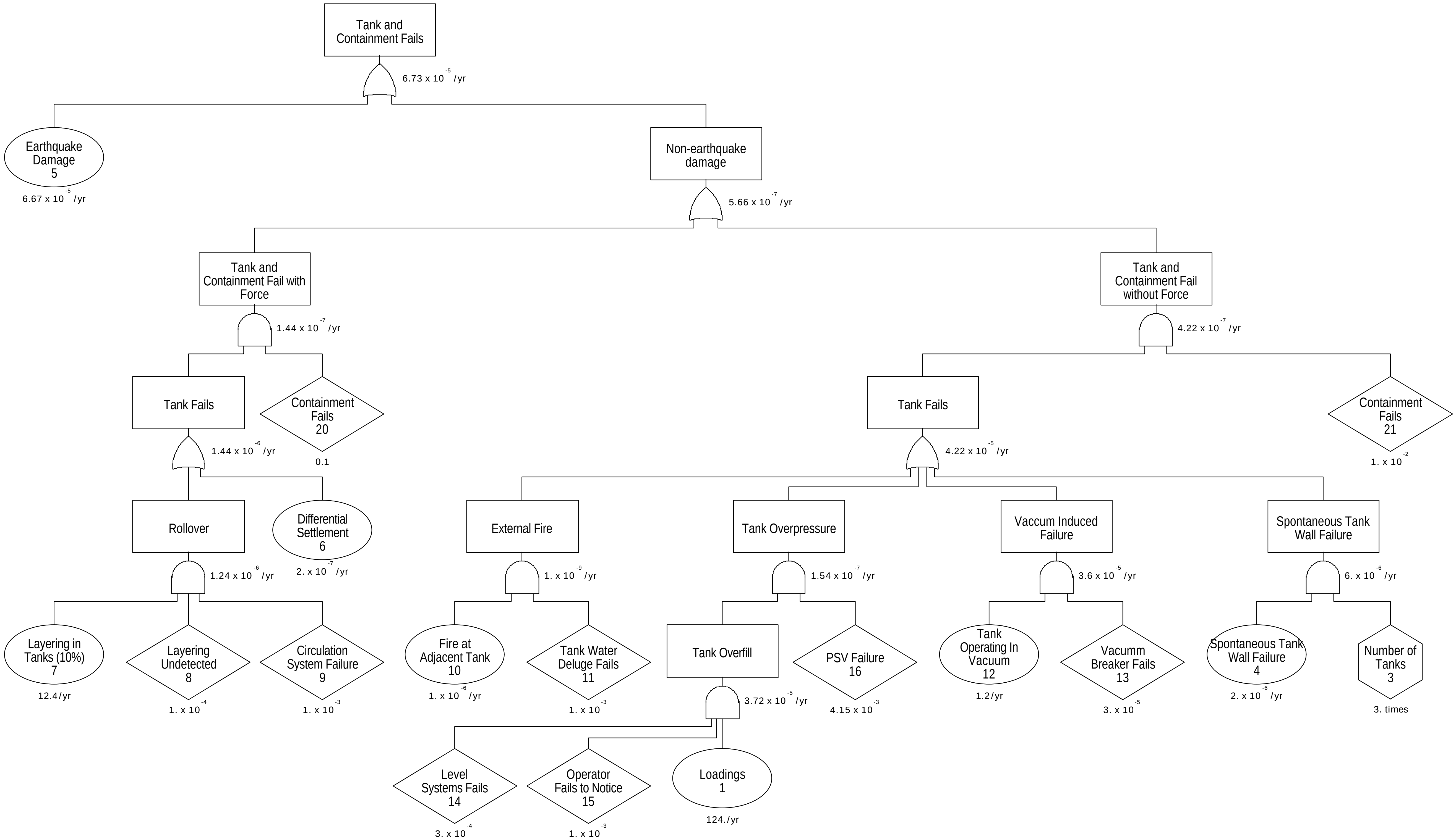
Attachment 1
Fault Tree Analysis

Major release from ship at berth



Release From Tank Storage



POLB Mitsubishi LNG Fault Tree and References

Summary	Freq
Ship-1 Release from ship pump-out piping with large spill onto water	1.87E-07
Ship-2 Rupture of ship tanks with spill onto water: at berth	4.67E-06
Ship-3 Collision/grounding at breakwater	7.67E-06
Tanks-1 Rupture of storage tank and containment, earthquake	6.67E-05
Tanks-2 Rupture of storage tank and containment, non-earthquake	5.78E-07
LNG-1 Release from loading arm	4.33E-06
LNG-2 Release from LNG piping between loading arm and tanks	4.22E-07
LNG-3 Release from LNG piping between tank pumps and sendout pumps	9.72E-06
LNG-4 Release from send-out pump, pump piping outlet to vaporizers inlet	1.73E-05
ESD-1 Emergency shutdown system fails to operate	6.50E-03
Combined Releases from Equipment, liquid	3.18E-05

All releases assumed ESD system fails to operate

Ref.	Event	Reference	Failure rate or probability	Units	No. of units	Event rate or probability
Ship-1 Release from ship pump-out piping with large spill onto water						1.87E-07
1	Full bore pipe rupture mainline	Rupture of pipe >150 mm diameter. Rijnmond ISBN 90-277-1393-6	9.00E-08	/m.yr	160	1.44E-05
2	Full bore valve rupture mainline	Rijnmond, WASH 1400 1975 10% of ruptures are catastrophic.	8.74E-06	/valve.yr	12	1.05E-04
3	Flange rupture	Shell, 1993, flange leak, significant rupture, assume 2 per valve connection	5.60E-06	/valve.yr	24	1.34E-04
4	Fraction of time loading	Number and hours per loading				0.11
5	ESD System Failure	See ESD Faultree				6.50E-03
Ship-2 Rupture of ship tanks with spill onto water: at berth						4.67E-06
1	Number of tanker visits	Loading based on Phase 2 and 150,000 m3 ships				124
2	Fraction of time loading	Number and hours per loading				0.11
3	Spontaneous Tank Wall Failure	Rijnmond, catastrophic tank wall failure	2.00E-06	/year	1	2.00E-06
4	Vapor Return Valve Fails Closed	Lees, valve plugs or fails closed	2.60E-03	/year	1	2.60E-03
5	Vacuum Relief fails	WASH 1400, vacuum valves fails to operate	1.00E-04	/demand	1	3.00E-05
6	Containment Fails: non-force related failures	Estimated 1% containment failure with tank failure				0.01
7	Ship Collision/casuality while moored/mooring	DOT collision rate while moored. Historical collision rate while moving for LNG vessels calculated at 2.3e-4.	2.00E-04	/unloading	1	2.00E-04
8	Ship Collision from other vessel	POLB and POLA data on ACG between 1992-1998 for deep draft vessels minus LNG ship allison rate in 7 above	1.30E-04	/year	1	1.30E-04
9	Prob of tank damage and rupture	DOT conditional probability of tank damage, rupture and estimated ship angle suffienct to cause damage (Ecoelectrica)	1.88E-04	/demand	1	1.88E-04
10	Engine running while moored	Fraction of time unloading	1.60E-01	/year	1	1.60E-01
11	Engine room fire	Rijnmond, probability for minor fire	1.00E-04	/demand	1	1.00E-04
12	Probability of fire impacting tank	Estimated	1.00E-03	/demand	1	1.00E-03
Ship-3 Collision/grounding at breakwater						7.67E-06
1	Number of tanker visits	Loading based on Phase 2 and 150,000 m3 ships				124
2	Collision or grounding	POLB and POLA data on ACG between 1992-1998 for deep draft vessels	3.30E-04	/year	1	3.30E-04
3	Prob of tank damage and rupture	DOT conditional probability of tank damage, rupture and estimated ship angle suffienct to cause damage (Ecoelectrica)	1.88E-04	/demand	1	1.88E-04

POLB Mitsubishi LNG Fault Tree and References (continued)

Ref.	Event	Reference	Failure rate or probability	Units	No. of units	Event rate or probability
Tanks-1 Rupture of storage tank and containment						6.72E-05
1	Number of tanker visits	Loading based on Phase 2 and 150,000 m3 ships				124
2	Fraction of time loading	Number and hours per loading				0.11
3	Number of tanks	Number of tanks		number		3
4	Spontaneous Tank Wall Failure	Rijnmond, catastrophic tank wall failure, 3 tanks	2.00E-06	/year	1	2.00E-06
5	Earthquake catastrophic	Quest earthquake	6.67E-05	/year	1	6.67E-05
6	Soil settlement, differential settlement	Rijnmond, subsidence, landslip	2.00E-07	/year	1	2.00E-07
7	Layering in Tanks	Assume 10% of deliveries produce layering	1.00E-01	/unloading	1	1.00E-01
8	Layering goes undetected	Smith, human error, fails to respond to annunciator	1.00E-04	/demand	1	1.00E-04
9	Circulation system failure	WASH pump failure to run on demand	1.00E-03	/demand	1	1.00E-03
10	Fire at adjacent tank/equipment	Rijnmond, major fire	1.00E-06	/year	1	1.00E-06
11	Water deluge system fails	WASH pump failure to run on demand	1.00E-03	/demand	1	1.00E-03
12	Vacuum Operation	1% of loadings estimated to induce vaccum	1.00E-02	/unloading	1	1.00E-02
13	Vacuum Relief fails	WASH 1400, vacuum valves fails to operate	1.00E-04	/demand	1	3.00E-05
14	Tank level indication failure	Lees, limit switch fails to operate	3.00E-04	/demand	1	3.00E-04
15	Operator fails to observe	Rijnmond 1982	1.00E-03	/demand	1	1.00E-03
16	PSV fails to open	CCPS, fails to open on demand, pilot operated	4.15E-03	/demand	1	4.15E-03
20	Containment Fails: force related failures	Estimated 10% containment failure with tank failure				0.1
21	Containment Fails: non-force related failures	Estimated 1% containment failure with tank failure				0.01
ESD-1 Emergency shutdown system fails to operate						6.50E-03
1	Automatic valve fails to close	Lees, failure to operate	1.00E-03	demand	1	1.00E-03
2	Hydrocarbon detector fails to detect	OREDA, monthly inspections	2.50E-02	demand	1	2.50E-02
3	High Stress, rapid actions, dangerous conditions	Rijnmond 1982	2.50E-01	demand	1	2.50E-01
	mitigated frequency (redundant valves and senors)					1.57E-04

Notes: Base rates general input	
Earthquake, Quest major producing tank failure	6.67E-05
Earthquake, Quest major producing equipment failure	2.00E-04
Number of tanker visits	124
Hours per unloading event	8
Fraction of time loading	0.114

Attachment 2
NFPA 59A and 49 CFR 193 Summary Checklists

This attachment contains NFPA 59A and 49 CFR 193 Summary Checklists that can be used to demonstrate compliance with applicable Federal codes and standards. A review of these checklists indicates that the project would not comply with some of the exclusion zone requirements of NFPA 59A. In addition, the EIS/R does not contain enough design information to determine if the project is consistent with the requirements of NFPA 59A and 49 CFR 193. While much of this detailed information is well beyond the scope of CEQA and NEPA, the fact that the project does not currently meet some elements of these standards raises the concern that there could be other project design deficiencies. In order to address compliance with NFPA 59A and 49 CFR 193, the EIS/R should, at a minimum, state that the project design meets or exceeds the NFPA 59A and 49 CFR 193 requirements. If possible, the EIS/R should include completed NFPA 59A and 49 CFR 193 Summary Checklists.

NFPA 59A and CFR 193 Summary Checklists

Issue Area	Complied/ Comments
NFPA 59A Section 2.0: General Plant Site Requirements	
A diked impounding area with drainage.	Y
Areas to be graded, drained and impounded include: process areas, vaporizations areas, transfer areas and tanks.	Are loading arms protected from spills into water?
Diked areas equal to largest tank size or sum of all tanks if no impact provisions used.	Y
Diked area of transfer and process areas only must have a volume equal to 10 minutes of leak	Y
Dikes made of compacted earth, concrete, metal as long as designed to withstand LNG temperatures and head pressures.	Not clear if barrier can withstand temperatures or dynamic load/sloshing effect or worst case earthquake.
Drainage of rainwater using an automatic pump with LNG shutoff or gravity drain with LNG release prevention.	?
Dike or impoundment was should subscribe to specific dimensions to prevent dike overwashing.	?
Allowable radiation flux distance of 5 kW/m2 from a design spill to a property line that can be built upon or an area of assemblage of more than 50 people.	Y
Design spill is defined based on equipment arrangement: lines into tank below liquid level, spill equal to tank volume above penetration or 1 hr. For overhead lines only, spill equal to 10 minutes of max flow if shutdown systems in place.	Y
Allowable radiation flux distance of 9 kW/m2 from a fire of total contents spill to the nearest point of a building or structure outside the owners property line classified as assembly, educational, healthcare, detention and correction or residential.	Y
Allowable radiation flux distance of 30kW/m2 from a fire of total contents spill to a property line that can be built upon.	Y
Minimum distance from impound area to buildable property line is the distance from a design spill to ½ LFL using F, 2 m/s conditions. Use of non-passive mitigation in dispersion calculations is ok.	This would be a large distance, as reported by Quest, and the project is no in compliance at the time the EIS/R was prepared
Minimum distance of 50 ft to a buildable property line or navigable waterway.	Y
Heat flux from a fire should not cause major structure damage to any LNG marine carrier that could prevent its movement.	Y
Containers less than 70,000 gal (265 m^3) should be equipped with automatic failsafe valves on	?

Issue Area	Complied/ Comments
all appurtenances which close with fire detection, excess flow of LNG, gas detection or manual operation from a local and a remote location. (not applicable to relief valves or 2 check valves also ok)	
Tank spacing between tank and buildable property line for large tanks (>70,000 gal or 265 m3) equals the larger of 100 feet or 0.7 times diameter.	Y
Distance between any two tanks (>70,000 gal or 265 m3) equals ¼ the sum of the two diameters or not less than 5 ft.	Y
Vaporizers and their heat sources should be placed at least 50ft from any other source of ignition (not including other vaporizers). Process heaters ok if interlocked to not operator when vaporizers are operating.	Y
Minimum separation distance between vaporizers of 5 feet.	Y
Heated vaporizers should be located at least 100 ft from buildable property line and 50 feet from impounding areas, drainage systems, liquid lines, tanks, loading/unloading connections, control buildings, offices, shops, or other occupied or important plant structures.	Y
Process equipment should be located at least 50 ft from ignition sources, buildable property lines, impounding areas, loading/unloading equipment, drainage systems, control buildings, offices, shops or other occupied structures.	Y
Pier or dock used for pipeline transfer at least 100 ft away from any bride crossing a navigable waterway and the manifold should be 200 ft from such bridge.	Y
Loading and unloading connections at least 50 ft away from ignition sources, buildable property lines, impounding areas, drainage systems, control buildings, offices, shops or other occupied structures.	Y
Building containing process equipment should be ventilated, non-flammable materials.	?, design
Ventilation rate should be at least 1 cfm or air per 1 ft2 of floor area.	?, design
NFPA 59A Section 3.0: Process Systems	
Pumps made of correct materials with isolation capabilities, check valves, pressure relief, foundation frost heaving prevention, precooling capabilities.	?, design
Tanks should have boiloff and flash gas handling systems.	?, design
Emergency controls conspicuously marked and accessible.	?, design
Provision to prevent flammable mixture with air in the internal gas stream.	?. Measures to prevent intake of combustible gas into boilers.

Issue Area	Complied/ Comments
Pressure relief on vessels and equipment venting to atm or a safe locations.	?, design
NFPA 59A Section 4.0: Stationary LNG Storage Containers	
All containers designed for both top and bottom filling unless another method provided to prevent stratification.	?, design
All tanks, piping, tank foundations and areas that could be exposed to LNG or LNG vapors should be designed for LNG service.	?, design
Site specific seismic analysis should be conducted including surface faulting, liquefactions, vertical and horizontal response, safe shutdown earthquake (SSE) and operating basis earthquake (OBE) and maximum credible earthquake (MCE) of 2% every 50 years.	Y, analysis should assess liquefaction potential
LNG containers, impounding systems, system components and fire protection systems should be designed to be operable OBE and to maintain integrity for an SSE event.	Is process equipment designed for SSE integrity?
After an SSE, tank emptied and an inspection required.	?, procedures
A 100 yr mean wind and snow occurrence used for wind and snow loads.	?, design
Insulation should be non-combustible, compatible with LNG and resistant to external fire causing breakdowns.	?, design
Filling volume a function of pressure relief, and container pressure after filling.	?, design
Foundation soils stratigraphy and physical properties testing required.	?, design
Bottom of outer tank should be above groundwater or protected.	?, design
Outer tanks in contact with soils require heating system with weekly maintenance and temperature monitoring system.	?, design
Outer tank pressure relief devices with discharge area of 0.00024 in2/lb of water capacity.	?, design
Foundations and supports should have a fire resistance of 2 hours.	?, design
Internal connections between the inner and outer tanks should be designed for internal tank pressure rating, and thermal stresses. No bellows allowed.	?, design
Containers should have nameplates detailing design specs, capacity and builder.	?, design
Containers should be leak tested.	?, procedures
Purge systems should be capable of purging before introducing materials and prior to taking out of service. Oxygen content should be determined using an oxygen analyzer.	?, design and procedures
Containers should be equipped with pressure/vacuum control systems.	?, design
Pressure and vacuum relief should be directly to the atmosphere vertically and have lockable/sealable isolation valves. Full relief capacities should be present when one valve is	?, design

Issue Area	Complied/ Comments
under service.	
Relief capacity based on fire exposure, operation upsets, vapor displacement during filling, loss of refrigeration, pump recirculation and barometric pressure changes.	?, design
NFPA 59A Section 5.0: Vaporization Facilities	
Each vaporizer should have inlet and discharge block valves.	?, design
Automatic prevention of high or low temperature exceedances of discharge design temperature.	?, design
Isolation of vaporizers accomplished with 2 inlet valves.	?, design
Heat source shutoff locally and from at least 50 ft distant.	?, design
LNG shutoff valve at least 50 ft from vaporizer or vaporizer building.	?, design
Vaporizers within 50 ft of storage must have automatic shutoff valves within 10 ft of vaporizer and close on loss of line pressure, high ambient temp or low temp in discharge line.	?, design, also consider shut-in if detection of hydrocarbons
Remote operation from 50 ft at attended facilities is ok.	?, design
Each vaporizers should have relief valves sized accordingly and protected from heat sources.	?, design
Combustion air supplied from outside buildings.	?, design
NFPA 59A Section 6.0: Piping Systems and Components	
Piping seismic design based on OBE.	Y
Piping that could be exposed to LNG or fire radiation in an emergency should be made of materials that can withstand the emergency, protected by insulation or capable of being isolated.	?, design
Insulation should maintain properties during an emergency.	?, design
Piping >2in should be welded or flanged.	?, design
Shutoff valves on all container, tank and vessel connections inside impounding area.	?, design
Valves that can be operated at both local and remote locations to isolate inventory should be installed.	?, design
Container connections > 1in should have a valve that closes automatically if exposed to fire, remotely controlled valve or a check valve.	?, design
Valves > 8in should have powered operators with means for manual operation.	?, design
Piping should be identified by color-coding, painting or labeling. Non-corrosive markings	?, design

Issue Area	Complied/ Comments
only.	
Piping should be pressure tested and welds inspected.	?, procedures
Thermal expansion relief valves should be installed in all sections of pipe that can be isolated.	?, design
Underground or submerged piping is subject to NACE RP 0169.	?, design
NFPA 59A Section 7.0: Instrumentation and Electrical Services	
LNG containers should have 2 independent liquid level gauges, 2 independent high liquid level alarms and a separate high level cutoff.	?, design
Containers should have pressure/vacuum and temperature gauges.	?, design
Vaporizers should have inlet and outlet temperature indication on all streams.	?, design
Power or instrument air failures should cause failsafe situation.	?, design
Electrical and wiring within classified areas should be NFPA 70.	?, design
NFPA 59A Section 8.0: Transfer of LNG and Refrigerants	
Transfer hoses and piping should have isolation valves and check valves.	?, design
Pump and compresses should have local and remote (at least 25 ft) shutdown capability and signal lights indicating operating status.	?, design
Ship cargo should not be handled within 100 ft of transfer connections.	Y
Transfer piping (liquid and vapor) should have isolation valving. All liquid lines, and vapor line > 8in, should have powered operators in addition to manual operation. Powered operated valves should be capable of being closed locally and remotely at least 50 ft away and be fire fail closed.	?, design
Liquid lines should have a check valve.	?, design
Tank vehicle loading lines should have a manual valve located 25 ft from the loading area or a remotely operated valve.	?, design
Liquid unloading lines should have a check valve.	?, design
Hoses should be rated at least 5 times working pressure.	?, design
Marine arms should have alarms to indicate limits of extension.	?, design
Hoses should be tested annually and visually inspected before each use.	?, procedures
Communications from transfer area to other personnel should be provided and nighttime loading should have lighting.	?, design

Issue Area	Complied/ Comments
NFPA 59A Section 9.0: Fire Protection, Safety and Security	
ESD systems installed capable of isolating/shutting off sources of LNG, flammable liquids, refrigerants, flammable gasses.	?, design
ESD systems failsafe design or protected against fire exposure.	?, design
ESD systems either manual or automatic with manual being activated by controls at least 50 ft from equipment.	?, design
All areas monitored for flammable gas (0.25 LFL) with alarms (audible and visible) and fire alarms (audible) at attended location.	?, design, specifically area with combustion air intake
Minimum 2 hour water supply at max design flowrate and capacity.	?, design
Maintenance program for all fire protection equipment.	?, procedures
Confined space procedures, PPE and monitors available.	?, design
Facility should have a controlled access security system with perimeter fencing or other barriers.	?, design
Two exit gates or doors required and lighting to promote security.	?, design
Manual emergency depressurizing system to vent to a safe location.	?, design
Detailed procedures for taking a tank out of service.	?, procedures
NFPA 59A Section 11.0: Operating, Maintenance and Personnel Training	
Operating, maintenance and training procedures required	?, procedures
Documented emergency plan with liaison to local authorities.	?, procedures
Conduct an analysis of safety related conditions.	?, a hazards analysis needs to be conducted on preliminary design
Operating procedures should include: startup/shutdown, purging components, cool-down, control systems, liquefaction issues, gas pressures, abnormal conditions, safe transfer of fluids, site security, emergency procedures, filling volumes, monitoring of operations.	?, procedures
Emergency procedures should include: notifications, emergency equipment, isolation procedures, recognizing emergencies.	?, procedures
Operation monitoring weekly at a minimum with recordkeeping of inspections and tests.	?, procedures
Loading operations: attended, written procedures, no smoking, no ignition sources, labeling, level monitoring, no traffic within 25-50 ft, purging of containers, no backing up.	?, procedures
Support systems inspected at least annually, emergency power sources tested monthly.	?, procedures

Issue Area	**Complied/ Comments**
Maintenance manual: manner and frequency for each component, testing of fire equipment, testing of control systems (annually), LNG relief valve testing (every 2 years), tank inspections after every meteorological or seismic disturbance, corrosion control, inspection of cathotic protection system (annually), external corrosion inspections (every 3 years).	?, procedures
Maintain records of all maintenance activities for at least 5 years	?, procedures
Training plan addressing: emergencies, operations, LNG hazards, transfer procedures, fire prevention, recognizing situations. Training sessions every 2 years.	?, procedures
CFR 48 Part 193 titled **"**Liquefied Natural Gas Facilities: Federal Safety Standards" details requirements for LNG facility siting, design, construction, operations, maintenance, training and security. Issues not covered by NFPA 59A are summarized below.	
Spills and leaks of LNG must be reported as follows: Any event that involves a release of gas from a pipeline or of liquefied natural gas or gas from an LNG facility AND (i) a death, or personal injury necessitating in-patient hospitalization; or (ii) estimated property damage, including cost of gas lost, of the operator or others, or both, of $50,000 or more. Any event that results in an emergency shutdown of an LNG facility must also be reported. (CFR 49, part 191).	?, procedures
Plans and procedures should be maintained at the facility. Updates to plans and procedures should take place when a component is changed significantly or a new component is installed and every 2 years.	?, procedures
Exclusion distances based on NFPA 59A. Tanks should be at least 1 mile from airport runway ends or 0.25 mile from nearest point on a runway.	Y
Dike areas must be 110% tank volume.	Y
LNG plants must have a control center with: protection from LNG facilities, remotely actuated valves operable from control center, continuous attendance, communication of hazards to all plant personnel.	?, design
All plant control systems, communication, emergency lighting and firefighting systems must have 2 sources of power.	?, design
Investigation of accidents that cause explosion, fire or LNG leak or spill resulting in death or hospitalization or property damage above $10k.	?, procedures
Communications system allowing for communication between all plant personnel in their stations. Plants above 70,000 gal, must have a separate emergency communications system.	?, procedures

Issue Area	**Complied/ Comments**
All communication equipment must have auxiliary power.	
Lock-out/Tagout system should be in place.	?, procedures
Fire protection control systems tested every 6 months.	?, procedures
LNG hoses tested annually and visually inspected before each use.	?, procedures
Exposed components subject to atmospheric corrosion protected by materials selection or coating/jacketing.	?, design and procedures
Buried components protected by materials selection or coating and cathodic protection.	?, design
Relief valves, automatic shutoff valves, control systems for internal shutoff valves tested annually.	?, procedures
Operators must demonstrate competence with a proficiency test and should follow a written plan to ensure no physical conditions that could impair duties.	?, procedures
Written plan of training instruction, including training, plant security, emergency response and plant fire drills conducted not more than every 2 years.	?, procedures
Security plan including security inspections and patrols, description of duties, actions to be taken, persons to be notified/contacted, methods for personnel identification, liaison with law enforcement.	?, procedures
Accesses to facility must be locked unless guarded. Means to unlock for all employees in the facility in case of an emergency.	?, procedures
Area around facility must be monitored and perimeter with warning signs.	?, procedures