



**Report: 2016-6708-VP**

# **Updated Risk Assessment Report for Costa Norte LNG Terminal & Atlantico Power Generation Plant At Panama City – Panama**

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*Prepared for:*

**Costa Norte LNG Terminal S. de R.L.**

**March 2016**

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## **ACRONYMS AND ABBREVIATIONS**

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<b>ABS</b>	American Bureau of Shipping.
<b>CEN</b>	Comité Européen de Normalisation (European Committee for Standardization).
<b>CFR</b>	Code of Federal Regulations.
<b>COTP</b>	Captain of the Port (i.e., USCG official locally in charge of port safety).
<b>CSA</b>	Canadian Standards Association.
<b>DOT</b>	Department of Transportation.
<b>EN</b>	European Norm (i.e., European Community standard).
<b>ERP</b>	Emergency response plan.
<b>ERS</b>	Emergency release system.
<b>ESD</b>	Emergency shutdown system.
<b>FERC</b>	Federal Energy Regulatory Commission.
<b>FSRU</b>	Floating storage regasification unit.
<b>FSU</b>	Floating storage unit.
<b>HAZID</b>	Hazard identification.
<b>HAZOP</b>	Hazard and operability.
<b>IMDG Code</b>	International Maritime Dangerous Goods Code.
<b>IMO</b>	International Maritime Organization.
<b>ISO</b>	International Organization for Standardization.
<b>ITPM</b>	Inspection, testing, and preventive maintenance.
<b>LNG</b>	Liquefied natural gas.
<b>LNGC</b>	Liquefied natural gas carrier.
<b>LPG</b>	Liquefied petroleum gas.
<b>MARAD</b>	Maritime Administration.
<b>NFPA</b>	National Fire Protection Association.
<b>NG</b>	Natural gas.
<b>NVIC</b>	Navigation and Vessel Inspection Circular.
<b>OCIMF</b>	Oil Company International Marine Forum.
<b>PERC</b>	Powered Emergency Release Coupling.
<b>PIANC</b>	International Navigation Association PIANC (formerly: Permanent International Association of Navigation Congresses).
<b>QMS</b>	Quality management system.
<b>RPT</b>	Rapid phase transition.
<b>SIGTTO</b>	Society of International Gas Tanker and Terminal Operators Ltd.
<b>SMS</b>	Safety management system.
<b>USCG</b>	United States Coast Guard.
<b>VCE</b>	Vapor cloud explosion.

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## **EXECUTIVE SUMMARY**

### **PURPOSE AND OBJECTIVES**

The purpose of this study is to develop a risk assessment of the liquefied natural gas (LNG) terminal in accordance with the design plans for the proposed terminal at Telfers Island, Panama for Costa Norte LNG Terminal and Atlantico Power Generation Plant.

The specific objective of the risk assessment was to:

- Selected scenarios to represent the design and operational plans for the terminal.
- Develop appropriate data to allow quantification of the frequency and consequences of the scenarios.
- Evaluate the risk results to help the client identify areas where additional prevention and mitigation efforts should be focused.

The risk assessment effort was based on the information supplied by AES in February and March 2016.


### **SCOPE**

The scope of this report includes quantification of the hazard scenarios selected from the HAZID carried out by ABSG in 2016. The scenarios selected for quantitative assessment are those involving the LNG and NG systems and equipment (including, piping, valves, and vessels) that could have significant impacts on members of the public, local communities, and personnel located on the terminal.

This study did not address scenarios related to terrorist events or any other intentional events. The study was limited to the following LNG terminal activities and equipment:

- (1) the LNG carrier moored at the terminal,
- (2) the breakwater and jetty,
- (3) LNG transfer equipment (e.g., arms, valves, piping),
- (4) the regasification unit,
- (5) the natural gas pipeline to the Power Plant and,
- (6) Several sections at Power Plant.

The present study does not consider any proposed changes to the port or terminal other than the addition of the LNG terminal as it is currently.

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In addition to the information provided on the HAZID report the primary source of design intent information was provided by AES via e-mail and teleconferences.

### **METHODOLOGY**

The ABS Group analysis team used the following steps to conduct the Risk Assessment Report of Costa Norte LNG project:

- Conduct the HAZID performed in Panama during 25 and 26 February in AEs offices. Suggest appropriate accident scenarios for the risk assessment
- Assessment of the frequency of the scenarios evaluated.
- Consequence assessment for the scenarios, assessing both:
  - the physical conditions that would results from LNG releases (e.g., thermal radiation, overpressure, and the potential for flash fires) and,
  - the impacts those conditions would have on personnel in the terminal.
- Risk evaluation for the terminal considering the frequency and consequence results for the terminal and how those risks can be managed.

Each of these steps and the resulting information are described in detail in the full report.

### **RISK EVALUATION**

The risks examined in this risk assessment for the Costa Norte import terminal appear to be consistent with the history for LNG import facilities over the last 50 years. Those facilities have not experienced any events that had adverse effects on members of the public and we are aware of very few events that caused LNG related severe injuries or fatalities to workers in those facilities. Similarly, the events examined in this study are relatively unlikely (i.e., severe events as postulated in this assessment are not expected to occur in the lifetime of the facility). Based on our assessment of the design and interaction with this project engineering staff from AES, we believe that an appropriate safety focus is in place for the aspects of the project examined in this effort.

The results of a QRA are the Individual Risk and the Societal Risk.

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These results should be preceded by a Hazid for determination of critical or severe scenarios that will be used in subsequent calculations. As mentioned in this report, the Hazid analysis was carried out in Panama in late February and critical scenarios described in Chapter 4 were selected by the assessment team and AES. The recommendations of this Hazid are presented in Appendix B.

Table S.1 presents the total frequency of all the events estimated for the Costa Norte LNG terminal. The reduction in the estimated frequencies for releases and fire/explosion events reflect both (1) the improvements in the terminal design and (2) changes in the risk assessment due to the availability of additional information regarding the design and its safeguards.

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**Table S-1 Frequency Summary for the LNG Terminal**

<b>Frequency estimate for LNG fire and explosion events in the analysis (i.e., jet fires, flash fires, pool fires, or vapor cloud explosions)</b>	<b>4.8 E-5 events per year</b> (approximately one event in 21000 years of operation)  This is the sum of the frequencies for all of the LNG release events examined that resulted in a fire or explosion consequence.
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All of the potential fatalities impacts estimated in this study represent threat to personnel at the terminal, either LNGG crew, terminal staff, or personnel on tug/support vessels. None of the events LNG release event examined in this study result in events that threaten members of the public on shore.

This estimate of risk posed by the terminal is the sum of the risks for all of the applicable scenarios. The risk estimates for each scenario are estimated as the product of the scenario frequency (in events per year) and the scenario consequence (in fatalities per event). Those risk estimates are presented in the detailed report.

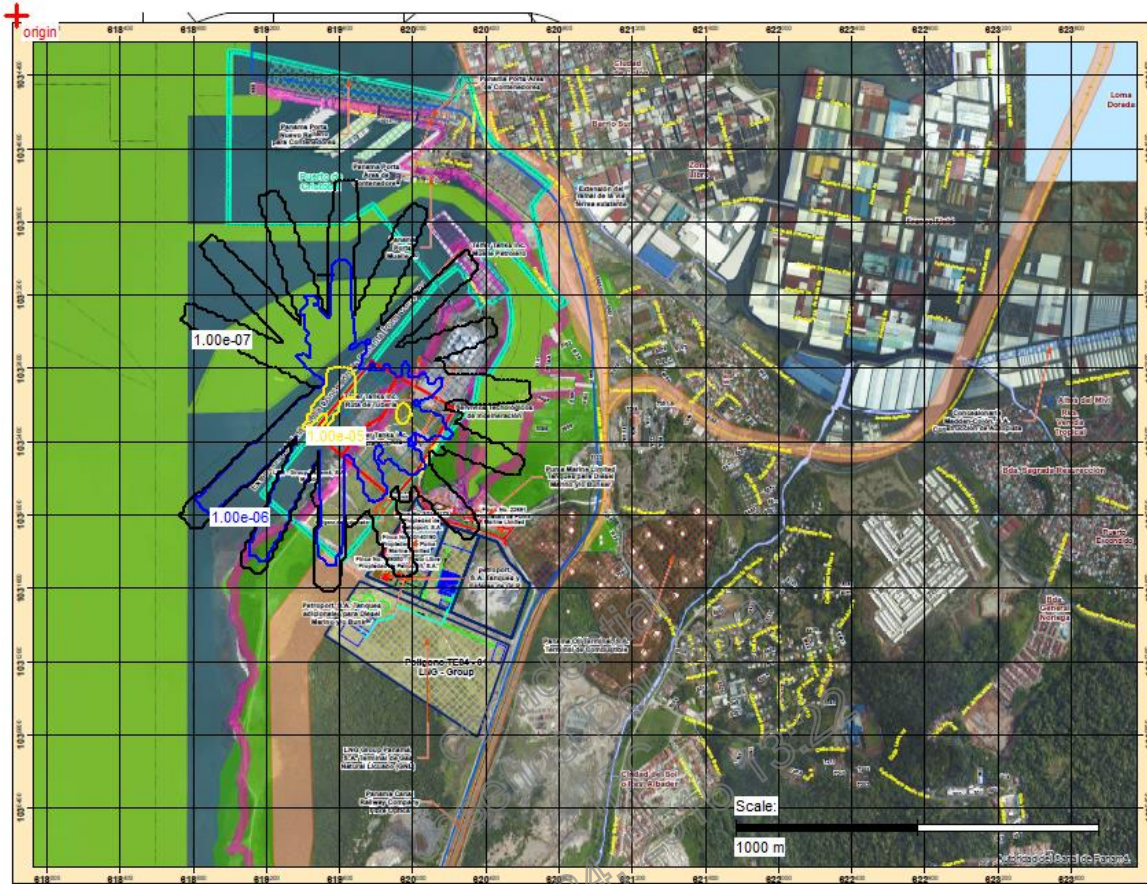
**Isorisk Curve.** The Individual Risk represents the frequency of an individual dying due to loss of containment events. The individual is assumed to be unprotected and to be present during the total exposure time. The Individual Risk is presented as contour lines on a topographic map.

As a first result of this QRA, Figure S.1 presented below the isorisk curves on a Costa Norte LNG terminal site map. It can be seen that the curve isorisk 1 E-5 (yellow) does not escape the limits of the property, provided that indicated in NFPA 59A 2013 Table 15.10.1 standard.

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**Figure S-1** Isorisk Curve for Costa Norte LNG Terminal

**F-N Curve.** Figure S.2 provides the data from this risk assessment effort in a Frequency-Number (F-N) curve format (AIChE 2009). On the horizontal axis of the figure the number of expected fatalities per event is plotted. In this study, that ranged from 1 fatalities to 1000, based on the number and location of personnel in the terminal (which only threatened personnel located outside). The vertical axis is a cumulative frequency distribution, marked as the blue curve. The points along the blue curve represent the sum of the frequencies of all events that lead to N or more fatalities. For example, the cumulative frequency of events that would result in 1 fatality is approximately 3 E-5 per year. Similarly, the frequency of all events in the risk assessment that could result in 10 or more fatalities is less than 10 E-6 per year. It should be noted that F-N curves are generally used to display societal risk results (i.e., threats to members of the public surrounding a facility). For the LNG terminal examined in this assessment, there were no events postulated that would cause public safety impact, all of the data shown on Figure S.1 represent potential threat to personnel working in terminal or on the ships docked at the terminal.

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The red and the blue lines on the F-N graph are examples of criteria often used to judge the acceptability of expected risk risks. For example it is the criteria presented in Chapter 15 of NFPA 59A. It divides the graph into three regions.

- **Unacceptable risks** - Above the top (orange) line events would be considered “unacceptable” and further risk reduction is required.
- **As Low As Reasonably Practicable (ALARP)** – Between the orange and green lines, events are considered tolerable, but additional, practical risk reduction measures should be considered.
- **Broadly Acceptable** – Below the green line events are considered low enough that additional risk reduction efforts are not called for (but should be considered if opportunities for such reductions present themselves).

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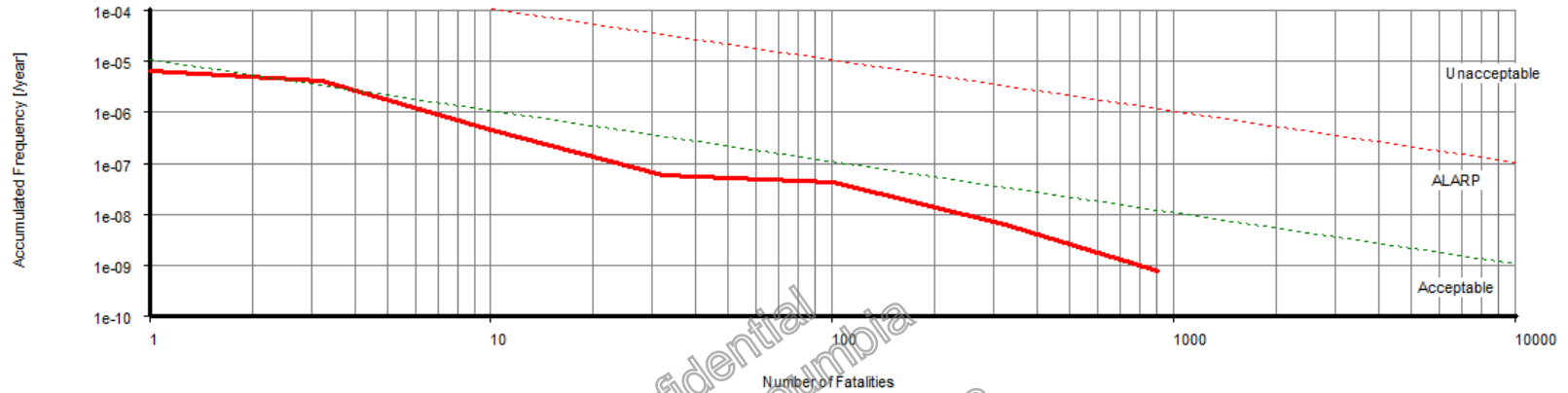


Figure S-2 F-N Curve for LNG Terminal Risk Results

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Based on the conservative risk assessment approaches used in this study, it is expected that, for the events included in the study, the estimates presented here over predict the risk. However, there are likely to be many other occupational issues and risks associated with ships (e.g., engine room fires, accommodations block fires) and terminal operations (e.g., small boat accidents, drowning, falls, maintenance accidents) that are not addressed here but that could cause fatalities on a more frequent basis.

The most severe events examined in this study are flash fires (e.g., releases where the flammable cloud is not immediately ignited, it extends to engulf a large portion -or all- of the terminal, and then ignites) and pool fires (where a pool of LNG burns as it evaporates). Conservatively, flash fires are assumed to cause all located outdoors and within the cloud to become fatalities and pool fires (based on the specific distance from the pool) also cause fatalities in a very short period of time. In fact, it is likely that some of the personnel would be able to take shelter before such a flash fire occurred or before a pool fire caused life caused serious injury. Also, in cases where the emergency shutdown (ESD) system was assumed to fail, the analysis assumed that there was no immediate detection of the release. In reality, in many cases where the ESD could fail to initiate the desired shutdown actions, it might still provide alarms that would alert the operators to take an emergency response (including seeking shelter).

Another conservatism in the analysis in this report stems from assuming that the radiant heat from jet fires (e.g., large releases from the high pressure natural gas lines) extends equally in all directions. In fact, the heat projected in various directions can vary greatly due to orientation of the jet fire (e.g., up, down, horizontal, toward personnel locations, away from personnel locations). The analysis does not account for all possible orientations, it assumes a worst case impact that all personnel expected to be outside of shelters or the ships would receive a radiant heat exposure based on their distance from the assume leak location.

In addition to estimating the risks discussed above, the assessment team also considered other information that could not be directly reflected in the risk results. These qualitative aspects of risk management include:

- **Siting of the terminal** – The terminal location is further from members of the public than any of the impact distances estimated for LNG events examined in this study. That indicates that worst case events at the terminal should not present any hazardous situations (i.e., severe thermal radiation or flammable concentrations) for members of the public.
- **Compliance with codes and standards specified by Costa Norte LNG terminal and implemented by AES for the terminal equipment** – Use of LNG codes and standards based on decades of industry experience means that measures will be included in the terminal design that reduce both the expected frequency and consequence for events that, although not likely, can occur.

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**Commitment to safety management** - Based on the codes and standards mentioned previously and other discussions with the AES project team, it is clear that management of LNG related risks is a major objective in their implementation of this import terminal project. In addition, AES's consideration of the recommendations provided in the HAZID report that have been considered in the design of this terminal.

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# 1 INTRODUCTION AND OBJECTIVES

ABS Group conducted this Risk Assessment to:

- Identify worsts scenarios of potential hazard scenarios during the HAZID carried out the 25<sup>th</sup> and 26<sup>th</sup> February 2016 in Panama, on AES offices. Reviewing in the layout design proposed by the design, that can lead to accident involving LNG and NG that may cause impacts on personnel and members of the public.
- Review the consequence of potential hazard scenarios identified in the layout design proposed that can lead to accident involving LNG and NG that may cause impacts on personnel and members of the public.

## 1.1 PHYSICAL SCOPE


The risk assessment effort was based on the information that was available in February and March 2016, including information (primarily regarding LNG layout design) available during the HAZID meetings conducted the days of February 25<sup>th</sup> and 26<sup>th</sup> 2016 and information provided by AES to review this risk assessment report.

In addition to the information provided by the participants in the HAZID meetings, the primary source of design intent information was provided by AES in March 2016. It was prepared for release to design, construction, and operations firms in order to obtain input from potential bidders on the project.

There is currently one layout option being considered by the project team, which is:

### **Layout: Unloading LNG, Onshore Storage and Regasification**

- Across jetty LNG unloading and transfer
  - The jetty head of the terminal shall be designed to safely accommodate LNGC with a capacity in the range of 30000 m3 to 180000 m3. The receiving facility shall be sized to accommodate unloading of the carriers at a rate of 12000 m3/h. The delivered LNG will be unloaded from the LNGC through three 16" unloading arms. LNG discharged from the tanker unloading arms will be directed into LNG storage tank through an unloading line of 36".
  - The LNGC will be kept moored (LNGC used as an FSU, in a rotating system) during an interim period approximately of one year until the commercial operation of the LNG tank. LNG will be transferred at slow flow rates during this period (~80 m3/h) and a maximum of 12000 m3/h between the vessel and the shore installations through three

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by 16" hard LNG arms, and 1 by 16" inch vapor return arm. These arms will be equipped with hydraulic coupler (QCDC) and emergency release systems (PERC).

- The terminal will have one tug boat on stand-by in the bay for the LNGC and one service boat parked on the service platform (for personnel movement).
- LNG storage
  - LNG offloaded from ships will be routed to the storage tank. The tank will be 180000 m3 of capacity and full containment.
- The sendout and vaporization
  - LNG is pumped from the storage tank using In-Tank Pumps. The LNG is routed to the send out pipeline via the Absorber, HP Pumps, and vaporizers from where vaporized natural gas is exported to the power block. Gas will be metered at a metering station before delivery.
  - From the Absorber, LNG is pumped by 3 x 50% HP Send Out Pumps to the LNG vaporizers.
  - The vaporizers type is STV for cold/heat exchange with the power block. 3 x 50% STV shall be installed. The heat will be brought by a glycol-water loop from the turbine air intakes and/or condenser in the power block.
  - Delivery of gas at the meter station will be a custody transfer point at a pressure up to 30.5 barg nominal pressure, at a minimum temperature of 2 °C.
  - The ESD valve immediately downstream of this metering station marks the Battery Limit for the terminal.
- Others
  - The terminal facilities and the LNG ships are protected by a 3.6 km long breakwater.

The layout is depicted in Figure 1.1.

The facilities within the scope of this assessment include:

- The LNG carrier (when moored at the terminal).
- LNG transfer lines including hard arms from the LNG to onshore installations.
- Onshore equipment to deliver natural gas.
- The power block and his equipments.

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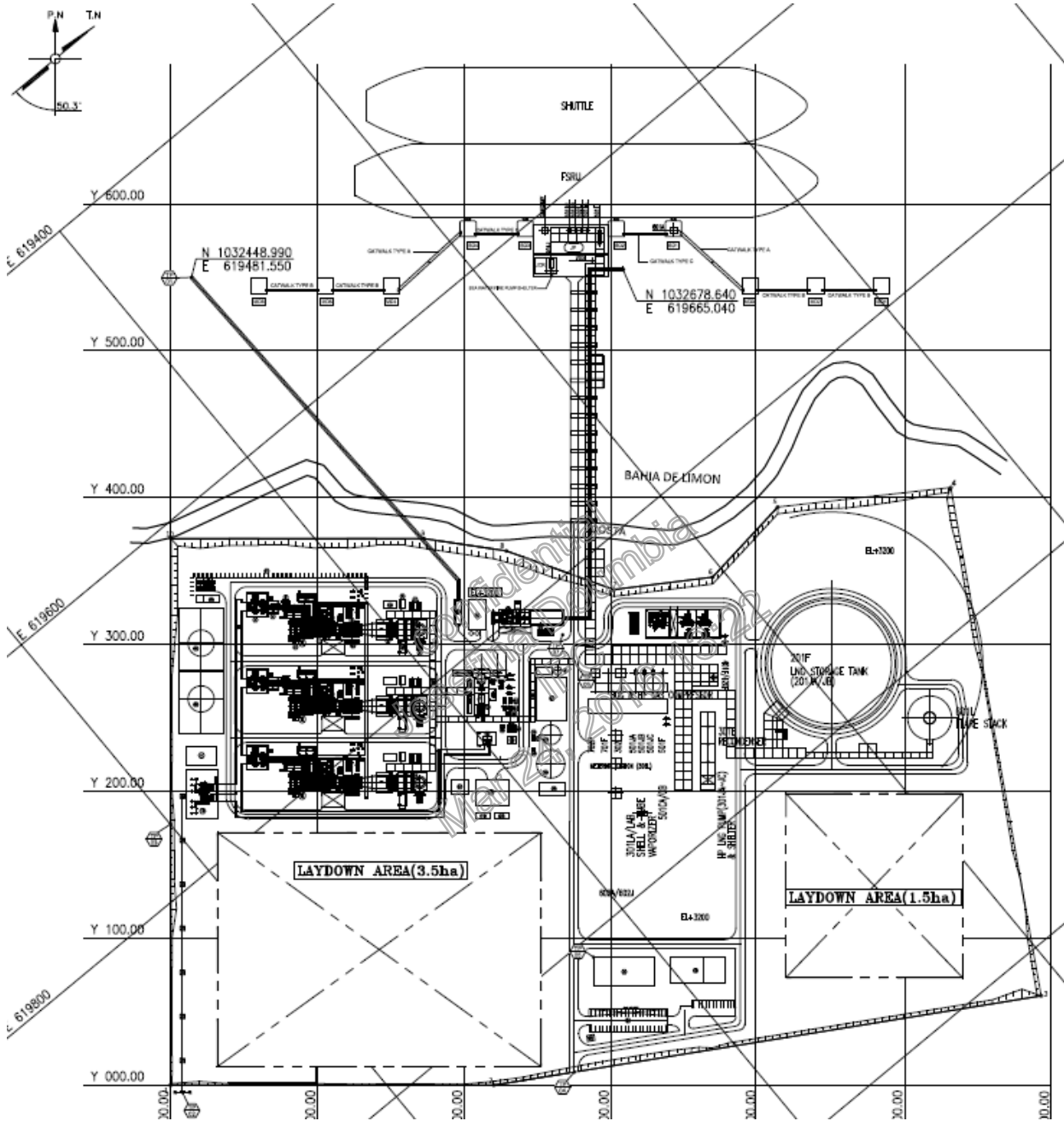


Figure 1-1 Costa Norte Terminal Layout.


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### 1.1.1 Additional Considerations

The results of this risk assessment reflect the current terminal design being implemented by the EPC contractor as required by AES for Costa Norte terminal. The following table reflect some valid considerations to keep in mind.

**Table 1-1 Summary of Considerations**

<p><b>Additional Details for Safety Systems and Mitigation Approaches.</b> Since this risk assessment was performed during the conceptual design phase, there was very little information regarding the safety system and LNG release mitigation approaches. There was a commitment by the project that the terminal would meet recommended guidelines where appropriate, but the risk assessment the team had to assume what those safety systems and measures would be. For this risk assessment, AES provided additional information regarding use of approaches that Tractebel have implemented in numerous LNG projects. These included:</p> <ul style="list-style-type: none"><li>○ Limiting the number of flanges and other potential leak points to the atmosphere.</li><li>○ Limiting the areas (i.e., fire zones) in which potential leaks might occur and providing spillage collection areas that would route potential liquid spills to impoundment areas that are provided to accumulate spills and are provided with the ability to provide a foam blanket over any accumulated LNG.</li><li>○ Provision of flammable gas, fire, and low temperature detection in the fire zones.</li><li>○ Low temperature embrittlement protection and fire proofing where needed for structural integrity in release situations.</li><li>○ Electrical classification of the jetty area beyond what is explicitly required by code.</li><li>○ Powered emergency release coupling and emergency shutdown systems that are designed for highly reliable operation and analyzed via a Safety Instrument Level (SIL) approach.</li><li>○ Firefighting equipment including monitors and fixed water sprays for specific equipment/areas to reduce heat loads if a fire occurs.</li><li>○ CCTV's for process monitoring, access control and security.</li></ul> <p>These details provide the risk assessment team the confidence to use both generic and LNG-specific failure data that has been collected over the years for systems with similar (or even lesser) mitigation philosophies. It helps ensure that the analyses provided here are appropriately conservative.</p>
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**Differences in Assumed Terminal Throughput.** This risk assessment assumed that the terminal would accept LNG from an LNG carrier 7 times during each year of operation and the carrier would spend about 52 days transferring cargo on each visit. After the construction of the LNG Tank the time needed for complete the discharge of full cargo of the LNGC will be quickly (~16.5 h). This study should consider this time approach in both Phases.

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## 1.2 ANALYTICAL SCOPE

The scope of this risk assessment includes evaluation of hazards that can lead to potential accident scenarios involving the LNG and NG systems, equipment (e.g., piping, arms, vessels, valves, piping, etc.), and activities and the magnitude that these accidents can have on adjacent port facilities, communities, etc. Events or conditions that contribute to those accidents scenarios include equipment failures, human errors, and natural events external to the terminal. However, the study does not consider specifically address scenarios related to terrorism events because such activities are considered low risk in Uruguay. The study is limited to: LNG Terminal, the Jetty, LNG transfer equipment, the LNGC, the natural gas pipeline up to the point where it exits the terminal and the Power Block. Only accident scenarios related to the operational safety of facilities involved (fires, explosions and releases flammable materials) are included in the scenarios in this assessment. It is not part of the scope of this effort to analyze events related only to occupational safety at the terminal facilities.

## 1.3 PROJECT TASKS


The projects tasks that comprised the preparation of this updated risk assessment included:

- Selection of appropriate LNG release scenarios for the revised design and operations.
- Development of event tree models for accident scenarios which required consideration of safety system capability.
- Estimation of expected frequencies and consequences for the selected scenarios.
- Evaluation of the acceptability of the risk posed by the terminal based on the likelihood and consequences of the scenarios evaluated.
- Documentation of this risk assessment report.

## 1.4 REPORT ORGANIZATION

Section 2 of this report provides a summary of LNG accidents including discussion of historical industry experience in order to provide perspective on the long and very safe history of LNG transportation and use around the world. Section 3 presents the LNG properties and hazards. Section 4 describes the analysis results, including:

- the release scenarios evaluated.
- the frequency analysis of selected of those release scenarios.
- the consequence analysis results for each scenario.

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Section 5 of this report provides the risk evaluation of the scenarios analyzed in this report comparing them to industry experience and other risk results. Section 6 lists references considered performance of this study and in developing the recommendations. Appendix A provides a list of the historical events involving LNG releases that supports the discussion in Section 2 of that incident history.

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## 2 LNG ACCIDENT/INCIDENT HISTORY

This chapter describes a selection of LNG-related accidents and incidents that have occurred in order to illustrate the kinds of safety issues that have (and have not) occurred during more than four decades on LNG operations. Appendix A to this document provides additional information regarding the LNG events that have been reported.

### 2.1 HISTORICAL LNG INCIDENTS

As part of this assessment, the risk assessment team examined the overall LNG accident record. This examination served to three purposes:


- To help understand the overall safety/risk of the LNG industry.
- To ensure that the events considered in this risk assessment include the kinds of events that has occurred in the LNG industry (i.e., ships and terminals) over the last 40 years.
- To help provide the reader with perspective regarding LNG safety based on past experience as they review. The results presented in this report.

This chapter documents an extensive summary of incidents and accidents involving LNG (or at least that have occurred at LNG facilities) - see Appendix A. This collection of events identified over 90 events, including events involving LNG carriers, import terminals, export terminals, peak-shaving facilities, and a few testing facilities.

Section 2.1.1 below presents a summary of incidents involving LNG carriers based on a variety of sources, including:

- Safety History of International LNG Operations (CH-IV 2009).
- LNG Safety and Security (CEE 2012).

Section 2.1.2 presents a summary of LNG accidents during LNG transfers. Both sections are supported by Appendix A that presents additional information regarding the events; the event date, location (city, state, country, and/or region), facility, and/or company name, type of facility, event description, and event cause are provided when available. The number of fatalities/injuries and whether the event involved spill/release, fire, and/or explosion are also provided when available. In general, incidents involving LNG spill or release of LNG vapor have no toxic or environmental impacts.

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### 2.1.1 Incidents Involving LNG Carriers

LNG carriers are constructed specifically for the storage and transport of LNG (e.g., with double hulls, extensive insulation, cryogenic materials). LNG carriers must meet requirements specified by the IMO International Gas Carrier (IGC) Code, any specific requirements of the vessel's flag administration, and specific national maritime authority requirements (if any) for the port states where the carrier operates. LNG carrier equipment design, operations, and safety training incorporate numerous spill and accident prevention measures (FERC and MMS 2001). The transportation of LNG by ship has proven to be an extremely reliable method since the first LNG maritime shipment in 1959. Commercial maritime shipments of LNG began in 1964.

Since that time, more than 50,000 shiploads of LNG have traveled worldwide over 100 million km while loaded, with no recorded fatalities to vessel crew or the general public and no recorded fires on deck or within cargo areas. In the shipments of LNG between 1964 and 2002, only 30 LNG carrier incidents have been reported, and seventeen of these reported incidents did not include release of LNG or methane (CH-IV 2002). This includes eleven incidents involving a ship collision, a ship running aground, or ship damage during rough sea conditions. None of these 11 incidents resulted in the spill of LNG cargo (CH-IV 2002).

Additionally, almost all of the LNG carrier transits that make up the industry experience referenced above have involved transits in and out of export and import terminals located onshore, in many cases, in ports with heavy commercial and other vessel traffic (e.g., Tokyo Bay, Boston Harbor, most export locations).

Some specific information on the LNG carrier events tells us that:

- Although there have been about 11 grounding, collision (ship to ship), or collision (ship to fixed structure) incidents involving LNG carriers, none have resulted in LNG releases. In two occasions, an LNG carrier grounded at high speed without suffering loss of cargo:
  - On June 29, 1979, the El Paso Paul Kayser LNG carrier grounded at 17 to 19 knots onto rocks near the Strait of Gibraltar. There was severe damage to the hull bottom, ballast tanks, motors, and the LNG secondary and primary containment membranes were deformed. However, there was no release of LNG, and the cargo was successfully transferred later.
  - On December 12, 1980, the LNG carrier Taurus grounded on rocks at 12 knots. This happened at Mutsure Anchorage off Tobata, Japan. Ballast tanks all flooded, the vessel listed, and there was extensive bottom damage. The LNG tanks were Kvaerner Moss design and were not damaged. The vessel refloated, proceeded under its own power to the Kita Kyushu LNG Terminal, and discharged its cargo

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- In another case, in 2002 the LNG carrier Norman Lady (as it was transiting the Straits of Gibraltar), collided with a U.S. Navy nuclear-powered attack submarine, the U.S.S. Oklahoma City. Apparently, the submarine surfaced under the bow of the carrier. The LNG carrier suffered leakage of seawater into the double bottom dry tank area. LNG cargo tanks were not damaged and both the carrier and the submarine had to be repaired.

**Conclusion:** This historical record tells us that LNG ships are well operated (i.e., few accidents occur, given the continuous operation basis for most LNG carriers). The LNG industry maritime accident record also indicates that even when failures or human errors have occurred, the ships are very robust structures and have not suffered accidental LNG releases, other than small valve leaks and vent releases.

### 2.1.2 Incidents Involving LNG Transfer

The survey identified over 90 events, including LNG carriers (described above) and incidents involving LNG transfer. A summarization of the accidents involving LNG import terminal during LNG transfer process is described below. From that it can be conclude:

- Of the 27 incidents involving LNG vessel - jetty transfer registered during the period of 2005 to 2010: 3 incident report remain unanswered while 24 have reported that the LNG jetty transference incidents have not resulted in a fire or in an explosion outcome (SIGTTO, 2011).
- Of the 60 incidents registered during 1944 to 2004, only 6 incidents were related LNG transfer at import terminal, during off-loading and normal operation. The scenarios are summarized below, for further details please refer to Appendix A.

- In 1995 at Montoir import terminal in France, a LNG Leakage occurred at a high pressure valve of the LNG line in the vaporizer and a LNG import terminal. LNG reached the water causing a rapid phase transaction (RPT). The RPT damaged the plastic structure around the vaporizers. There were no injuries only equipment damage.
- In 1988 at the Everett LNG import terminal in USA approximately 30,000 gallons of LNG leaked through flange gaskets during an LNG transfer interruption. The leakage was contained in a small area. The calm night avoided the movement of the vapor cloud out of this immediate area. There were no injuries and damage other than the gaskets that failed. As a result, both manual and automatic procedures were modified.

– On October 6, 1979 at Cove Point LNG import terminal in USA, LNG leaked through an electric penetration seal too tight at an LNG pump. The LNG vaporized, went through 60

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m of electrical conduit and entered an electric substation. The natural gas was ignited by the normal contacts in the arches of a circular brake, resulting in an explosion. Since the natural gas had never been expected in this substation, there were no gas detectors. The explosion killed one operator, severely injured another person and caused US\$3 million worth in damages.

- In 1973 at Canvey Island LNG import terminal in England, a small quantity of LNG was leaked into a rain water pool during LNG off-loading. The consequent vapor explosion, an RPT, caused loud booms. The incident resulted in broken glass, however no one was hurt.
- On October 21, 1971 La Spezia LNG import terminal in Italy, a storage tank suddenly developed an increase in pressure 18 hours after the completion of the transfer operation. LNG vapors were off-loaded through vents and tank safety valves. The tank ceiling suffered small damage, however vapors did not ignite.
- Again in 1965 at Canvey Island LNG import terminal, LNG spilled from a tank during maintenance. The spill ignited and an employee was severely burned.

**Conclusion:** The historical record indicates that spills during transfers and tank operations are possible, but have never resulted in offsite impacts and have affected very few personnel on site. Annual LNG transfers have greatly increased in number over the last decade, but equipment improvements, safety management programs, and training programs for LNG personnel have also improved, resulting in increased activity without a significant increase in adverse safety consequences.

### 2.1.3 Incidents Involving LNG Fatalities

Of all the events reported since 1944 (i.e., in about six decades), only eight events involved fatalities. Of the eight events involving fatalities, only one involved members of the public. That incident occurred in Cleveland, Ohio, on October 20, 1944 (128 fatalities and 225 injuries). It involved failure of an LNG storage tank (in a peakshaving facility that obviously did not meet safety standards of today) that was located such that the LNG drained into the city sewer system. The LNG in the sewer system ignited and burned for 20 minutes, causing damage to a region of about 3/4 of a square mile in area. The tank was built with a steel alloy that had low (about 3.5%) nickel content. This made the alloy brittle when exposed to the extreme cold of LNG. The consequences escalated because there was no adequate dike to help contain the spill. Because of this event and other improvements made in the codes and standards for LNG facilities, this event is not something that could occur for facilities currently operating

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or under construction (storage tank metallurgy and testing requirements and LNG impoundment requirements that have been implemented since that time).

The other seven fatal events did not involve the public, and two of them were construction accidents when an LNG peakshaving facility was being built or undergoing repair. In these two cases, there was no LNG involved, but these events are often listed in LNG risk studies because they occurred at LNG facilities:

- On February 10, 1973, in Staten Island, New York, 40 workers died during the cleaning/repair of an LNG tank.
- In Portland, Oregon, in March 1968, natural gas (not LNG) leaked into the interior of an unfinished LNG storage tank through a line that was supposed to be blind flanged. This was a construction accident, and neither the tank nor the facility had been commissioned at the time the accident occurred.

Three of the fatal events involved worker fatalities at liquefaction facilities (i.e., where LNG is made from a natural gas production field):

- On January 19, 2004, in Skikda, Algeria, 27 workers perished mostly due to blast overpressures during an accidental release of hydrocarbons.
- On April 14, 1983, three workers died during an accident at a liquefaction facility in Bontang, Indonesia.
- On March 15, 1977, an aluminum valve failed upon contact with cryogenic temperatures in an LNG production facility in Arzew, Algeria. One worker was sprayed with LNG and froze to death.

Two of the fatal events involved worker fatalities at regasification facilities:

- In 1979, at the Cove Point, Maryland LNG import terminal, LNG escaped, vaporized, migrated into an electrical substation, and exploded killing one worker. This event resulted in changes in electrical codes for LNG facilities so such events can be avoided.

- On January 16, 1966, in a peakshaving facility in Raunheim, Germany, an inadvertent venting of 500 kg of LNG resulted in a vapor cloud that drifted toward the control room where it ignited. This caused a fire/explosion and killed one worker (many more were injured).

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### 2.1.4 Conclusions Based on Historical LNG Events

**Public Risks.** The historical record for LNG facilities indicates a long history of LNG terminal operation with no events pertinent to the Costa Norte LNG terminal (because of the use of modern terminal technology) that have impacted members of the public (i.e., no LNG releases from regasification terminals of modern design have caused injuries or fatalities to members of the public). This does not mean that such events are impossible, but is evidence that they are very unlikely.

**Occupational Risks.** While there have been a small number of fatalities involving regasification facilities (i.e., the two events, each with a single fatality – at Cove Point and Raunheim), this level of worker risk is low, given that LNG regasification facilities have operated for more than 40 years and now include scores of facilities around the world. Additionally, in the U.S. the fatality rate is 10 times higher for time spent at home than at work (for all work environments) and workers are one and a half times more likely to be injured at home than at work (NSC 2011 – with both measures presented on an exposure hour basis). In fact, manufacturing facilities (including energy facilities) have injury and fatality rates even lower than these overall worker population estimates, so we would expect LNG facilities to be much safer than average workplaces. This results because of the awareness of the hazard presented by LNG, the safety management programs implemented by facility owners, and the commitment to safety by LNG workers.

While we are not aware of comparable statistics for Panamanian workplaces, standards for LNG facilities like the planned Costa Norte terminal can achieve similar results (note: These fatality/injury statistics include all occupational threats to personnel in the workplace, such as falls, impacts, drowning, vehicle accidents, fires, etc.). The work in this report only addressed scenarios related to LNG or natural gas releases, which should represent only a small fraction of overall occupational risk for employees in the facility. The safety management program recommended in the HAZID report provided earlier to the project should address all occupational risks potentially faced by terminal employees and contractors.

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### 3 LNG PROPERTIES AND HAZARDS

This section presents basic information regarding:

- The properties of LNG (Section 3.1).
- The hazards presented if LNG is released to the environment (Section 3.2).

This information is presented to assist readers who are not familiar with LNG, its properties, and potential hazards. If you already understand that information, you may wish to skip this section and focus on the LNG risk assessment activities and results (Sections 4 through 5).

#### 3.1 LNG PROPERTIES

LNG composition varies with the source location and operating conditions where the LNG is liquefied. Typically, imported LNG is about 95 to 97 percent methane in liquid form, and the remainder consisting of ethane, propane, and gases (e.g., carbon dioxide and nitrogen). When natural gas is cooled to -162 °C (-260 °F), it decreases in volume and becomes a clear and odorless liquid. LNG is transported and stored at near atmospheric pressure. LNG within a well-insulated storage tank does not need refrigeration. The insulation reduces external ambient heat from warming the LNG. As the liquid vaporizes and expands to form a gas within a LNG storage tank, a pressure slightly above atmospheric pressure is maintained. This elevated pressure precludes air from entering the storage container.

Pertinent physical properties for LNG include:

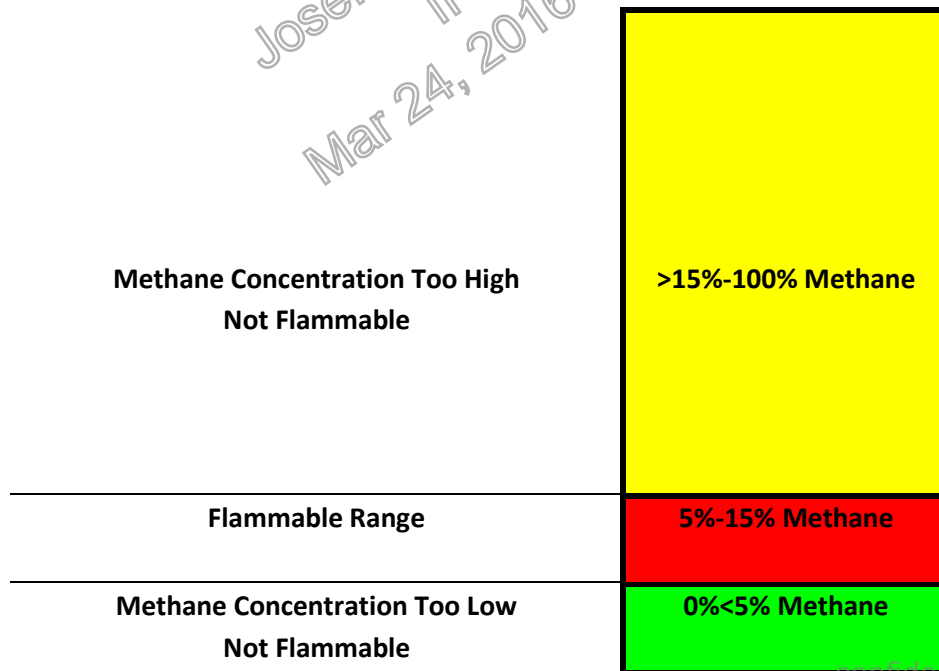
- LNG is colorless, odorless, and non-toxic.
- LNG vapor can asphyxiate humans by displacing air. This is primarily a hazard to personnel in confined spaces.
- When initially vaporized, LNG vapor or a vapor/air mixture will generally be colder and denser than the ambient air and will remain heavier than air, until it warms up. The vapor cloud at cold temperatures would be visible because of the condensed moisture forming a fog.
- Methane gas at ambient temperatures is lighter than air.
- Methane gas occupies about 600 times more volume than LNG.
- When mixed with air, the lower and upper flammability limits of methane are 5 to 15 percent natural gas by volume, at 77°F (25°C). Outside these limits as shown in Figure 3.1,

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methane/air mixtures will not burn or combust. However, it needs to be recognized that any release of LNG to the atmosphere results in some part of the resulting vapor cloud being within the flammable range as the cloud mixes with air, disperses, and at some point drops below the flammable range.

- LNG is a flammable gas, but when compared to other fuels (e.g., LPG, gasoline, and diesel); it has the highest auto-ignition temperature.
- If unconfined mixtures of LNG vapor in air are ignited, the flame would burn back through the flammable vapor cloud toward the source of the release. No significant overpressure or explosion effects would occur.
- However, ignition of a flammable LNG mixture in a confined or highly congested space could result in a vapor cloud explosion.
- When spilled onto water, a physical phenomenon called a Rapid Phase Transition (RPT) (the result of rapidly absorbing heat from the sea), can occur as the methane rapidly transitions from its liquid phase to its gas phase. (Note: This phenomenon is not a form of combustion.)

Regardless of the cause of a spill, the size of the resulting flammable methane/air mixture and its movement depends on the quantity and rate of the spill, whether it is on land or water, the stability of the atmospheric conditions, specific wind conditions, and the temperature of the atmosphere and water.



**Figure 3-1 Flammable Range for Methane in Air (Methane is the primary component in LNG)**

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### 3.2 POTENTIAL LNG HAZARDS CONSIDERED IN THIS STUDY

There are hazards potentially associated with large releases of LNG or natural gas that could result in impacts over wide areas and affect the general population. The hazards depend on the process conditions of the material being released.

#### For low pressure LNG [e.g., LNG transferred between vessels at pressures up to 6 barg]

- When released to ambient environmental conditions, the LNG will drop to the surface of the deck, jetty, or the water and begin to vaporize. Since there is not generally enough heat transfer to vaporize all of the LNG instantly, a liquid pool will form that grows as long as the rate that LNG is released is larger than the rate that the available heat transfer can vaporize. The pool will spread as it also boils, producing methane vapor.
- Initially, the LNG vapor concentration in air will be above its upper flammable limit (i.e., it is too rich in fuel to burn). Very quickly, however, the vapor will move downward and downwind and continue mixing with air, eventually reaching the flammable range (i.e., between the upper and lower flammable limits for methane in air) (note: Although methane is lighter than air, in the early stages of an LNG release, the cloud will be very cold and the mixture of cold air, water vapor, and methane will behave like a heavy gas, and it has to be analyzed as such). The cloud will continue to move downwind, with its concentration at the edges of the cloud being below the flammable range and some fraction of the cloud being within the flammable range.
- If a portion of the cloud within the flammable range encounters an ignition source, the cloud will catch fire and the fire will burn back toward the source of the release. In open areas, this will result in a flash fire, followed by a fire that burns vapor that comes off the pool of liquid that has formed. If any portion of the flammable vapor cloud has accumulated in an area that is congested or confined, that portion of the cloud may produce a vapor cloud explosion, generating overpressure that potentially can cause injuries or equipment damage.

Based on these effects, for the large, low pressure LNG releases examined in this study, we estimated the consequence types below:

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- **Flash fire**, represented by the maximum distance for which a flammable cloud would extend (i.e., range to lower flammable limit). If people are located within the downwind area to that distance when the cloud ignites, they could be injured or killed.


At the client's request for this risk report, that analysis also presented the distance to which **1/2 of LFL** would potentially reach. For consistency, we report 1/2 LFL distances in this report as well. It is true that some regulations and codes (e.g., NFPA 59A) use the 1/2 LFL point to provide additional conservatism in their consideration of the flammable hazard. However, the 1/2 LFL value is used for a siting criteria that is not risk-based, it is simply a specific dispersion analysis that defines a siting criteria. It is not used for consequence calculations or risk assessment purposes. This risk assessment for the terminal and the analysis in this report doesn't assume any potential fatality impacts in areas beyond the estimated LFL distances. Although we recognize that the LFL concentration will not necessarily be completely uniform at the maximum LFL distance, we believe that the conservatism of the vapor dispersion assumptions (i.e., very stable atmospheric conditions, low wind speed, no interference/turbulence from structures and wind in a constant direction throughout the period of the release and downwind travel of the vapor cloud) make the distance calculated conservative enough to address the maximum extent of the LFL, even with possible non-uniform concentration patterns (i.e., pockets of higher concentration vapor).

- **Vapor cloud explosion** with potentially damaging overpressure if a large area of flammable vapor developed and was ignited in a confined or highly congested area. For this study, we the areas deemed congested were:
  - The location on the LNGC between the bridge and the accommodations area.

The jetty top sides as well as the service platform are not congested spaces because they are well ventilated and they are 'open to the sky'.

If a vapor cloud from a postulated release could reach on of these areas, the assessment assumed that an explosion could result. The factor of interest for VCEs is the distance to which dangerous overpressure levels would reach.

- **Pool fire** is the third type of consequence of interest for low pressure LNG releases. If the release finds an ignition source early, or if a late ignition creates a flash fire that burns back to the pool, a pool fire will result that burns off the flammable vapor that evaporates from the pool. This type of fire threatens unprotected people or structures due to the level of radiant heat it produces. For pool fires, the reported result is the distance to which specific radiant heat levels would extend. Note: For the relative short duration releases postulated

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for even worst case release events for the terminal (e.g., five minutes) pool fires would not last very long (i.e., minutes rather than hours).

**For high pressure LNG releases [e.g., at about 110 barg]**

To produce natural gas at gas pipeline pressures (100 bar), the terminal will pump LNG at 110 bar through the LNGC. An LNG release from that pressure to the environment is expected to result in formation of aerosol droplets and rapid vaporization and mixing of the LNG. If ignited, it would result in a jet fire, like a release from a high pressure natural gas line. That type of fire can cause damage to any structure within the extent of its flame and presents radiant heat impact on people or equipment near the flame. High pressure releases are very likely to ignite in the short term. If they do not, the high velocity jet will continue to disperse until it loses its momentum and eventually drops below the lower flammable limit. Ignition that does not occur at the initial time of release is likely to flash back to the source of the release and then present jet fire hazards.

Based on these effects for the high pressure LNG releases, this assessment includes the consequence of **Jet Fire** and downwind distances for the specific vapor concentrations (**UFL, LFL and 1/2 LFL**) and reports them in Table D.1 (provided in Appendix D) as “Gas Dispersion”.

**For high pressure natural gas releases (e.g., from the natural gas pipeline at 100 bar)**

The releases postulated for the high pressure natural gas pipeline will result in high energy jet formation. If ignited, these scenarios are modeled as **Jet Fires** and if unignited will present flammable hazards along the length of the jet as it mixes with air, so this study also reports the distances to the **UFL, LFL and 1/2 LFL** under the name of Gas Dispersion. A **VCE** can occur for large HPNG leaks if there is a delayed ignition and the jet flow is blocked by process equipment, or buildings, or trees that provide congestion. A **Flash Fire** is also possible if there is no congestion/confinement and a delayed ignition. The distance reached by flash fire hazard is bounded by the flammable gas concentration distances. Therefore the reader should refer to gas dispersion flammability concentrations in order to observe the maximum distance potential for flash fire hazards.

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### 3.3 OTHER POTENTIAL LNG HAZARDS NOT INCLUDED IN THIS STUDY

Other potential hazards can occur but they are not considered pertinent for evaluation of the significant risks from potential LNG releases. These hazards include effects that are either only pertinent in specific situations or that industry information indicates is not pertinent to the terminal.

- Asphyxiation (i.e., loss of consciousness due to lack of oxygen) that could occur if a person was exposed to very high concentrations of LNG vapor, like could occur in a confined space.
- Frostbite that could occur if a person was contacted directly by LNG because of its very low temperature.
- A rapid phase transition (RPT) that could occur from rapid expansion of LNG in contact with water or another surface much warmer than the LNG.
- The potential for a fireball resulting from a boiling liquid expanding vapor explosion.

**Asphyxiation** - Even though LNG vapor is not toxic, a vapor cloud could displace enough air to make the atmosphere unsafe for humans to breathe. This represents a hazard to the personnel in close proximity to an LNG release (i.e., terminal and/or shipboard personnel), especially if a person enters a confined space with a high vapor concentration. However, any such spaces that contain LNG equipment and are accessed by personnel will either be routinely monitored by gas detection or will require atmospheric testing prior to entry. Vapor in the open atmosphere due to LNG releases presents a flammable hazard that is considered more of a threat than any potential for asphyxiation.

**Frostbite and other Cryogenic Effects.** The low temperature of LNG is also sufficient to cause rapid frostbite, severe tissue damage, or death, should a person's skin be directly exposed to LNG. These conditions are only a threat to personnel immediately at the point of release and are controlled by minimizing leaks and using proper safe work practices and personal protective equipment.

Furthermore, as a cryogenic liquid, LNG quickly cools the materials it comes into contact with, and causes extreme thermal stress, in materials not specifically designed for low temperature conditions. These thermal stresses can cause brittleness and possible fracture of common construction materials, including certain steels, which are used for some portions of an LNG carrier (FERC 2003) or typical terminal construction. However, applicable regulations (USCG 46 CFR 154, 2004) and codes and standards that the applicant will follow for this terminal design (e.g., National Fire Protection Association [NFPA] 59A, 2013) require that areas likely to be exposed to such

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conditions include design measures to address the potential for brittle fracture or other low temperature effects.

**Rapid Phase Transitions (RPTs).** RPTs can occur when the temperature difference between a hot liquid and a cold liquid is sufficient to drive the cold liquid rapidly to its superheat limit, resulting in spontaneous and explosive boiling of the cold liquid. When a cryogenic liquid such as LNG is suddenly heated by contacting a warm liquid such as water, very rapid boiling of the LNG can occur, resulting in localized overpressure releases. In spill experiments, energy releases equivalent to several kilograms of high explosive have been observed. The impacts of this phenomenon would be localized near the spill source and should not cause extensive structural damage (Sandia 2004). RPT consequences are not included in the scenarios examined in this study.

**Boiling Liquid Expanding Vapor Explosion (BLEVE).** Some discussions of LNG hazards also address BLEVES. BLEVES occur when a pressure vessel containing a liquid above its boiling point fails catastrophically, releasing a large quantity of flashing liquid instantaneously. If the liquid is flammable, the BLEVE event can cause an intense fireball in addition to projecting pieces of the failed vessel for long distances. BLEVES have occurred for onshore propane and butane vessels, but are not considered a potential outcome for LNG vessels or equipment at the LNG terminal and therefore consequences for BLEVE events are not included in this study. A BLEVE would require that a large external fire exist for a long period of time to cause the pressure inside the LNG tank to rise to a significant level such that upon tank failure due to thermal weakening a large flash of pressurized methane would occur. However, the LNG containers used on LNG ships and in LNG terminals cannot hold a pressure sufficient to cause a large flash of liquid and consequent BLEVE event. This is true for both membrane and spherical design LNG tanks on LNG vessels (**SIGTTO, 2009**) and for typical onshore LNG tank designs. Additionally, ships storing LNG have a combination of physical barriers (e.g., double hull, deck plating, tank covers, insulation) that make direct thermal input to the LNG inner tank more limited than that required to cause a BLEVE. The terminal does have a couple of small pressure vessels in its design (i.e., the buffer drum designed for 10 barg and the drain drum designed for 8 barg). However, these vessel are typically filled with LNG and in locations where they would be expected to be exposed to the kind of flame impingement that is required to cause a BLEVE. For these reasons, we do not consider a BLEVE a credible event for the LNG terminal and consequences for them are not included in this report.

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## 4 ANALYSIS RESULTS

This section describes the results of the various tasks implemented in performing this risk assessment.

- The scenario frequency assessment (Section 4.1).
- LNG release consequence analysis (Section 4.2).
- Risk assessment (Section 4.3).

### 4.1 SCENARIO FREQUENCY ASSESSMENT

After the HAZID meeting (presented in Appendix B) and the selection of the specific scenarios to analyze in detail, the ABS Group members of the assessment team reviewed each event to determine how the frequency of the event would be assessed. The team used event tree logic models to brainstorm safety functions, phenomenology, and potential outcomes. The starting point of each event tree is termed an initiating event or top event. An initiating event is an event that could eventually result in an accident scenario of interest. The likelihood of occurrence of each initiating event was estimated based on the frequency of occurrence of hydrocarbon (LNG or NG) release from lines and equipment in the respective section/ system. The branch points of an event tree represent the various engineering and administrative controls whose successes or failures define the spectrum of scenarios that can develop from an initiating event. A more complete discussion on developing event trees can be found in Section 6.10 of the *Guidelines for Hazard Evaluation Procedures* (CCPS 1992).

#### 4.1.1 Failure Data Selection

All data for this study (including the branch point probability numbers) are single-point; “best-estimate” values. The true number may be higher or lower than the estimate; the scope of this study does not include uncertainty analysis to analyze the upper and lower bounds of these values. Typically, for a risk study like this, a best-estimate analysis is sufficient to provide the information needed to make a risk-informed decision.

The data estimates used here are based on (1) discussions with operating and engineering personnel, (2) review of industrial equipment failure databases, and (3) consideration of potential human error considerations. Actual experience is preferred, but we supplement any available data from our own database library, as needed. ABS Group’s database library consists of (1) documentation of our experience from similar industrial facilities and (2) most applicable generic databases (e.g., the Center for Chemical Process Safety’s Gray Book, Guidelines for Process Equipment Reliability Database). The

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initiating event frequencies were derived from the report *Failure Rate and Event Data for use in Risk Assessment* (HSE 2012) and *LNG Risk Based Safety*, (CCPS, 2010). It provided data specific to liquefied gas loading arms. In some cases, the data presented in and the *Offshore Reliability Data Handbook* (OREDA 2002) and the *Safety Equipment Reliability Handbooks* (Exida 2007) were considered as well.

Although the LNG industry is working to accumulate release data (e.g., GIIGNL 2004) that data is of limited use in estimating the frequency of rare events. The large consequence events of interest in this study are rarer than the events that have been experienced in the industry. The “problem” that there is limited data to perform risk assessment of significant events in the LNG industry is a reflection of the safety achieved by the industry (i.e., very few events have occurred from which to develop failure frequencies and other risk data).

The largest releases deemed credible in the HAZID review were associated with loading arm failures. However, the proposed facility design has specific safety features to deal with such releases, so in this portion of the risk assessment, the team examined those scenarios using event tree models. The event trees represent an accepted approach based on industry experience and risk assessment approaches used for other recent LNG terminal risk assessments. The models consider:

- the likelihood of external damage to the unloading arms.
- subsequent success or failure of the safety systems to terminate the LNG release immediately (i.e., by successful actuation of the PERC devices).
- followed by actuation of the emergency shutdown system and closure of the remotely operable isolation valves.

These events could occur during the transfers described above, but the event tree analyses only address releases from the unloading arms; releases from other sections of line (e.g., fixed piping) involved in those transfers are described separately, see Appendix D. Because of the high integrity of the fixed piping, the frequency of process piping leaks and the size of potential releases from fixed piping sections are considered smaller than is possible for releases from the unloading arms which are periodically connected/disconnected and are subject to ship movements.

Because of these safety systems, the event trees were required to properly assess the frequency of these potential releases. It requires the estimation of:

- Frequency of the initiating event (i.e., damage to the arms or inadvertent disconnection during transfer operations);
- Safety system failure on demand probabilities for:
  - PERC system.
  - Emergency shutdown system.

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Small leakage is possible during unloading arm operations, but such events are mitigated by proper connection procedures (including measures such as pressure testing) and rigorous monitoring during the

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transfer (both by gas detection equipment and the operating staffs on the ship and on shore). The magnitude of the releases examined here would only occur if an arm was grossly damaged or inadvertently disconnected during operation. For that to happen, the initiating event would have to be unanticipated (i.e., the condition would have to occur rapidly, in a manner that did not lead the ship or staff to discontinue the transfer). Very few of these types of event have occurred in the history of LNG marine transfer, which represents about 50,000 LNG carrier deliveries. Since each delivery involved both a carrier loading and unloading process, this represents 100,000 vessel transfers, with typical transfer duration of a day or less.

Although some extreme vessel motion/pull away events have occurred, none of the events reported have resulted in major damage to arms such that large releases resulted. (Note: There is no formal data base that documents such events; the analysis here is based on accounts in industry meetings and personal communication with industry representatives). The most severe events that have been reported have occurred due to extreme swell conditions or very rapid wind storm development.

Based on information from the project team including AES, the Costa Norte LNG terminal will employ current LNG industry technology and controls (e.g., modern hardware, instrumentation, and process/procedural controls). However, available data sources are based on the performance of existing terminals, that may not be as sophisticated as the proposed terminal will be. For example, many of the older terminals do not employ modern day mooring equipment and instrumented systems for monitoring mooring line loads. Even older terminals may not have modern ESD and PERC systems.

In this analysis, we used the initiating event data for the transfer of liquefied gases through ship hard arms (Data Item FR 3.3.1) from the HSE failure rate report (HSE 2012). For full rupture of an arm (i.e., guillotine break), the report provides a failure frequencies per transfer operation of 12 hours of:

- Single arm 7 E-6.
- Two arms 1.3 E-5.
- Three arms 1.9 E-5.

For the initiating event frequency for Figure 4.1 (Transfer Arm Rupture During Unloading from LNGC) the risk assessment team used the a frequency for failure of one of three arms, adjusted for 7 transfers per year and an average unloading time of 16.5 hours duration. Scenarios were developed separately for the arms on the LNGC and the transfer line to the onshore equipments (Scenarios S.2 and S.3, respectively). These data and assumptions resulted in the following initiating event frequencies for rupture of one of the three arms in service for a vessel:

- Frequency for inadvertent arm disconnection during LNGC transfer for 7 = 1.74 E-4 events per year.

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### Failure Probabilities for PERC and ESD System

Detailed information for the PERC and emergency shutdown systems was not available when this study was initially performed. Since there is no reliable database for failure on demand probabilities for this type of equipment, one approach would be to model these systems at the component level and estimate system failure probabilities. However, that type of reliability/failure analysis requires very detailed design, operations, and maintenance/testing information that is not yet available for this terminal. Because of these limitations, the risk assessment team made conservative estimates of the necessary failure probabilities. That conservatism results in overestimation of the failure frequency for the scenarios involving this equipment; even those overestimated results represent relatively low risk due to LNG releases.

**PERC Failure on Demand Probability.** For the PERC systems, the team assumed a failure on demand probability of .01 (i.e., we assumed the PERC system would be successful 99 times out of 100 times it is needed). The PERC system is a relatively simple mechanical system, but involves closing two actuated valves and actuating the de-coupling mechanism, allowing the arm to separate into two pieces). A similar application would be a power operated relief valve, which typically is assumed to be .99 to .999 percent reliable (i.e., failing 1 out of 100 to 1 out of 1000 times it is demanded). The team assumed the upper end of the relief valve failure range because the PERC requires at least two actuations (i.e., the upstream valve and the decoupler) to prevent a large LNG release. This assessment is also consistent with the project requirement that the PERC system meet safety integrity level 2 (SIL 2) reliability.

**ESD System Failure on Demand Probability.** The ESD system consists of a combination of instrumentation, logic solvers, and actuation devices (e.g., switches to stop pumps, valves to stop flow). That complexity would generally mean such a system could be less reliable than a simple mechanical system like the PERC; however, LNG ESD systems generally include redundancy to address the need for higher reliability. Based on the description provided by AES for the proposed ESD design and the commitment to employ an appropriate safety instrumentation level design approach, the risk assessment team assumed an ESD system probability of failure on demand of .01 for the LNG carrier unloading ESD. The failure on demand probability for the LNG carrier system reflects the ease with which that ESD system can be tested, since unloading requires less than a day and is estimated to occur 7 times a year. For the leak analyzed for the high pressure natural gas line, the analysis team assumed that a lower reliability for the ESD is appropriate and used a .01 failure probability. Along a pipeline it is more difficult to place detectors adequately and also, low temperature detectors that are used in LNG areas do not apply for the gas pipeline.

### **4.1.2 Event Tree Frequency Analysis for Unloading Arm Releases**

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The largest LNG release rates considered in the scenarios examined in this report are those associated with full bore releases from the unloading arms. Because of the safety systems (i.e., the PERC and ESD systems) that apply to these releases, the risk assessment team estimated the frequency of these scenarios using event trees.

Figure 4.1 - Large release of LNG from transfer arms on the jetty head (Scenario S-2) provides a graphical view of the frequency analysis for events representing releases from the unloading arms.

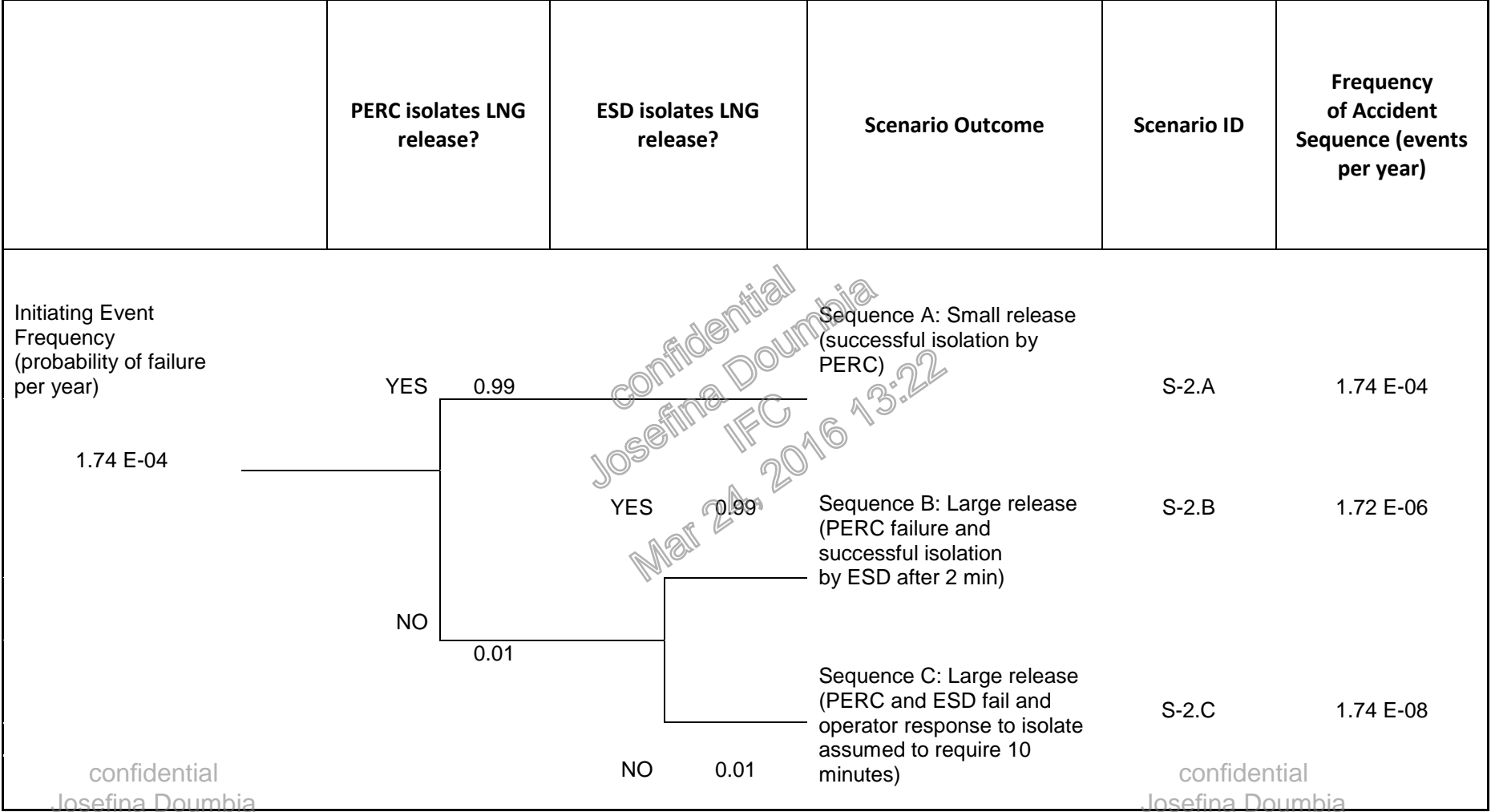
Three potential outcomes (accident sequences) are depicted on the event tree:

- Scenario S-2.A: The accident sequences labeled “Small Release (successful isolation by PERC) are not relevant based on their limited consequence. Given the small quantity of LNG that is released when the PERC operates successfully, the sequences would not be expected to have a consequence very far from the point of the release and is not of interest for this assessment.
- Scenario S-2.B: The second accident scenario “Large Release (successful isolation by ESD after 2 minutes)” was included in the consequence analyses.
- Sequence S-2.C: The third scenario has a frequency estimate that is much lower than Scenario S-2.B, only occurring if the ESD system also fails. However, it is unreasonable to think that a release that has manual shutdown capability from multiple locations and that requires operator involvement would remain unisolated in the long term, even if the automated systems fail to stop a release. This analysis assumes that manual isolation would occur in 10 minutes. In most cases, the assessment team believes that operator action would occur even more quickly, but a 10 minute was used for the consequence calculations associated with this event.

Event trees are not presented in this report for all of the scenarios analyzed, but event tree logic is used in the calculations documented in Appendix D (Frequency Analysis).

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**Figure 4-1 Large release of LNG from transfer arms on the jetty head (Scenario S-2)**



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## 4.2 LNG RELEASE CONSEQUENCE ASSESSMENT

This section mainly describes the release scenarios selected for evaluation. These events were selected to represent the types of large releases that, if they occurred, could potentially affect personnel in and off the terminal property (e.g., members of the public or workers). However, listing the scenarios presented in section 4.2.3 does not mean that the risk assessment team considered the events credible. This section also addresses:

- Software Employed (Section 4.2.1).
- Inputs and Assumptions (Section 4.2.2).
- Scenarios Selected for Analysis (Section 4.2.3).
- Outcomes Considered for Analysis (Section 4.2.4).

### 4.2.1 Software Employed

To predict the magnitude of consequences from LNG/NG releases the risk assessment team used TRACE<sup>1</sup> tools and PROFILER<sup>2</sup> Risk Integration tools.

**TRACE PROGRAM** TRACE Version 9.1, developed by SAFER SYSTEMS, is a computational package for analysis of consequences in risk assessments of process engineering: it aims to predict consequences of accidental scenarios originated during process operation/conditions that could cause harm to people, assets and environment. The calculation steps are:

- Selection and input of basic data including parameters of the chemical product, environmental and meteorological conditions;
- Components and premises of the mathematical models and maps for overlaying results; choice of the failure hypotheses, such as the characterization of the leaks (the locations may also be indicated on maps);
- Consequence assessment for selected events, including pool evaporation, cloud dispersion, flame radiation, toxic and explosion effects.

<sup>1</sup> SAFER Systems, 2006, TRACE – Toxic Release Analysis of Chemical Emissions, TRACE Version 9.1.

<sup>2</sup> PROFILER Integrations Tools.

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The processing used by the program integrates several mathematical models employed during each case study. In order to perform consequence analysis of the scenarios selected, the risk assessment team made some inputs and assumptions to best approach these events.

Trace tools was used in the analysis of scenarios related to LNG and NG releases which could result in LNG pool evaporation, vapor cloud dispersion and pool fire radiation.

TRACE was used for propane releases, VCE scenarios (i.e., flammable clouds considered confined or congested due to equipment arrangement), and jet fires resulted from the HP NG pipe releases.

It estimates the consequences of fires related to liquefied flammable gases, including LNG.

**Vaporization Model:** Trace will be use also in the prediction of vaporization rate of instantaneous or continuous LNG spill, over land or water. It allows for specification of: (1) rupture characteristics (size and position); (2) shape and material composition for contingency area (i.e., dike); (3) releases from liquefied gas tank - size, volume and height above and below ground.

**Dispersion Model:** Trace – heavy gas dispersion model, it calculates the concentration of the NG plumes in dispersion.

**Thermal Radiation Models:** Fireballs principally resulting from BLEVEs, liquid pool fires, jet fires, flares and stacks, flash fires and generic sources could be considered.

**PROFILER PROGRAM**

The PROFILER software is a tool integration risk, ie, is a system to calculate and graph representation of individual and social risks arising from potential accidents, integrating the results of the simulation of consequences and vulnerability, calculated with the software Trace.

The system makes calculations according to the following steps:

- Generates meshes distributed population and population areas in a mesh proportional to a level of resolution in the calculations set size. To do this you must have demographics of the area under study.

- The calculations are made for each scenario identified.

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- For each accident, an average of each cell of the grid point, the probability of fatality associated with the (Probit) physical effect is verified.
- The probability calculated for each cell is applied to the population contained therein, to estimate the number of fatalities.
- The points calculated in the cells are interconnected to represent iso-risk curves individually.
- The social medium risk and F-N curves are processed for each event in isolation, for determining the number of fatalities associated.

The program takes into consideration a better estimate of risk in each of addresses likely wind from the origin of the accident, from the probability of occurrence of wind in every direction. This influence on the calculation of risk depends on the type of event of an accident and can be very significant if scenarios involved, for example, the movement of the clouds of gas / toxic vapor over significant distances, or much less involving fires jet in which the wind could basically cause the inclination of the flame produced.

#### 4.2.2 Inputs and Assumptions

##### Hole Sizes

**Large leaks** – Large leak events will be evaluated based on a release rate of 30% of normal flow when the likelihood of having a pool formation is reasonable. For scenarios involving HP LNG releases, the Jet model was used which take into account pipe diameter. For this was assumed a hole size of 10% of diameter.

**Ruptures** – The only full bore ruptures that will be evaluated are those involving inadvertent disconnection of an unloading or transfer arm including both the LNG arms and HP NG arm from the LNGC to the LNG pipeline.

##### Release Duration

The release duration depends on the upstream inventory and means of detection and subsequent isolation of the release.

**Automatic Responses.** For automatic response without human intervention (e.g., when a gas detector automatically initiates an ESD and closes automatic valves), the risk assessment team

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will use 120 seconds for the leak to be detected and isolated. We are assuming that automatic response is always pertinent to full bore ruptures that involve transfer arms.

**Manual Responses.** The release duration for manual detection and isolation for leaks will be limited by the upstream inventory up to:

- A maximum duration of 120 seconds when the LNG is transferred from LNGC to onshore equipments (i.e., operations that require the LNGC crew member/operating staffs on the ships to be involved during the entire transfer process);
- A maximum duration of 600 seconds during transfer of NG to the pipeline. During these send-out operations, all monitoring may be from locations other than personnel on deck.

**Pipelines and Flexible Arm Diameters.** Based on information provided by AES the LNG headers on the LNGC are 16" piping. The LNG transfer arms are 16-inch diameter, and the HP natural gas transfer arm is 16", the LNG pipeline connecting the LNGC to the piping on the jetty is 36".

### Meteorological Conditions

For meteorological conditions, we used the recommendations from NFPA 59A and made adjustments to reflect site specific data.

### Thermal Radiation Calculations

For evaluation of events for thermal radiation zones NFPA 59A suggests the use of atmospheric conditions of:

- 0 (zero) for wind speed,
- 21 °C for ambient temperature and
- 50% for relative humidity.

However, low wind speed is not generally conservative for thermal radiation assessments, so NFPA also suggests using other wind speeds for more conservative results. Based on the project data provided by the terminal developers, the analyses used the average prevailing wind speed which is 3.1 m/s, 75% for relative humidity and 27 °C. This is not necessarily the most conservative for all potential thermal radiation calculations but it was a practical choice for this purpose. The analysis does not consider wind speed direction probability, but assumes the wind blows a vapor cloud and/or flame towards to the worst receptor location.

### Flammable Dispersion Calculations

For calculation of flammable hazard distances NFPA 59A and EN 1473 suggest the same parameters. Their requirements are:

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- Pasquill-Gifford atmospheric stability Category F,
- 2 m/s wind speed and
- Relative humidity of 50%.

Based on the data provided by the client, the average prevailing wind speed of 3.6-8.8 m/s has a 73% frequency of occurrence. Since the more conservative choice (i.e., the lower wind speed category) occurs more than 10% of the time, the risk assessment team will use 3.1 m/s wind speed and Pasquill-Gifford atmospheric stability Category D. However, as discussed above, we used an average value of 75% for humidity. This is a more conservative value for flammable dispersion calculations.

For additional data needed we followed the Nova Scotia LNG Code suggestions and collect the site singularities:

- Receptor elevation of 0.5 ,
- Surface roughness of 0.10 m.

**Hazard Evaluation Measures**

The results calculated for each scenario will include the following parameters:

- Thermal Radiation. Distances to thermal radiation levels of 5, 9, 30 kW/m<sup>2</sup> based on the limits suggested in NFPA 59A.
- Flammable Concentration. Distances to the cloud concentration corresponding to:
  - 100% of the upper flammable limit (UFL),
  - 100% of the lower flammable limit (LFL) and,
  - 50% of the lower flammable limit (LFL).

**Thermal Radiation.** Tables 4.1 and 4.2 present explanations of the effect on people for various thermal exposure levels. The table present levels that are widely accepted in industry and are provided to help the reader understand the potential effect on people of the results calculated here. Unfortunately, they do not correspond exactly to the levels used by NFPA 59A (i.e., 5, 9 and 30 kW/m<sup>2</sup>) but there are so many other variables (e.g., humidity, smoke, clothing, shelter) that affect the level of thermal radiation that would reach a person exposed to heat from a fire, they are considered adequate. Table 4.1 presents the impact criteria used in this study. They were used to define fatality probabilities for the various radiant heat fluxes calculated for analyzed events (see Section 4.4 for a discussion of those criteria). At a thermal flux of 30 kW m<sup>-2</sup>, a high thermal dose is achieved rapidly, offering little chance of escape for an exposed individual, resulting in a high probability of fatality, 100%. At a thermal flux of 9.0 kW m<sup>-2</sup>, the 1% fatality level is achieved in

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approximately 30 seconds, offering some chance of escape. For a thermal flux of 5 kW m<sup>-2</sup>, an exposure of almost 1.5 minutes is required to achieve 1% fatality probability

For Flash Fires, impact can be determined based on the extent and concentration of flammable vapors, expressed as Lower Flammability Limit (LFL). People outdoors within the flash fire envelope (in the LFL contour) are considered to be killed. People outside the LFL contour are assumed not to be injured, even if they are within the 1/2 LFL radius.

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Table 4-1 Thermal Radiation Impacts on People (API 1997 and GRI 2000)

<b>Radiant Heat Flux* (kW/m2)</b>	<b>Impacts on People</b>
31.5	Death after a seconds of exposure without protection.
12.5	Onset of pain in 3 seconds of unprotected exposure.
9.5	Onset of pain in 6 seconds of unprotected exposure.
5	Second degree burns after 30 seconds of unprotected exposure.
1.5	No significant hazards for continuous exposure.

\*excluding solar radiation

Table 4-2 Permissible Thermal Radiation Exposure (ABSC 2005)

<b>Radiant Heat Flux* (kW/m2)</b>	<b>Type of Damage</b>
1.6	Permissible level at any location where personnel are continuously exposed.
4.7	Permissible level in areas where emergency actions lasting several minutes may be required by personnel without shielding but with appropriate clothing.
6.3	Permissible level in areas where emergency actions lasting up to 1 minute may be required by personnel without shielding but with appropriate clothing.
9.5	Permissible level in areas where exposure to personnel is limited to a few seconds, sufficient for escape only.

\*excluding solar radiation

Although thermal effects on structures were not analyzed in this effort, Table 4.3 is provided to document typical limits used to define acceptability of thermal exposure for various classes of

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equipment. This information is drawn from EN 1473 (2007) – *Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations*.

**Table 4-3** Allowable Thermal Radiation Flux from Fires for Equipment Inside the Facility Boundary (Based on EN 1473 (1997) - Table A.1)

Equipment Inside boundary	Maximum Thermal Radiation Flux (excluding solar radiation) (kw/m <sup>2</sup> ) (Note 2)
Concrete outer surface of adjacent storage tanks (Note 1)	32
Metal outer surface of adjacent storage Tanks	15
The outer surfaces of adjacent pressure storage vessels and process facilities	15
Control room, maintenance workshops, laboratories, warehouses, etc.	8
Administrative buildings	5

Note 1: For prestressed concrete tanks, maximum radiation fluxes may be determined by analysis.

Note 2: Heat flux levels can be reduced to the levels above by means of separation distance, water sprays, fire proofing, radiation screens or similar systems.

**Overpressure.** Vapor cloud explosions are characterized by the level of overpressure they produce. Such overpressures can cause damage to equipment and destruction of buildings well beyond the flammable cloud boundary. Although any person within the flammable cloud is likely to be fatally injured, direct human fatalities from blast outside the flammable cloud are unlikely. Most casualties beyond the cloud envelope arise indirectly (i.e. from crush injuries in collapsed buildings or injuries from fragments).

To determine the overpressure, the team assumed that the vapor cloud would find an ignition source within the first 30 sec from the release due to the extension and location (offshore).

The results calculated for each scenario include distances to overpressures of:

- 87 mbar – threshold for lung damage, and 1% fatality due to flying objects from a collapsed house.
- 170 mbar – threshold 50% destruction of brickwork of house or light metal structures.
- 483 mbar – threshold of pipe rack collapse.

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Tables 4.4 and 4.5 present explanations of the effect on people and structures for various overpressure levels respectively. The tables show levels that are commonly reported in industry guidelines and studies and it is clear that a variety of approaches exist. Differences in values can result from a variety of reasons, including alternative approaches to providing a single value to represent explosions of different durations. For example, the data from Lee’s 1996 reference represent much less conservative data than other sources. The HSC data is an example of a different data presentation and are more conservative (i.e., they indicate greater injury potential at the same overpressure level), in all likelihood because the Lee’s data focuses on long duration blast waves that are more likely in process applications as opposed to incidents involving commercial explosives. The fatality probability values used for the consequence assessments in this study are presented in Section 5 of this report.

**Table 4-4 Data for Direct Effect of Overpressure on People from Two Sources**

<b>Source: Lees (1996)</b>	
<b>Overpressure (mbar)</b>	<b>Direct Effect on People</b>
1000-1400	50% eardrum rupture among adults.
800-1000	Threshold for lung damage, long duration blast wave.
2750	Threshold lethality, long duration blast wave.
4300	50% lethality, long duration blast wave.
<b>Source: HSC Advisory Committee on Dangerous Substances, 1991 Major Hazard Aspects of the Transport of Dangerous Substances</b>	
<b>Direct Overpressure (mbar)</b>	<b>Fatality Probability</b>
170 (2.4 psig)	1%
900 (13.1 psig)	50%
3000 (43.5 psig)	95%

From these data it can be seen that the overpressure levels required to cause harm and injury to people directly (i.e. the actual blast wave causing harm rather than flying debris or collapsing structures) are significantly greater than the levels required to damage structures (e.g., an overpressure of around 500 mbar would be sufficient to destroy a house but would be below the threshold for lung damage). This means that the fatality probabilities for people outdoors and away from structures tend to be less than

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those for people within buildings, where secondary blast effects (the structure collapsing on to the occupants) may cause injury or fatality.

**Table 4-5** Direct Effect of Overpressure on Structures (Lees 1996)

Overpressure (mbar)	Direct Effect on Structures
2.0	Occasional breakage of large glass windows already under strain.
7.0	Breakage of windows, small, under strain.
10.0	Typical pressure for glass failure.
48.0	Minor structural damage to house structures.
69.0	Partial demolition of houses, made uninhabitable.
173.0	50% destruction of brickwork of house.
207.0 – 276.0	Steel frame building distorted and pulled away from foundations. Frameless, self-framing steel panel building demolished.
345.0 – 483.0	Nearly complete destruction of houses.

### 4.2.3 Scenarios Selected for Consequence Analysis

This section describes the scenarios for which this risk assessment estimated consequences. Details of the input data for each scenario are provided in Table E.1 in Appendix E, along with the analysis results.

#### Scenario 1. Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve.

The unloading rate of 12000 m<sup>3</sup>/h. The team assumed that the leak occurs in the 36” main line. The team assumed a release corresponding to 10% of pipe line diameter for the normal flow rate (i.e., 12000 m<sup>3</sup>/h).

For this scenario there are two possible events (sequence S-1.A and S-1.B) and are three possible outcomes examined for each event:

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- Gas dispersion. The scenario was modeled using Trace transient duration. The simulations were performed for 120 and 600 seconds release.
- Pool fire. If the LNG vapor within the LFL concentration finds an ignition source possibly would result in a pool fire outcome. The pool fire as modeled using continuous release for 120 and 600 seconds releases.
- VCE. If the flammable gas from a LNG spill finds an ignition source in a congested area (e.g., under the jetty head or in the area between LNGC funnel and the accommodation block), a VCE is likely to occur. The risk assessment team assumed that the vapor cloud would if it finds an ignition source, it would be likely to occur within the first 30 sec from the release.

### Scenario 2. Large release of LNG from transfer arms on the jetty head

This scenario assumes that one of the three transfer arm handling LNG ruptures. The flow rate per arms is as 12000 m<sup>3</sup>/h (104423 kg/m). For this scenario there are three possible events and also several outcomes for each event:

- Sequence 2.A: The accident sequences when the PERC successful isolates in 10 seconds. In this sequence the PERC operates successfully and the consequences, although small, are estimated.
- Sequence 2.B: The second set of accident sequences, "Large Release (successful isolation by ESD after 2 minutes)" were included in the consequence analyses. For each of the initiating events considered, these sequences have frequencies of 1 E-4 events per year.
- Sequence 2.C: In this event tree, the sequences, "Long Term Unisolated Release" have frequency estimates that are more than two orders of magnitude lower than 1E-6 per year. In addition to the frequency calculations, it is unreasonable to think that a release that has manual shutdown capability from multiple locations would remain unisolated in the long term, even if the automated systems fail to stop a release. For analysis purposes, the risk assessment team assumed the release would be stopped manually in 10 minutes.

Potential releases of this nature are mitigated by unloading arm operating limits and leakage detection (e.g., flammable gas, low temperature, and fire detection) - any of which can manually or automatically shut down the LNG flow (by stopping the pumps) and isolate the arms (by closing remotely operable isolation valves). In addition, a mooring tension monitoring system is also available in the terminal and the LNGC control room in order to give early warnings to the ship operator.

Because the unloading arms are the most likely location for an event that would cause a large LNG release, they are protected by multiple safety systems. If the arms are physically pulled apart by

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abnormal vessel motion, there are powered emergency release couplings (PERCs) that would stop the LNG release (Sequence 2.A). If other causes for rupture occur (e.g., external damage, coupling failure) or if the PERC system does not work the release should be terminated by automatic action of emergency shutdown system based on flammable gas and/or low temperature detection or by a manual action of the field operator on the deck who sees the with gas cloud. In Scenario 2.B, the analysis team assumed the emergency shutdown system detection and actuation would require 2 minutes.

Scenario 2.C portrays the case where the automatic ESD system does not work so an unisolated “long term release” will occur. Such a release would not continue indefinitely, the assessment team assumed a worst case isolation time of 10 minutes if all automatic systems failed and the release had to be achieved manually.

The team assumed a release correspondent to 100% of normal flow rate of an arm finds the sea, that is, 104423 kg/m finds the sea surface.

The possible outcomes for this event in terms of the consequence calculation are:

- Gas dispersion. The scenario was modeled using Trace transient duration. The simulations were performed for 120 and 600 seconds release.
- Pool fire. If the LNG vapor within the LFL concentration finds an ignition source possibly would result in a pool fire outcome. The pool fire as modeled using continuous release for 120 and 600 seconds releases.
- Vapor Cloud Explosion (VCE). As the LNG is releasing on sea surface its vapor cloud could be trapped between the jetty and the LNGC resulting in a VCE due to the semi-confined space. This simulation was performed using TRACE Software using the Multi Energy Method approach considering the level of confinement to be 7. The risk assessment team assumed that the vapor cloud would if it finds an ignition source that would likely to occur within the first 30 seconds from the release due to the terminal extensions and location (offshore).

**Scenario 3. Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber).**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes, assuming a release corresponding to 10% of pipe line diameter for the normal flow rate (i.e., 12000 m3/h).

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In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes, assuming a release corresponding to 10% of pipe line diameter for the normal flow rate (i.e., 12000 m3/h).

**Scenario 5. Large leak of vaporizer.**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes, assuming a leak size from 1" orifice diameter.

**Scenario 6. Large leak of vaporizer high pressure natural gas outlet line.**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes, assuming a release corresponding to 10% of pipe line diameter for the normal flow rate. Temperature here is 2 °C and pressure is 35 barg.

**Scenarios 7. NG Power Block pipeline leak.**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes assuming a release according a diameter of 10% diameter of the 6" line. Temperature here is 20 °C and pressure is 30.5 barg.

**Scenario 8. Leakages of NG in flow controlers.**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes assuming a release according a diameter of 10% diameter of the 18" line. Temperature here is 35 °C and pressure is 30.5 barg.

**Scenario 9. NG Leakages in gas turbine.**

In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes assuming a leak size from 1" orifice diameter. Temperature here is 35 °C and pressure is 30.5 barg.

**Scenario 10. Leakage in HRSG (assuming NG burner).**

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In this scenario the team considered two events; the ESD acting successfully in 2 minutes and manual isolation in 10 minutes assuming a release according a diameter of 10% diameter of the 10" line. Temperature here is 20 °C and pressure is 12 barg.

**Scenario 11. External Fire or explosion.**

In this scenario the team considered this events; an external fire or explosion, an Propane Bleve from Petroport, LPG Cylinders Bleve from Petroport Terminal and Propane Jet Fire from existing pipeline. The different variables used are in the Appendix C. In all these events the Team assumed the corresponding ESD acting successfully in 2 minutes. Pressure is 8 barg in all events.

All these events were developed with assumptions that must be validated by AES and Costa Norte LNG terminal's neighbours.

**Scenario 12. LNGC strucks by another ship during entry.**

In this scenario the team considered one event; the LNGC ESD acting successfully in 2 minutes assuming a release according a orifice of 500 mm diameter. Temperature here is -162 °C and pressure is 170 mbarg.

**Scenario 13. Large leak of Storage tank contents.**

In this scenario the team considered one event; the LNGC ESD acting successfully in 2 minutes assuming a release according a orifice of 500 mm diameter. Temperature here is -162 °C and pressure is 170 mbarg. As you can see, this variables are the same that used in the Scenario 12.

The outcomes analyzed for each scenario described in this section are presented in Table E.1 in Appendix E.

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### 4.3 CONSEQUENCE RESULTS

#### 4.3.1 Maximum Impact Distances

The maximum consequences (in terms of maximum distance where the effects could be experienced) estimated for each type of consequence are presented in Table 4.6. The table gives the results for the main operating modes (ship transfer and regas operations) as there are only 7 unloadings per year. The maximum consequences reflect release size, duration, elevation, and type of scenario outcome (e.g., jet fire, pool fire, VCE).

**Table 4-6 Maximum Distance for Each Consequence Type**

Consequence Type	Scenario	Distance
Distance to radiant heat flux of 30 kW/m <sup>2</sup>	Large leak of Storage tank contents (S-13.A)- Flash Fire.	<b>242 m</b>
Distance to lower flammable limit	Full rupture of one LNG transfer arm during transfer from LNG carrier – flash fire (S-2.B and S-2.C)	<b>798 m</b> (10 second PERC)
		<b>1217 m</b> (2 minute ESD)
	Large leak of vaporizer (S-5.A and S-5.B)	<b>1721 m</b> (10 minute isolation)
		<b>202 m</b> (2 minute ESD)
		<b>233 m</b> (10 minute isolation)
Distance to overpressure level of 483 mbar	Rupture of LNG transfer arm – VCE (S-2.B and S-2.C) Note: For a VCE to occur with a natural gas release, confinement or significant congestion would be required. In the areas of the unloading arms and regas areas, semi-confinement might be provided by the vessel, jetty structure, and process equipment. If not, a VCE would not be expected	<b>238 and 253 m</b>  (for 2 and 10 minute isolation)

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### 4.3.2 Detailed Consequence Analysis Results

Table E.1 in Appendix E presents the consequence analysis results for each of the scenarios identified in the previous section. It presents data useful in judging the potential of each scenario on personnel in the terminal:

- Distance to a radiant heat flux of 5, 9 and 30 kW/m<sup>2</sup>,
- Distance to the upper flammable limit (UFL), lower flammable limit (LFL), and 1/2 LFL and,
- Distance to overpressure levels of 87, 170, and 483 mbar.

The table also notes the total LNG/NG estimated to be released in the scenario, when that parameter is pertinent. For dispersion scenarios, the results reported comes either from a light gas dispersion calculation or a dense gas dispersion calculation, depending on which is most applicable.

The results of worst selected scenarios are plotted on the layout of the terminal and presented Appendix C.

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## 4.4 RISK ASSESSMENT APPROACH

### 4.4.1 Assessment of Human Impacts

To calculate risk in terms of impacts on personnel, the physical consequence effects described in the previous sections and presented in Table E.1 were combined with the fatality probabilities (Tables 4.7 and 4.8). These criteria were developed by the assessment team based on mathematical models used to estimate the areas potentially subjected to physical effects of accidental events. These mathematical models are known as vulnerability models.

For the vulnerability calculation of the workers and publics exposed and of the probable damage to the installations, the Eisenberg Vulnerability Model, developed by the United States Coast Guard, was used, which makes use of the probabilistic functions of the PROBIT type. It is a widely used approach to relate the phenomena intensity (like fire heat radiation, explosion overpressure, and toxic load in the case of exposure to a toxic cloud) to their consequences. The PROBIT equation is shown as the following:

$$Pr = a + b \times \ln V$$

Pr = Probit, measure of the vulnerable resource percentage (people, structures, etc.) affected by the accident.

V = function or causal factor of damages to vulnerable resources (overpressure, thermal radiation, toxic concentration).

a and b = specific parameters for each type of damage and substance.

Probit is a random variable with a measure of five and variance of one. The probability (interval from 9 – 1) is generally replaced in a Probit result by the percentage (interval 0 – 100). Probit is a number related to the probability of damages, injuries or fatalities, expressed through the percentage of the population or physical installations affected.

The relation between percentages and Probits (from Probability units) are given by the Table 4.7. Probit is a three-digit number. The percentages are read vertically and horizontally in the table. The vertical column corresponds to the tens and the horizontal to the units. The last two lines show a finer adjustment for high percentage values, from 99 to 99.9%.

It should be noted that the vulnerable area corresponds to the area that can be affected in case of an accident scenario. The area primarily affected will be influenced by the local climatic and geographic

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condition at the instant of the leak, such as the combination of the location of the release and the direction and speed of the wind.

**Vulnerability Due to Fires**

A large fire may cause effects on people properties and assets. Although all models of heat transfer are involved, the most important, considering an open environment, is thermal radiation.

The levels of damage caused by fire is a function of its effective duration and radiation intensity, being expressed by means of the Probit equation for death or burns resulting from pool-fire, and jet-fire.

$$Pr = -38.48 + 2.56 \ln (t Q^{4/3})$$

Where:

t = exposure time to thermal radiation (s)

Q = intensity of effective thermal radiation (W/m<sup>2</sup>)

The Probit value is transformed into a percentage by means of Table 4.7 and has been adapted accordingly by the assessment team to attend NFPA 59A. The result is presented on Table 4.8.

**Table 4-7 Conversion of Probit to Percentage**

%	0	1	2	3	4	5	6	7	8	9
0	-	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.77	4.75	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33
%	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
99	7.33	7.37	7.41	7.46	7.51	7.58	7.65	7.75	7.88	8.09

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**Table 4-8 Human Impact Criteria for Thermal Radiation**

Scenario Type	Type of Human Exposure	Fatality Probability
<b>Jet or Pool Fire</b>	Radiant Heat > 30.0 kW m <sup>-2</sup>	1.0
	30.0 kW m <sup>-2</sup> < Radiant Heat > 9.0 kW m <sup>-2</sup>	0.5
	9.0 kW m <sup>-2</sup> < Radiant Heat > 5 kW m <sup>-2</sup>	0.05
<b>Flash Fire</b>	Persons located within a cloud of LFL concentration or higher	1.0
	Persons located outside the LFL concentration Note: To provide additional information the project team requested, for unignited flammable releases, the assessment team calculated ranges to a ½ LFL concentration; however, that distance was not used for assessing human impacts because they are not assumed to be ignited.	0.0

**Vulnerability Due to Explosions**

The levels of damage caused by explosions may be estimated by means of the following probit equations<sup>3</sup>:

$$P_r = -16.7 + 2.03 \ln (P_p) \text{ – For eardrum rupture in human.}$$

$$P_r = -18.1 + 2.79 \ln (P_p) \text{ – For breaking glass.}$$

$$P_r = -77 + 6.91 \ln (P_p) \text{ – For death by lung hemorrhage.}$$

Where,

$$P_p = \text{overpressure peak in (Pa)}$$

There are other correlations that can also be used, normally associated with impulses or pressure pulses, with indirect fatalities by the collapse of structures for example. In this analysis, the direct effects of overpressure were considered, and the level of 483 mbar was selected, considering the “threshold” of probable fatality 58%. Table 4.9 shows Human Impact Criteria for overpressure adopted by the assessment team in this report.

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**Table 4-9 Human Impact Criteria for Overpressure**

Overpressure Level	Fatality Probability
Overpressure $\geq 483$ mbar	.58
483 mbar > Overpressure $\geq 170$ mbar	.03
170 mbar > Overpressure $\geq 87$ mbar	.005

The rest of this section outlines how the assessment team calculated the number of fatalities that would result from each of the scenarios quantified for this analysis.

The assessment team took the population data provided by AES and made assumptions regarding locations of those personnel for each type of operation at the terminal, including:

1. LNGC unloading during Phase I and II;
2. Send out of LNG to the onshore equpments.
3. Vaporization of LNG and send out of NG to the Power Block.

Operation 1 and 2 occurs only periodically. Operation 3 was assumed to occur continuously in order to supply natural gas to the transmission pipeline and Gas Turbines of Power Block.

The personnel mapping required the team to judge how many people were indoors versus outside for the ship and the terminal personnel. That difference is important because being inside protects people from most of the effects of LNG releases. Those assignments were based on input from AES using plans for terminal operations and their experience with similar facilities.

**Carrier Crews.** In general, there is only a small portion of a vessel crew on deck, in part because the overall crew size is defined for 24 hour operation and many jobs must be performed at stations inside the ship. The team assumed that there were 2 crew members on deck in the manifold area of the LNGC.

**Terminal Personnel.** The number of terminal personnel was also assumed to vary based on activities on the jetty. If no transfers were underway, the team assumed that at most one member of the terminal crew would be outside on a jetty and two would be present during transfers. The remainder of the terminal/vessel staff were assumed to be onshore or indoors (in the electrical building, in the service boat, in the jetty control building or in the LNGC control room).

Finally, two stand-by tug is foreseen for the berthed LNGC. It means that two tug boat is on stand-by on the LNGC side in unloading mode. The team assumed that one member of the tug crew is outside on each of the tug.

**Power Block.** Another personnel in considered working in the Power Block.

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#### 4.4.2 Assessment Approach for Each Type of Scenario

Figures 4.2, 4.3 and 4.4 apply to Scenario S-2.B: Rupture of a LNG transfer arm during unloading transfer, with failure of the PERC and success of the ESD system in two minutes (120 sec).

The consequences displayed in the figures include:

- Overpressure resulting from a vapor cloud explosion (which would generally require buildup of natural gas vapors in a confined or at least congested area) – Figure 4.2

Figure 4.2 shows the maximum distances reached by overpressures from a VCE that could occur if an unloading arm ruptures during unloading of an LNGC. The reader should be aware the level of congestion and confinement of a LNG terminal such as proposed by AES, there are only limited areas in which medium to low congestion and confinement exist, so such an event is very unlikely. However, the risk assessment team assumed that a VCE could occur if LNG released to the water surface is trapped between the jetty and the ship. It should be noted that the area under the jetty and between the ships is not considered fully confined, it is open on the sides of the jetty that are perpendicular to the vessel hulls. Therefore, the analysis treated liquid releases to the surface of the water in that area as semi-confined.

- Distances to various concentrations of methane downwind of a large release of LNG at the unloading arm – Figure 4.3

Figure 4.3 depicts the potential range of distances (i.e., from the UFL to the LFL) to which a flammable concentration of methane would reach if a large LNG release occurred at the LNG transfer arm while unloading an LNG carrier. Please note that flammable hazards occur almost totally in the downwind direction only. However, Figure 4.3 depicts the plume distances as a circle because the wind could be blowing in any direction at the time of the release.

The image depicts the concentrations at the time the area within the flammable range is the largest. At that point, the flammable range for the release (i.e., concentrations from the UFL down to the LFL) extends out to 1217 meters (i.e., the yellow portion of the plume).

Because of uncertainty associated with these type of dispersion calculations, some standards (e.g., NFPA 59A) require calculation of concentrations for onshore terminals down to 1/2 of the LFL. However, other standards (EN 1473) only require consideration of hazard areas based on the LFL, because beyond that there is little or no likelihood of a fire occurring. Also these distances are estimated using very conservative assumptions for wind speed and stability (D stability and 3.1 m/sec wind speed), which would only occur a small fraction of the time.

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- Distances to various level of heat radiations in case of pool fire or jet fire of a large release of LNG at the unloading arm – Figure 4.4

Figure 4.4 shows the maximum distances reached by thermal radiation in an event of pool fire for the same unloading arm rupture. The estimated distances for the three radiant heat levels are noted on the figure. The reader should refer to Table 4.1 to aid in understanding what each of these radiant heat exposures mean.

In both cases arm rupture or disconnection, the emergency shutdown system (or manual shutdown by the operators) was assumed to terminate the events in 2 minutes. Depending on the specific release rate examined, rapid shutdown can affect the distance to which hazardous effect are experienced and always affects the duration of the event, because the LNG will either disperse or burn up quickly.

Images like these are provided in Appendix C for all of the worst scenarios selected.

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**Figure 4-2 Overpressure Results (VCE) for Scenario S-2.B**



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**Figure 4-3 Flammable Gas Dispersion for Scenario S-2.B**



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**Figure 4-4 Thermal Radiation (Pool Fire) Results for Scenario S-2.B**



### Pool Fire Scenario S2.B

Scenario: Large release of LNG from transfer arms on the jetty head – PERC fails but ESD succeeds - two minute isolation time

Description:

Pool fire distance (radios) in [m]

- 120 m Radiation 5 kw/m<sup>2</sup>
- 85 m Radiation 9 kw/m<sup>2</sup>

Notes:

Referrece Images from Google Earth, 01/01/2016

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#### 4.4.3 Risk Results Calculation

This portion of the report describes how the assessment team used the images in Appendix C and the data in Appendix E to develop risk estimates for each type of release scenario:

- Pool fires.
- Jet fires.
- Flash fires.
- Vapor cloud explosions.

##### Pool Fires

For pool fires, the exposure areas are circles around the pool location with the distance to the three radiant heat levels noted in Table 4.8. The distances are reported in Table E.1. The assessment team selected a location for each scenario and estimated the number of personnel located outdoors within the circle to the highest radiant heat level and then estimated the additional number of outdoor personnel exposed to each of the lower radiant heat levels. For pool fires, there is the potential for personnel to be shielded from the radiant heat by structures, either when the fire initially starts or for them to move behind shelter once the heat begins to affect them. Structures could be ships, walls, process equipment or buildings.

##### Jet Fires

Jet fires also present radiant heat hazards but such events occur rapidly and are directional in their impact. The jet fire was assumed to present the radiant hazard to all personnel in a triangular area along the direction of the jet, getting narrower further from the source of the jet. No credit was provided for shielding or moving away from the jet because of the speed with which it initiates, the potential for initial severe burns and the fact that safe shelter is not as likely to be provided by buildings or other structure not designed to withstand flame impingement. The numbers of personnel estimated to be with the area of affect for each of the radiant heat levels given in Table 4.8 were multiplied by the appropriate fatality fraction to estimate the fatalities for each jet fire scenario.

##### Flash Fires

If an LNG/natural gas release does not ignite initially, gas from the release will disperse downwind and mix with air to form a flammable mixture. If the release continues, the cloud will eventually form a steady state cloud where the outer edges of the cloud drop below the flammable concentration (i.e., below the lower flammable limit). In this assessment, the team calculated the distance to the LFL for clouds of various release rates and isolation times. To estimate the flash fire hazard, the team assumed that the cloud did not ignite until it had reached the maximum extent to


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which it would be flammable (i.e., the distance reported in Table E.1 for each “Gas Dispersion” scenario). As indicated in Table 4.7, all people within the cloud that is in the flammable range are assumed to suffer fatal injuries when the cloud ignites. To estimate the number of people that would be within a downwind cloud, the assessment team selected a worst case direction based on population and estimated the number of people within the LFL distance in that direction.

### Vapor Cloud Explosions

For the purposes of estimating risk from blasts it is necessary to develop some overpressure harm criteria that account for direct blast injuries and injuries from flying debris or collapsing structures (i.e. some compromise between the data presented in Table 4.3 and Table 4.4). The fatality probabilities used in this study consider the data shown above and are presented in Table 4.8.

However, in assessing the threat to personnel on the terminal, we assumed that personnel in ships and terminal personnel in buildings (e.g., offices, maintenance shops, control room) would either be located far enough from potential releases or that the terminal structures would be designed to provide overpressure protection. Therefore, personnel in ships and structures were assumed not to contribute to potential fatalities assessed in this study.

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## 5 RISK EVALUATION AND RECOMMENDATIONS

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This section presents a brief summary of the risk results for this effort and provides recommendations related to the objectives of the study and the lessons learned from the risk results. The details of this risk information are presented in Appendix F to this report.

The results of a QRA are the Individual Risk and the Societal Risk.

These results should be preceded by a Hazid for determination of critical or severe scenarios that will be used in subsequent calculations. As mentioned in this report, the Hazid analysis was carried out in Panama in late February and critical scenarios described in Chapter 4 were selected by the assessment team and AES. The recommendations of this Hazid are presented in Appendix B.

### 5.1 COSTA NORTE LNG TERMINAL INDIVIDUAL RISK

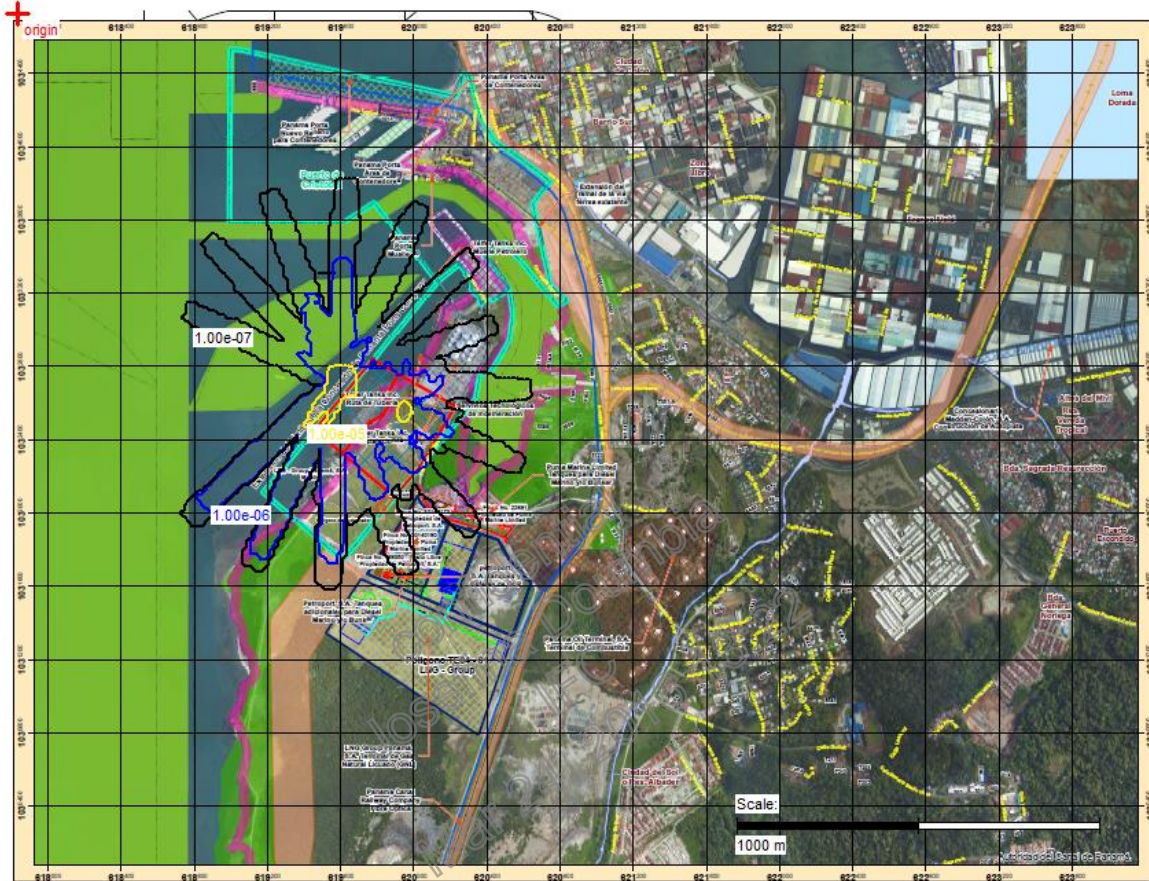
The Individual Risk represents the frequency of an individual dying due to loss of containment events. The individual is assumed to be unprotected and to be present during the total exposure time. The Individual Risk is presented as contour lines on a topographic map.

As a first result of this QRA, they are presented below the isorisk curves on a Costa Norte LNG terminal site map. It can be seen that the curve isorriesgo 1 E-5 (yellow) does not escape the limits of the property, provided that indicated in NFPA 59A 2013 Table 15.10.1 standard.

It should be noted that this determination of individual risks, took into account the interim case of about 1 year when the LNGC be permanently moored to the dock sending way reduced flows of LNG to the onshore equipment without storage. Details of this interim scenario for the most critical case (Arms Rupture) are presented at the end of Appendix D and E.

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As expected, although the probability of occurrence of these events will increase by having the permanent LNGC moored, the reduced flow of operation makes the expected consequences are much smaller in terms of distances.




**Figure 5-1 Isorisk Curve for Costa Norte LNG Terminal**

Table 5.1 presents the total frequency of all the events estimated for the Costa Norte LNG terminal, representing the design as proposed by AES.

**Table 5-1 Frequency Summary for the Terminal**

<b>Frequency estimate for LNG fire and explosion events in the analysis (i.e., jet fires, flash fires, pool fires, or vapor cloud explosions)</b>	<p><b>4.8 E-5 events per year</b> <b>(approximately one event in 21,000 years of operation)</b></p> <p>This is the sum of the frequencies for all of the LNG release events examined that resulted in a fire or explosion consequence.</p>
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The risks for individual events are based on the scenario frequencies that were calculated and the number of fatalities estimated for each event. Based on the conservative and preliminary risk assessment approaches used in this study, it is expected that, for the events included in the study, the estimates over predict the risk. However, there are likely to be many other occupational issues and risks associated with ships (e.g., engine room fires, accommodations block fires) and terminal operations (e.g., small boat accidents, drowning, falls, maintenance accidents) that are not addressed here but that could cause fatalities on a more frequent basis.

**Flash Fires.** The events that present the most risk (as estimated in this analysis) are large LNG or natural gas events that do not ignite initially, generate large unignited clouds and then find an ignition source (i.e. delayed ignition). The events that present the highest risk to personnel in the terminal are flash fires and they present about 97% of the estimated risk. This represents the fact that releases are often not expected to ignite immediately and the times assumed that it would take to isolate potential leaks. If leaks are isolated more quickly than assumed or if personnel take shelter prior to these releases ignited, much of this risk would be avoided. These same measures will also help reduce the risk from jet fires, the next class of highest risk events.

**Worst case consequences.** To provide a summary of worst-case consequences, Table 5.2 lists the maximum distances estimated in this effort for each type of consequence outcome, along with the range of estimated frequencies for those sizes of events. The most likely of these events occurs once in a about 20,000 terminal years while others are 3 to 4 orders of magnitude less likely. The point of this review of risk data is that there are hazards at low frequencies that may require design attention. This study helps identify some of those hazards but before extensive investment is spent in prevention and mitigation measures, additional more detailed evaluations should be considered.

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**Table 5-2 Maximum Distances Estimated in the Consequence Assessment**

Metric	Distance	Individual Scenario Frequencies (events per year)
Distance to Radiant Heat Level of 30 kW/m <sup>2</sup> due to Jet Fire	38 m	1.8 E-7 to 9.0 E-6
Distance to LFL due to LNG release and emergency shutdown system failure	1750 m (10 minute isolation) 1217 m (2 minute isolation)	8.7 E-9 to 1.7 E-6
Distance to LFL due to NG release and emergency shutdown system failure	99 m (10 minute isolation) 15 m (2 minute isolation)	8.1 E-7 to 1.3 E-4
Distance to 483 mbar due to VCE from unloading arm failure	253 m (10 minute isolation) 238 m (2 minute isolation)	2.9 E-9 to 8.4 E-8

**5.2 TERMINAL RISK COMPARISON TO AN EXAMPLE RISK CRITERIA**

The Societal Risk represents the frequency of having an accident with N or more people being killed simultaneously. The people involved are assumed to have some means of protection. The Societal Risk is presented as an F-N curve, where N is the number of deaths and F the cumulative frequency of accidents with N or more deaths.

Figure 5.1 provides the data from this risk assessment effort in a Frequency-Number (F-N) curve format (AIChE 2009). On the horizontal axis of the figure, the number of expected fatalities per event is plotted. In this study, that ranged from 1 fatalities to 1000, based on the number and location of personnel in the terminal (which only threatened personnel located outside) and outside properties (terminal surroundings). The vertical axis is a cumulative frequency distribution, marked as the blue curve. The points along the blue curve represent the sum of the frequencies of all events that lead to N or more fatalities. For example, the cumulative frequency of events that would result in 1 fatality is approximately 3 E-5 per year. Similarly, the frequency of all events in the risk assessment that could result in 10 or more fatalities is less

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than 10 E-6 per year. For the LNG terminal examined in this assessment, there were no events postulated that would cause public safety impact, all of the data shown on Figure 5.1 represent potential threat to personnel working in terminal or on the ships docked at the terminal.

The red and the blue lines on the F-N graph are examples of criteria often used to judge the acceptability of expected risk risks. For example it is the criteria presented in Chapter 15 of NFPA 59A. It divides the graph into three regions.

- **Unacceptable risks** - Above the top (orange) line events would be considered “unacceptable” and further risk reduction is required.
- **As Low As Reasonably Practicable (ALARP)** – Between the orange and green lines, events are considered tolerable, but additional, practical risk reduction measures should be considered.
- **Broadly Acceptable** – Below the green line events are considered low enough that additional risk reduction efforts are not called for (but should be considered if opportunities for such reductions present themselves).

Based on the conservative risk assessment approaches used in this study, it is expected that, for the events included in the study, the estimates presented here over predict the risk. However, there are likely to be many other occupational issues and risks associated with ships (e.g., engine room fires, accommodations block fires) and terminal operations (e.g., small boat accidents, drowning, falls, maintenance accidents) that are not addressed here but that could cause fatalities on a more frequent basis.

The most severe events examined in this study are flash fires (e.g., releases where the flammable cloud is not immediately ignited, it extends to engulf a large portion (or all) of the terminal, and then ignites) and pool fires (where a pool of LNG burns as it evaporates). Conservatively, flash fires are assumed to cause all located outdoors and within the cloud to become fatalities and pool fires (based on the specific distance from the pool) also cause fatalities in a very short period of time. In fact, it is likely that some of the personnel would be able to take shelter before such a flash fire occurred or before a pool fire caused life caused serious injury. Also, in cases where the emergency shutdown (ESD) system was assumed to fail, the analysis assumed that there was no immediate detection of the release. In reality, in many cases where the ESD could fail to initiate the desired shutdown actions, it might still provide alarms that would alert the operators to take an emergency response (including seeking shelter).

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Additionally to this assessment, the team estimate some external scenarios grouped in the S-11 scenario. Those are related with the worst events could be occur in the Site surrounding. Populations surrounding densities were used to place data obtained from Panama Census 2010. This data can be displayed in Appendix F.

For this, the assessment team also took into account the following existing neighbours and distances as well know future projects (i.e. LNG Power and new waste incineration).

Project	Estimated Personnel	Distance
Proyecto LNG Power	30	836 m
Jetty NG Power	2	814 m
Puma Marine Limited	90	723 m
Petroport	15	738 m
Telfer Tanks	80	433 m
STI	61	544 m

Naturally, this information must be validated with the owners or sponsors.

These scenarios and their consequences are estimated in Appendix C and evidently have no incremental effect with the Costa Norte LNG terminal

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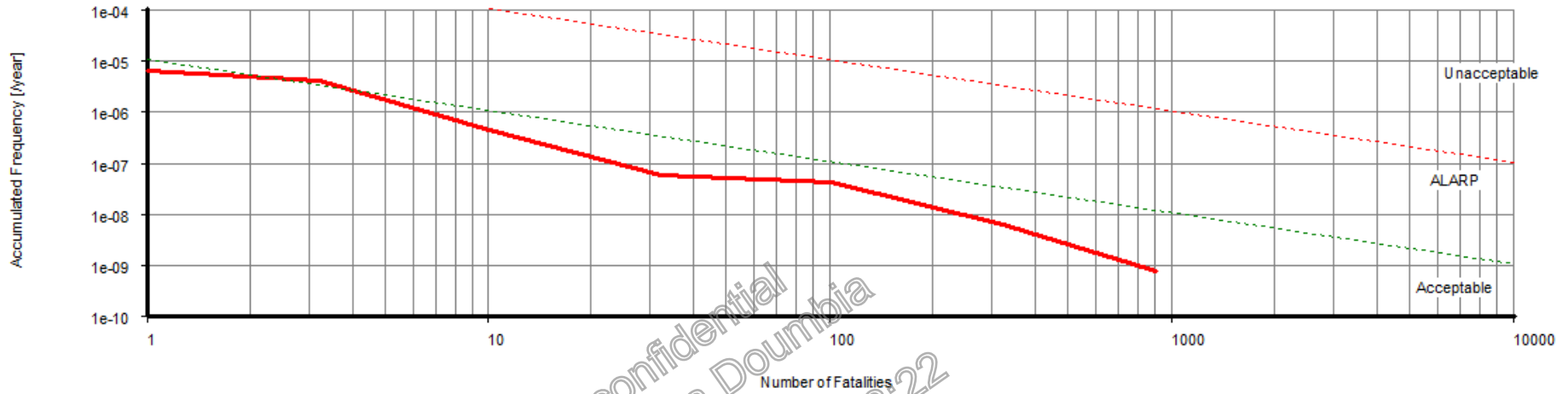


Figure 5-2 F-N Curve for LNG Terminal Risk Results

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### 5.3 RISK EVALUATION BASED ON INDUSTRY CONSISTENCY

The proposed Costa Norte LNG terminal design standards, safety philosophy, and LNG equipment are consistent with that employed in other LNG terminals around the world. That approach employs proven technologies (e.g., a vessel certified by a recognized third party for the service as an LNGC, transfer arms appropriate for continuous service, powered emergency release couplings, and a comprehensive emergency shutdown system (including release detection, alarm, and shutdown functions) as a prevention and mitigation features.

Assuming that the facility is constructed and operated consistent with the safety philosophy documented by the project, we have the following observations based on consistency of the terminal with the LNG industry at large:

- The risks of an LNG facility that meets industry guidelines for design, operational controls, and safety management systems are not expected to pose an unacceptable risk to its neighbors.
- Although LNG terminals receive a level of regulatory and public attention that is much higher than other types of energy and hydrocarbon processing facilities, they historically have not been, and should not be considered, higher risk than many of those other facilities.
- LNG facilities that are in very close proximity to other users within a port have operated for more than 30 years in the United States and Japan and occupy some of the most densely developed industrial property in the world in Japan (with five LNG terminals in Tokyo Bay, one of the busiest harbors in the world).
- Based on the incident data for LNG import terminals, a typical facility is not likely to have a severe event (i.e., one with impacts on people not involved in operating the facility) in many facility lifetimes
- We are not aware of any facility that meets modern siting requirements that has ever had an accident that resulted in significant safety impacts outside the facility.

This does not mean that accidents cannot happen or that the proposed LNG terminal should not receive very close attention from experienced LNG terminal developers, engineering contractors, terminal operators, and regulators. It is that attention and care employed in continuing to manage safety that are major parts of making LNG facilities as safe as they have been in the industry's history.

### 5.4 RISK MITIGATION BASED ON CURRENT DESIGN

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The design and proposed operation of the Costa Norte LNG terminal is consistent with that employed in other LNG terminals around the world. In order to further reduce the risk, AES should ensure that the following mitigation measures are taken in the design and in the operation of proposed LNG terminal:

**5.4.1 Gas Dispersion**

In order to limit the consequences of potential gas releases, AES and ship operators should take measures to: (1) reduce the potential for LNG leaks, (2) rapidly detect and isolate leaks, (3) control the ignition sources within the LFL areas:

- 1) **Leak Prevention:** Most of the LNG lines are welded. A strict procedure for line cooldown will be applied to avoid shock cooling.
  - 2) **Leak Detection and Isolation:**
    - a) Gas, spill, fire detectors are located in the process areas and provide inputs to the automatic ESD that stops the flow by shutting down pumps and closing isolation valves.
    - b) Foam can be activated to reduce the vaporization.
    - c) LNG leaks are collected within drip trays and within LNG impounding on jetty head.
    - d) The ship unloading is monitored by jetty and ship operators and there are CCTV's in process areas to provide additional monitoring.
  - 3) **Control of Ignition Sources:**
    - a) Outdoor electrical material is classified (on the jetty head, ship decks, and on the service platform).
    - b) The jetty building and the electrical building are pressurized.
    - c) Strict operating procedures limit the ignition sources (no mobile equipment, no matches, a permit procedure controlling ignition sources) within the LFL contour.
- (1) A restricted access area controlled by the port authorities from the LNG transfer arms will be implemented and consequently engineering measures to reduce exposure surface of LNG spilled implemented in the jetty.
- d) . So, it is recommended to put the stand-by tug in open sea on the east of the LNGC and the service boat on the small pier in order to minimize the number of personnel within the zone.

**5.4.2 Thermal Radiation**

In order to limit the consequences of potential radiations in case of pool or jet fire, the design team indicated that the following measures have been taken in the design:

- (2) Implementation of strict operating procedures limit the ignition sources (no mobile equipment, no matches, work permit procedures) within the 5 kW/m2 contour. In the S-2.B scenario (Figure 4.4) in the Pool Fire outcome, this result in a 120 m contour distance.
- (3) A restricted access area controlled by the port authorities from the LNG transfer arms will be implemented and consequently engineering measures to reduce exposure surface of LNG spilled

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implemented in the jetty. As part of this, it is recommended to put the stand-by tug in open waters to the east of the LNGC and the service boat on the small pier. For more information about this issues and exclusion zones, see Appendix G.

- (4) Provide a stand-by tug with firefighting capacities.
- (5) Provide fire fighting capacities on the LNGC and on the jetty head including:
  - a. fire water pumps, monitors & spray system for cooling purposes,
  - b. foam system on the jetty head (to reduce heat radiation), and
  - c. dry powder extinguishers located appropriately.
- (6) Fire proofing insulation of the process pipes within the fire zone and of the primary metallic structures on the top sides to avoid escalation effect.

**5.4.3 Explosions**

In order to limit the consequences of potential overpressures in case of vapor cloud explosion, the design team indicated that the following measures have been taken in the design (in additions to those mentioned above as gas dispersion and thermal radiation mitigation measures:

- (1) Limits on the number of confined or congested spaces by ensuring a proper ventilation of the areas and pressurization of the buildings.
- (2) Installation of any lightweight structures (vent, feedwater pump shelter, inboard/outboard arms, gangway) outside the 170 mbar contour from potential onboard explosion areas.
- (3) Design of the jetty building (which is manned during LNG transfers and which protects the ESD/F&G hardware) for an overpressure of 200 mbar.

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# **APPENDIX A**

## **HISTORICAL INCIDENTS INVOLVING LNG**

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## APPENDIX A: HISTORICAL INCIDENTS INVOLVING LNG

Incidents/ Accidents Involving LNG																	
Event Number	Date	Location	Plant/ Company Name	Type of Plant	Mode of Operation	Event Description	Cause	Safety of Employees and External Population			Release	Fire	Explosion	Damage to Equipment	Material/ Substance	Source	
								No. of Fatalities	No. of Injured	Total							
1	12/15/09	Puerto Rico	Suez Matthew	LNG Carrier	-	The Norwegian-flagged LNG tanker <i>Suez Matthew</i> grounded on the reef off Cayo Maria Langa, a small island near Guayanilla, Puerto Rico. The accident occurred on Dec. 15, 2009, at about 06:15 a.m.  The 920-foot ship ran aground while inbound to the Eco Electrica terminal pier at Guayanilla. At the time of the grounding all local aids to navigation were reported to be on station and working properly. The ship's agent and operator both confirmed that the pilot had not yet embarked. The pilot and master were in communication the morning of the incident, and the pilot had asked the master to proceed inbound (from the pilot station) to pick him up. When the vessel slowed to safely pick up the pilot, steerage was reduced, and the vessel consequently touched bottom. The vessel was maneuvering at a slow bell. There were no mechanical problems with the vessel.  The ship has a draft of about 40 feet. It grounded on the south side of Cayo Maria Langa. About 20 percent of the bow was aground while the stern remained in 150 feet of water. The crew shifted ballast to the stern and was able to refloat the vessel three hours later. Once afloat, <i>Suez Matthew</i> proceeded to the Eco Electrica terminal pier under its own power for inspection by contract divers. No damage was found.		0	0	0	No	No	No	Yes	NA	Media accounts	
2	12/27/08	Massachusetts	Suez Matthew	LNG Carrier	-	Suez Matthew, a 30-year-old LNG vessel, lost power and drifted just before midnight Dec. 27, 2008, about 45 miles east of Boston. The 920-foot tanker was inbound from Trinidad to the Distrigas LNG facility in Everett, Mass., with a crew of 31 and a full load of LNG.  The crew of Suez Matthew was able to reactivate one of the ship's two boilers at about 0330. The second boiler was brought online two hours later. Once the U.S. Coast Guard was satisfied that the boilers were functioning properly and propulsion was normal, the ship was escorted by tugs to an anchorage in Broad Sound, not far from the Distrigas LNG facility.	The cause was a malfunctioning control valve.		0	0	0	No	No	No	No	NA	Media accounts-

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Incidents/ Accidents Involving LNG																
Event Number	Date	Location	Plant/ Company Name	Type of Plant	Mode of Operation	Event Description	Cause	Safety of Employees and External Population			Release	Fire	Explosion	Damage to Equipment	Material/ Substance	Source
								No. of Fatalities	No. of Injured	Total						
3	02/11/08	Boston	Catalunya Spirit	LNG Carrier	-	The LNG Carrier Catalunya Spirit lost power from both main generators Feb. 11, 2008, and drifted in the Atlantic Ocean about 50 nm southeast of Boston. The Spanish-flag ship lost power during a voyage to the Distrigas LNG terminal in Everett, Mass., from Trinidad and Tobago. Z-drive tugboats were able to bring the loaded 932-foot ship under tow, preventing the ship from grounding on Stellwagen Bank shoal, the Coast Guard said in an investigative report.	The five-day blackout off Massachusetts occurred because of dirty relays that caused a low-water level in the boiler and because of inadequate training of the crew on how to restart power manually, U.S. Coast Guard investigators have determined.	0	0	0	No	No	No	No	NA	Media accounts -
4	01/19/04	Skikda, Algeria	Skikda Liquefaction Plant and Export Terminal, Sonatrach	LNG Export Terminal	Normal	A fire completely destroyed the trains 20, 30, and 40, however, did not damage the loading plant and three large LNG storage tanks, also located at the terminal. NOTE 1: deaths were mainly related to the explosion; a few deaths were related to the fire. NOTE 2: area without wind and semi-confined (cold boxes, boiler, control room in three sides).	Limited understanding of specific details of the accident. According to a report (Hint 2004), 'the explosion was the result of a catastrophic failure in one of the cold boxes of Unit 40, which resulted in an LNG or refrigerant VCE. The most probable ignition source was the boiler on the north side of Unit 40.	27	74	101	Yes	Yes	Yes	Yes	Hydrocarbon Vapors	USCG/MARAD, 20061, Hint 2004.2
5	08/16/03	Bintulu, Malaysia	-	LNG Liquefaction and Export Facility	-	A major fire occurred in the exhaust system of the propane compressor gas turbine in the first train (train 7) of the MLNG Tiga project. A crack had developed in the joint between the tube and header of the regeneration gas coil in the waste heat recovery unit (WHRU). This leakage went undetected. The propane compressor and turbine experienced a trip that was unrelated to the gas leakage. The procedure was then for the turbine to go into a slow rotation of 6 rpm using the barring motor, which successfully occurred. Because of the rotation of the turbine blades and the chimney effect of the turbine exhaust stack, air was drawn in through the turbine and into the exhaust duct. The natural gas escaping from the regeneration coil crack mixed with the air inside the WHRU that was still at a very high temperature, near the normal operating exhaust temperature of 570°C. When the gas air mixture reached its lower flammability limit and auto ignition temperature of 537 °C, an explosion inside the WHRU resulted. The incident caused damage to the WHRU ducting, hot oil and regeneration coils, gas turbine and compressors, as well as superficial damage to the compressor building. No injury occurred to any personnel. While the incident involved natural gas and was in an auxiliary system for one of the major pieces of the refrigeration system it did not directly involve LNG or any part of the cryogenic systems.	-	0	0	0	Yes	Yes	Yes	Yes	NG	CH-IV 2009.3

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Incidents/ Accidents Involving LNG																
Event Number	Date	Location	Plant/ Company Name	Type of Plant	Mode of Operation	Event Description	Cause	Safety of Employees and External Population			Release	Fire	Explosion	Damage to Equipment	Material/ Substance	Source
								No. of Fatalities	No. of Injured	Total						
6	2002	Strait of Gibraltar	Norman Lady	LNG Carrier	At sea	Following collision with a submarine, there was water leakage into the sea in the area of the spud tanks. Cargo tanks were not damaged.	Collision with an American nuclear submarine, U.S.S Oklahoma City.	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006.
7	2000	Savannah, Georgia, USA	-	-	N/A	A vessel of 177 meters, Sun Sapphire, lost control on the Savannah River and collided against the LNG off-loading pier on the Island of Elba. The plant on the Island of Elba was being re-activated, however the unit did not contain LNG. The Sun Sapphire, transporting palm and coconut oil, suffered a tear measuring 12 meters on the hull. The point of impact on the terminal was the LNG off-loading platform. The LNG plant suffered significant damage, including the need to replace five off-loading arms of 16". Nevertheless, there were no signs of LNG presence in the line, since release would have been noticed. According to CH-IV 2002, given the geometry of the Savannah River on the Island of Elba, it is doubtful that if the LNG vessel had been submitted to this force there would have been penetration of the hull and release of LNG.	There are no details on the root causes of the loss of control of the Sun Sapphire.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.4
8	09/06/99	Trinidad and Tobago	Methane Polar	LNG Carrier	Berthing	Supply vessel collided and damaged the Petrotrin Pier. There were no injuries.	Engineering failure during approximation to the breakwater of the Atlantic LNG.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
9	10/31/97	Japan	LNG Capricorn	LNG Carrier	Berthing	Collided against a mooring dolphin at a pier next to the LNG terminal in Senboku in Japan. Some damage to the hull, however, there was no entry of water in the hull or loss of cargo	Collision with a dolphin.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
10	05/21/97	-	Northwest Swift	LNG Carrier	At sea	Collided with a fishing vessel about 400 km from Japan. Some damage to the hull, however, there was no entry of water in the hull or loss of cargo.	Collision with a fishing vessel.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
11	1995	France	Montoir Terminal	LNG Import Terminal	Normal	Leakage occurred at a high pressure valve of the LNG line in the vaporizer. LNG reached the water causing a rapid phase transaction (RPT). The RPT damaged the plastic structure around the vaporizers.	-	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
12	1992	Bontang, Indonesia	Indonesian Liquefaction Plant and Export Terminal	LNG Export Terminal	Plant modification	LNG leakage occurred in an open line of product during a modification of a lines project. LNG entered into the concrete underground sewer and there was an RPT which broke the lines. This incident resulted in significant damage to the pluvial drainage system.	-	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
13	09/12/92	Baltimore, Maryland, USA	-	LNG Peakshaving Facility	-	A relief valve on LNG piping near one of the three LNG tanks failed open and released LNG into the LNG tank containment for over 10 hours, resulting in an estimated loss of over 25,000 gallons into the LNG tank containment. The LNG also impinged on the LNG tank causing embrittlement fractures on the outer shell. The LNG tank was taken out of service and repaired. No plant personnel were injured, no vapor was ignited and none traveled outside the plant area.	-	0	0	0	Yes (25,000 gallons)	No	No	Yes	LNG	CH-IV 2009

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14	1990	-	Bachir Chihani	LNG Carrier	At sea	Structural cracks caused by stress and fatigue in the internal hull. Fractures in the internal hull resulted in the entry of sea water in the space behind the tank insulation while the vessel was being ballasted.	A fracture occurred in a part of the vessel's structure, which is susceptible to intense stress which may accompany the complex deflections that the vessel may face in high sea.	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006, CH-IV 2002.
15	1989	Skikda, Algeria	Tellier (LNG Carrier)	LNG Carrier/LNG Export Terminal	Loading	Cargo transfer arms broke when the supply vessel moved. Vessel's piping was highly damaged. According to hearsay about this accident, LNG was released from the transfer arms and the LNG fractured the hull and the deck.	The chains broke and the wind dragged the vessel from its berth.	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
16	1989	Thurley, UK	-	LNG Peak Shaving Plant	-	While the vaporizers cooled in preparation for the export of natural gas, low point drainage valves were opened in each vaporizer. One of these drainage valves was not closed when the pumps were reinitiated and the LNG entered into the vaporizers. As consequence, the LNG was released into the atmosphere in a high pressure jet. The resulting vapor cloud ignited about 30 seconds after the release started. The cloud fire covered an area of 40 m x 25 m. Two operators suffered burning on their hands and face. The source of ignition could have been a pilot flame in one of the other submersible combustion vaporizers.	A procedural error resulted in an open drainage valve. "Lack of attention to the procedures or insufficient training probably resulted in the open drainage valve."	0	2	2	Yes	Yes	No	Yes	LNG	CH-IV 2002, ioMosaic 2005.
17	1988	Everett, MA, USA	-	LNG Import Terminal	Off-loading	Approximately 30,000 gallons of LNG leaked through flange gaskets during an LNG transfer interruption at Distrigas. The leakage was contained in a small area, as projected. The calm night avoided the movement of the vapor cloud out of this immediate area. There were no injuries and damages aside from the gaskets that burst. As a result, both manual and automatic procedures were modified.	The cause was later determined as "condensation induced the hammering." According to ioMosaic 2005, when the LNG off-loading was shutdown, the system was at equilibrium under the off-loading conditions. Some small pockets filled with vapor in some points of the instruments or purge connections. When off-loading was reinitiated, these dead points were rapidly refilled with liquid and the methane vapor re-condensed, causing a phenomenon similar to the hammering in piping. The resulting pressure burst a gasket.	0	0	0	Yes	No	No	No (only a gasket burst)	LNG	CH-IV 2002, ioMosaic 2005.

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18	08/29/87	Mercury, Nevada, USA	Department of Energy Test Facility	Test Facility		The large-scale tests involving spills of LNG on water were sponsored by the Department of Energy and Gas Research Institute to study the effectiveness of vapor fences in reducing the extent of downwind dispersion of LNG vapor clouds. The cloud accidentally ignited during Test #5 just after a sequence of relatively strong rapid phase transitions (RPTs) which damaged and propelled polyurethane pipe insulation outside the fence. The duration of the fire was 30 seconds. The flame length was about 20 feet above the ground.	The official explanation was that a spark generated by static electricity approximately 76 seconds after the spill was the most likely source of ignition. An independent investigation on behalf of Gas Research Institute showed that a more likely source of ignition was oxygen enrichment between the surface of the LNG pipe and the combustible polyurethane foam insulation. Oxygen enrichment occurred during the long cool-down period with liquid nitrogen that preceded the LNG test. Such enrichment had been previously observed during tests carried out by an LNG tank design and manufacturing company. Impacts during the RPTs may have ignited the insulation but not the nearby fuel-rich vapor cloud. However, when a smoldering insulation fragment was propelled outside the fence by an RPT, it ignited the portion of the cloud that was within the flammable limits.	0	0	0	Yes	Yes	No	No	LGN	CH-IV 2009
19	1985	Pinson, Alabama, USA	-	LNG Peak Shaving Plant	Normal	The welding on a repair plate measuring 8"3 x 12" in a small aluminum vessel (1 m in diameter by 2 m in height) failed when the vessel was receiving LNG. The plate was launched at an installation which housed the control room, Boiler, and offices. Some windows of the control room broke and the natural gas which was being released from the vessel entered into the installation and ignited.	-	0	6	6	Yes	Yes	Yes	Yes	LNG	CH-IV 2002, ioMosaic 2005.
20	1985	-	Gradinia	LNG Carrier	At port	Steering gear failure. No details were registered as to damages.	-	0	0	0	No	No	No	No	NA	USCG/MARAD, 2006.
21	1985	Anabella		LNG Carrier	Off-loading	Load valve failure, resulting in the overfilling tank. The release caused fractures on the deck.	-	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002.
22	1985	-	Isabella	LNG Carrier	-	LNG was released as a resulted of tank overfilling. Fractures on the deck caused by weakening due to cryogenic temperature.	-	0	0	0	Yes	No	No	Yes	LNG	CH-IV 2002.
23	1985	-	Ramdane Abane	LNG Carrier	-	Collision while loaded. Bow and port were affected.	-	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
24	1984	-	Melrose	LNG Carrier	At sea	Fire in the engine room. No structural damage. Damage limited to the engine room.	-	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006.
25	1983	-	Norman Lady	LNG Carrier	Off-loading	During cooling of the transfer arms, prior to off-loading, the vessel moved. All transfer arms broke and LNG was released. No ignition occurred.	Vessel moved by itself.	0	0	0	Yes	No	No	Yes	LNG	CH-IV 2002.

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26	04/14/87	Bontang, Indonesia	Indonesian Liquefaction Plant and Export Terminal	LNG Export Terminal (Liquefaction Plant)	Startup	The main liquefaction column of Train B broke due to overpressure. Debris and coils were launched at a distance of 50 m. Debris of the column explosion killed three workers. The ensuing fire was extinguished in 30 minutes.	The overpressure of the heat exchanger was the result of a flange left at flare line during startup. All of the pressure relief systems were connected to these lines. The exchanger was designed to operate at 60 psig on the hull side. Gas pressure reached 180 psig, causing failure in the exchanger.	3	0	3	Yes	Yes	Yes (Mechanical explosion)	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002, ioMosaic 2005.
27	Early 1980s	-	El Paso Consolidated	LNG Carrier	-	Minor release of LNG from a flange. Deck plating fractured due to low temperature embrittlement.	-	0	0	0	Yes	No	No	Yes (Deck plating fractured due to low temperature embrittlement)	LNG	CH-IV 2009
28	Early 1980s	-	Larbi Ben M'Hidi	LNG Carrier	-	Vapor released during transfer arm disconnection	-	0	0	0	Yes	No	No	No	NG	CH-IV 2009
29	12/12/80	Tobata, Japan	Taurus	LNG Carrier	In Mutsure Anchorage	Grounded on rocks at 12 knots. This occurred in Mutsure Anchorage next to Tobata. All ballast tanks were inundated and heeled. Extensive damage in the lower part. LNG tanks were Kvaerner Moss and were not damaged. The vessel was able to float on its own power until the LNG Terminal in Kita Kyushu, and off-loaded its cargo.	Grounded under bad weather caused by a typhoon. The supply vessel entered the channel without a pilot.	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006, CH-IV 2002, ioMosaic 2005.
30	1980	-	Libra	LNG Carrier	At sea	The shaft moved against the rudder. The shaft end fractured.	-	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006.
31	1980	-	El Paso Consolidated	LNG Carrier	-	Small release at a flange. Metals of the deck fractured due to weakening due to low temperature.	-	0	0	0	Yes	No	No	Yes	LNG	CH-IV 2002.
32	1980	-	Larbi Ben M'Hidi	LNG Carrier	-	Release of vapor during the transfer arm disconnection.	-	0	0	0	Yes	No	No	No	Vaporized LNG (natural gas)	CH-IV 2002.
33	10/6/79	Cove Point, Maryland, USA	LNG Receiving Terminal Cover Point, Columbia LNG Corporation	LNG Import Terminal	Normal	LNG leaked through an electric penetration seal too tight at an LNG pump. The LNG vaporized, went through 60 m of electrical conduit and entered an electric substation. The natural gas was ignited by the normal contacts in the arches of a circular brake, resulting in an explosion. Since the natural gas had never been expected in this substation, there were no gas detectors. The explosion killed one operator, severely injured another person and caused US\$3 million worth in damages.	Penetration seal too tight.	1	1	2	Yes (30.000gallons)	No	Yes	Yes (\$3 million)	Vaporized LNG (natural gas)	CH-IV 2002, ioMosaic 2005.

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34	06/29/79	Strait of Gibraltar	El Paso Paul Kayser Carrier	LNG Carrier (membrane tank)	At sea	Grounded between 17 to 19 knots on rocks. Serious damage to the hull bottom and ballast tanks; damage to the water engines, bottom of storage system; primary/ secondary LNG membranes deformed. However, there was no cargo leakage and LNG was successfully transferred later.	-	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006, CH-IV 2002, ioMosaic 2005.
35	04/25/79	Everett, MA, USA	Pollenger	LNG Carrier	Off-loading	Valve leakage. Fractures on the tank cap plates. Probably only a few liters, however the fractures on the tank cap plates have an area of 2 m <sup>2</sup> .	LNG Leakage in overlapping valve.	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002.
36	4/8/79	Cove Point, Maryland, USA	Mostefa Ben-Boulaid	LNG Carrier	Off-loading	Valve leakage, LNG spill, and small fractures on deck.	The spill was caused by an inclined check valve in the liquid line. In this valve the hinge journal is fixed by a screw which penetrates in the valve wall. Apparently, the vibration disconnected the screw, launching an LNG jet on deck.	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002.
37	1978	Island Das, the UAE		LNG Export Terminal		The bottom of a connection line of a LNG tank failed, resulting in an LNG spill inside the tank container. Liquid flow was impeded by the shutdown of the internal valve, designed for such task. A huge vapor cloud was formed and dissipated upon ignition.	There are no details on the cause of the line failure. In this case, the safety systems functioned as designed to avoid that an escalation of the event.	0	0	0	Yes	No	No	No	LNG	CH-IV 2002, ioMosaic 2005.
38	8/14/78	Strait of Singapore	Khannur	LNG Carrier	At sea	Collision with the cargo vessel Hong Hwa. There was no release of LNG.	-	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
39	1977	Bontang, Indonesia	Aquarius	LNG Carrier	Loading	Tank was overloaded by the mast vent. Surprisingly, the thin plate of steel of which the tank cap was made did not fracture due to the spill.	It could have been caused by difficulties in the level indication system. The high alarm had been put in by-pass mode to eliminate inconvenient alarms.	0	0	0	Yes	No	No	No	LNG	USCG/MARAD, 2006, CH-IV 2002.
40	3/15/77	Arzew, Argelia	Camel	LNG Export Terminal		An aluminum valve failed upon coming in contact with cryogenic temperatures. This resulted in the release of LNG without ignition. An employee was hit by an LNG jet and died due to freezing. In addition, RPTs broke windows.	A wrong aluminum alloy in a replacement valve. The valve body was made of an aluminum template. Currently, LNG valves in considerable services are manufactured of stainless steel.	1	0	1	Yes (from 1,500 to 2,000 m <sup>3</sup> )	No	No	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002.
41	1975		Philadelphia Gas Works			Not caused by LNG. An iso-pentane which served as fluid heat exchanger leaked, caught fire and burned the entire vaporizers area.	-	0	0	0	Yes	No	No	Yes	Isopentane	USCG/MARAD, 2006.
42	11/9/74	Tokyo Bay, Japan	Yuyo Maru No. 10	LPG vessel and Petroleum refined products	At sea	Collided against the vessel Pacific Ares. Yuyo Maru No. 10 ended up with great hole on the point of collision. Nafta flowed into the sea initiating a fire at sea. Many explosions took place and Yoyo Maru No. 10 grounded during attempts to tow it out of the bay. Eventually it was towed and sunk on November 27th by cannons, aerial bombs and torpedoes launched by the Self-Defense Navy. Five crew members of Yuyo Maru No. 10 died and seven others were hurt. The entire crew of Pacific Ares died with the exception of one person, who was hurt.	Collision with another vessel.	38	2	40	Yes	Yes	Yes	Yes	Naphtha, propane, and butane	CH-IV 2002.

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43	1974	-	Euclides	LNG Carrier		Grounded, Damaged the bottom and the propeller. There was no release of LNG.	-	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
44	6/12/74	Canvey Island, Essex, England	Methane Princess	LNG Carrier	Anchored	The cargo vessel Tower Princess collided with the LNG Carrier, which ended up with tear of 1 m on the external hull. There was no release of LNG.	-	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006, CH-IV 2002.
45	7/16/74	-	Barge Massachusetts	LNG barge	Loading	Following a power loss and the automatic shutdown of the main valves of the liquid lines, a small quantity of LNG spilled out from globe valve through a nitrogen purge of 1" into the liquid sump and distributor of the vessel. Many fractures occurred on the deck plates. They extended over an area measuring around 1 m to 2 m. The release was around 40 gallons. USCG banished this vessel to perform LNG services.	Subsequent investigation conducted by USCG discovered that overpressure caused by the valve shutdown induced the leakage of LNG by the cap and gasket valve of 1".	0	0	0	Yes	No	No	Yes	LNG	CH-IV 2002.
46	1974	La Havre, France	Euclides	LNG Carrier	-	Small damage due to contact with other vessel.	Contact with other vessel.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
47	1974	Everett, MA, USA	-	-	Loading	A valve leakage resulted in a spill which fractured the deck.	-	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
48	1974	Arzew, Argelia	Methane Progress	LNG Carrier	At port	Touched the bottom in Arzew. Rudder was damaged. There was no release of LNG.	-	0	0	0	No	No	No	Yes	NA	USCG/MARAD, 2006, CH-IV 2002).
49	2/10/74	Staten Island, New York, USA	Texas Eastern Transmission (TETCO)	LNG Peak Shaving Plant	Plant maintenance (repair)	During repairs in the LNG storage tank, Mylar Liner ignited and resulted in a fire. The fire caused an increase in the tank's temperature, creating sufficient pressure to dislocate a dense concrete ceiling of 6". The ceiling collapsed and fell on the employees inside the tank. Reports indicate that 40 employees died asphyxiated underneath the collapsed ceiling.	Standard operational procedures for the use of anti-explosion equipment in the tank. However, wipers and iron which were not explosion proof were being used in the sealing and cleaning of the insulation refuse. It is assumed that an electric spark in one of the iron or vacuums ignited the Mylar Liner. NOTE: This was an industrial incident unrelated to the presence of LNG (i.e., it happened during construction activities while the tank was being repaired).	40	0	40	No	Yes	Yes	Yes	NA	USCG/MARAD, 2006, CH-IV 2002, ioMosaic 2005, CNY 1973.5
50	1973	Canvey Island, Essex, England	Canvey Island Import Terminal	LNG Import Terminal	Off-loading	A small quantity of LNG was leaked into a rain water pool during LNG off-loading. The consequent vapor explosion, an RPT, caused loud booms. The incident resulted in broken glass, however no one was hurt.	-	0	0	0	Yes	No	No	No (except for broken glass)	LNG	USCG/MARAD, 2006.

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51	01/27/72	Montreal, Quebec, Canada		LNG Peak Shaving Plant	Normal	Nitrogen was supplied to the recycling compressor as a sealing gas during thawing operations. The nitrogen valve lines, which were maintained open during the thawing operation, were not shutdown following the completion of the operation. This resulted in an overpressure of the compressor with 250 to 350 psig of natural gas, which entered the nitrogen distributor. (The Nitrogen distributor pressure was 75 psig.). The natural gas in the nitrogen distributor eventually entered the air system of the instruments because the instruments controlled pneumatically were being operated with nitrogen due to instrument failure of the air compressor. The instruments blew their contents into the atmosphere in the control panel. Natural Gas entered the control room and was ignited while an operator tried to light a cigarette.	Adverted flow of natural gas in a nitrogen distributor due to ill-aligned valves of the nitrogen system. In addition, the air system of the instrument (IA) was receiving nitrogen due to compressor failure of the IA.	0	5	5	Yes	No	Yes	Yes	Vaporized LNG (natural gas)	CH-IV 2002, ioMosaic 2005.
52	08/21/71	La Spezia, Italy	La Spezia LNG Import Terminal	LNG Import Terminal	Off-loading (shortly after)	A storage tank suddenly developed an increase in pressure 18 hours after the completion of the transfer operation. LNG vapors were off-loaded through vents and tank safety valves. The tank ceiling suffered small damage, however vapors did not ignite.	Rollover. This was the first documented case of LNG rollover.	0	0	0	Yes	No	No	Yes	Vaporized LNG (natural gas)	USCG/MARAD, 2006.
53	1971	-	Descartes	LNG Carrier		A small flaw in the connection between the main tank and the tank arch allowed the entry of gas between the barriers.		0	0	0	No	No	No	Yes	NA	CH-IV 2002.
54	09/02/70	-	Artic Tokyo	LNG Carrier	At sea	LNG sloshing in tank No. 1 during bad weather caused localized deformation in the first barrier and support for insulation. LNG leaked in the space between the barriers at a single location. There was no release of LNG.	Sloshing due to bad weather.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
55	11/17/68	-	Polar Alaska	LNG Carrier	At sea	LNG sloshing in tank No. 1 resulted in the breaking of a part of the electric cable tray of the cargo pump, causing serious perforations to the main barrier. LNG leaked into the space between the barriers, however there was no release of the tank's LNG.	Sloshing.	0	0	0	No	No	No	Yes	NA	CH-IV 2002.
56	1968	-	Aristotle	LNG Carrier		Grounded off the coast of Mexico. Bottom was damaged. It is believed that it was rendering LPG services when this occurred.	-	0	0	0	No	No	No	Yes	NA	CH-IV 2002.

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57	1968	Portland, Oregon, USA	-	LNG Peak Shaving Plant	Construction (prior to inspection)	This accident occurred during pressure test on the new line as a part of the construction activities. The natural gas used in the pressure test leaked into the unfinished LNG tank interior and ignited. The resulting explosion killed the employees inside the tank, which measured 36 m in diameter, 30 m in height and the capacity for 176,000 barrels. Neither the tank nor the unit had been inspected when the accident occurred and the tank never contained LNG.	Natural gas (not LNG) leaked into the LNG tank's interior unfinished due to a line which should have been flanged.	4	0	4	Yes	Yes	Yes	Yes	Natural Gas	USCG/MARAD, 2006, CH-IV 2002, ioMosaic 2005.
58	01/16/66	Raunheim, Germany	-	-	-	A liquid level control failed in a vaporizer. This resulted in the venting of 500kg of LNG. The vapor cloud deviated toward the control room where it ignited. Causing a fire and an explosion.	A liquid level control failed in a vaporizer, allowing the LNG to be vented into the atmosphere.	1	75	76	Yes	Yes	Yes	Yes	Vaporized LNG (natural gas)	ioMosaic 2005.
59	11/4/66	-	Methane Progress	LNG Carrier	-	Cargo leakage registered. There are no details.	-	-	-	-	-	-	-	NA	CH-IV 2002.	
60	1965	Canvey Island, Essex, England	Canvey Island Import Terminal	LNG Import Terminal	Off-loading	LNG spilled from a tank during maintenance. The spill ignited and an employee was severely burned.	No details were found for the cause of the spill.	0	1	1	Yes	Yes	No	LNG	USCG/MARAD, 2006, CH-IV 2002.	
61	1965	-	Methane Princess	LNG Carrier	Disconnection following off-loading	LNG loading arms were disconnected prior to the complete draining of the liquid lines, allowing the LNG to seep through a leaky shut valve onto a waste tray of stainless steel positioned below the arms. Sea water was used in the area. Eventually, a fracture in the shape of a star appeared on deck due to the application of sea water.	-	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
62	1965	Arzew, Algeria	Jules Verne	LNG Carrier	Loading	LNG spill fractured the tank cap and the deck.	Cargo Tank No. 1 suffered overfilling, however the cause was never dully explained. Nevertheless, it is known to be associated to a failure in the liquid level instrumentation and insufficient familiarity with the equipment on behalf of the individual in charge of observing the cargo handling.	0	0	0	Yes	No	No	Yes	LNG	USCG/MARAD, 2006.
63	1964	Arzew, Argelia	-	-	Loading	While LNG was being loaded, lightning struck the forward vent of the vessel and ignited vapor, which was being routinely vented by the vent system. Loading was shutdown when a storm drew close to the terminal, however, the vapor generated by the loading process was being released into the atmosphere. The shore return line was still not in operation. The flame was rapidly combated through a nitrogen purge by a riser connection.	-	0	0	0	Yes (through the vent)	Yes	No	No	Vaporized LNG (natural gas)	CH-IV 2002.

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Incidents/ Accidents Involving LNG																
Event Number	Date	Location	Plant/ Company Name	Type of Plant	Mode of Operation	Event Description	Cause	Safety of Employees and External Population			Release	Fire	Explosion	Damage to Equipment	Material/ Substance	Source
								No. of Fatalities	No. of Injured	Total						
64	10/20/44	Cleveland, Ohio, USA	East Ohio Gas Company	LNG Peak Shaving Plant	Normal	A cylindrical LNG storage tank failed in this equalization plant. The tank did not have a trench or an area of containment, allowing the LNG to reach neighboring streets and pluvial water systems. A vapor cloud of natural gas was formed from the LNG pool vaporization which ignited. A second spherical tank failed 20 minutes after exposition to the fire, increasing the duration of the accident. The area directly involved measured around 1.92 km <sup>2</sup> (475 acres), occurring total devastation in an area of 30 acres.	The tank was constructed with an alloy which had a low nickel content (around 3.5%). This weakened the alloy when exposed to the low temperature of the LNG. Consequences increased because there was no containment trench to aid in the leakage containment. (NOTE: There was a partial trench designed to contain pipeline leakage, which flooded.	128	225	353	Yes	Yes	Yes	Yes	LNG	USCG/MARAD, 2006, CH-IV 2002.

**Additional Events Related to LNG Transfers<sup>6</sup>**

Incidents/ Accidents Involving LNG In Vessel-Jetty Transfers														
Event Number	Date	Cause	Remedial Action	Further Details	Safety of Employees and External Population			Estimated Release (liters)	Fire	Explosion	Damage to Equipment	Material/ Substance	Data Source	
					No. of Fatalities	No. of Injured	Total							
65	11/2010	-	-	-	0	0	0	<5	No	No	No	LNG	Ship	
66	09/2010	Component Failure	Water in switch and loose connection. PERC valve closed, but did not separate.	Two incidents. All connections checked and switch seals replaced.	0	0	0	<5	No	No	No	LNG	Terminal	
67	08/2010	Multiple causes	-	Lightning strike caused blackout to terminal. ESD I & II activated.	0	0	0	<5	No	No	No	LNG	-	
68	04/2010	Component Failure	Replaced seal and seal sent to SVT for examination.	During cooling down, a gas leak was detected at ERC seal. No apparent damage to seal noted. Failed Seal was sent to SVT for analysis with no determination as of this date. NB No release of ERC.	0	0	0	Minimal	No	No	No	LNG	Terminal	
69	03/2010	Multiple causes	Improve operational procedures. Design mod by mfr. Change maintenance procedures. Update management of change procedures. Change maintenance procedures.	-	0	1	1	2000-4000	-	-	Yes	LNG	Terminal	
70	03/2010	Component Failure	Switch replaced.	Faulty ESDL switch. Arms were in parked position	0	0	0	-	No	No	No	LNG	Charterer	
71	02/2010	Component Failure	Replaced seal and seal sent to SVT for examination	During draining of arm upon completion of cargo discharge, Emergency Release Coupling Seal failed and caused release of LNG. Approx. 2/3 of seal failed under 3 bars of pressure. Failed Seal	0	0	0	~5	No	No	No	LNG	Terminal	

6 SIGTTO, The Society of International Gas Tanker and Terminal Operators Ltd., 2011.

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Incidents/ Accidents Involving LNG In Vessel-Jetty Transfers													
Event Number	Date	Cause	Remedial Action	Further Details	Safety of Employees and External Population			Estimated Release (liters)	Fire	Explosion	Damage to Equipment	Material/ Substance	Data Source
					No. of Fatalities	No. of Injured	Total						
				was sent to SVT for analysis with no determination as of this date. NB No release of ERC.									
72	2010	-	-	-	-	-	-	-	-	-	-	LNG	-
73	12/2009	Other	Investigated and action taken by terminal	False activation of ESDII from shore.	0	0	0	<5	No	No	No	LNG	Ship
74	10/2009	Component Failure	Electrical circuitry checked and limit switch changed	-	0	0	0	300	No	No	Yes	LNG	Charterer
75	10/2009	Other	Taken by Terminal & follow up by Repsol	False activation of ESD -2 from shore, resulting in sudden disconnection of loading arm.	0	0	0	<5	No	No	No	LNG	Ship
76	08/2009	Component Failure	Switch replaced	Switch by passed for loading.	-	-	-	<5	-	-	-	LNG	Ship
77	08/2009	Operational	-	Maintenance crew pulled out wrong breaker and lost power to loading arms IPS.	0	0	0	<5	No	No	No	LNG	Ship
78	03/2009	Software	-	Believe caused by GMT/BST discrepancy of ship and shore computers.	0	0	0	10	No	No	No	LNG	Press
79	01/2009	Software	Check power supply & UPS	Hard arms mfrg recommends changing logic of PERC initialization.	0	0	0	<5	No	No	No	LNG	Ship
80	05/2008	Operational	Reset and reconnected	ESD2 initiated by shore due to a mistake during maintenance. Three attempts required to reset.	0	0	0	Minimal	No	No	No	LNG	Ship
81	01/2008	Component Failure	Card replaced	-	0	0	0	-	No	No	Yes	LNG	Charterer
82	05/2007	Operational	-	-	0	0	0	<5	No	No	No	LNG	Ship
83	05/2007	Operational	Training given	-	0	0	0	-	No	No	Yes	LNG	Ship
84	05/2007	Operational	Training given	-	0	0	0	-	No	No	Yes	LNG	Ship
85	04/2007	Other	System checked and reset	Release occurred immediately after warm ESD test. False signal from shore.	0	0	0	0	No	No	No	LNG	Ship
86	11/2006	Other	System checked and reset	Release occurred immediately after warm ESD test. False signal from shore.	0	0	0	0	No	No	No	LNG	Ship
87	08/2006	Operational	-	-	0	0	0	<5	No	No	No	LNG	Ship
88	07/2006	Software	Loading resumed after investigation	Special safety precautions agreed to continue cargo operations, including 10m exclusion around manifold and crew member by ESD button.	0	0	0	<5	No	No	No	LNG	Ship
89	05/2006	Operational	Vessel informed that an investigation by Atlantic LNG will be undertaken		0	0	0	<5	No	No	No	LNG	Ship
90	05/2006	Operational	Training and procedures changed	BP report indicates a card was pulled sending ESD II signals to both jetties. See Bilbao Knutsen.	0	0	0	-	No	No	No	LNG	Ship

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Incidents/ Accidents Involving LNG In Vessel-Jetty Transfers													
Event Number	Date	Cause	Remedial Action	Further Details	Safety of Employees and External Population			Estimated Release (liters)	Fire	Explosion	Damage to Equipment	Material/ Substance	Data Source
					No. of Fatalities	No. of Injured	Total						
91	03/2005	Multiple causes	-	Mooring hooks released as a result of a blackout ashore. ESD activated from shore.	0	0	0	<5	No	No	No	LNG	Ship

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# **APPENDIX B HAZID RESULTS**

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**Project No. [number]**

***Hazid AES Panamá***

Leader: Andrés Vargas

Scribe: Jorge Sáez

Meeting Location: Panamá City

Meeting Days: 2

Site: Panamá City

Plant: Telfers Island

*March 2016*

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**Table 1 Planos Used in the Analysis**

**(There are no Planos)**

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**Table 2 Equipo de Trabajo**

Nombre	Apellido	Compañía	Cargo	Rol en el Análisis
Cedric	Andrieu	Head ownwer Engineer - Projects	Vice President Chief of staff, Global E&C	
Cristian	Cuevas	AES	Deputy Construction Manager - Power Block	
José Gregorio	De Souza	AES	Business Development Senior Manager	
Kimberly	Farley	AES	Vice President Chief of staff, Global E&C	
Angel	Guastaferro	AES		
Francisco	Itriago	AES	Integrador	
Yamada	Kinji	AES		
André	Lardinoit	Tractebel	Gas&LNG International Expert Power& Gas	
Arturo	Matus	AES	Global E&C Safety Manager	
Chester	Rades	Sargent & Lundy	Senior Project Manager	
Brian	Reeves	AES	Project Management	
Jorge	Saez	ABS Consulting	Consultor	
Rodrigo	Sartori	Market Development Director	GLobal Enginnering and Constructions	
Narender	Singh	AES		
Hassan	Tariq	AES		
Andrés	Vargas	ABS Consulting	Consultor	Facilitador
Cristian	Zech	Tractebel	Gas&LNG International Expert Power& Gas	

**Table 3 Recomendaciones**

Type	No.	Recommendations	References
Recommendation	1	LNGC Reliability	1.1 LNGC entering the bay struck by another ship – LNGC during entry; LNGC Enters Harbor and Moors 2.1 LNGC collides with jetty head – LNGC collides with Jetty head 32.1 LNGC struck by another ship during departure – LNGC struck bay another ship during emergency departure 33.1 LNGC runs aground during emergency departure – LNGC runs aground during emergency departure
Recommendation	2	Carrier Docking Simulation	1.1 LNGC entering the bay struck by another ship – LNGC during entry; LNGC Enters Harbor and Moors 2.1 LNGC collides with jetty head – LNGC collides with Jetty head
Recommendation	3	Tug Fleet Requirements	1.1 LNGC entering the bay struck by another ship – LNGC during entry; LNGC Enters Harbor and Moors 2.1 LNGC collides with jetty head – LNGC collides with Jetty head 3.1 Another Ship strikes the shuttle carrier at the jetty – LNGC is collided in Jetty head 32.1 LNGC struck by another ship during departure – LNGC struck bay another ship during emergency departure 33.1 LNGC runs aground during emergency departure – LNGC runs aground during emergency departure
Recommendation	4	Mooring System Design and Limits	5.1 Mooring system failure (shuttle carrier) – Mooring System Fairlure of LNGC
Recommendation	5	Integrated LNG Operation Plan	1.1 LNGC entering the bay struck by another ship – LNGC during entry; LNGC Enters Harbor and Moors 2.1 LNGC collides with jetty head – LNGC collides with Jetty head 3.1 Another Ship strikes the shuttle carrier at the jetty – LNGC is collided in Jetty head 8.1 Another ship strickes the LNGC at its mooring location – Another ship strickes the LNGC at its mooring location (Phase I) 32.1 LNGC struck by another ship during departure – LNGC struck bay another ship during emergency departure 33.1 LNGC runs aground during emergency departure – LNGC runs aground during emergency departure 38.1 Limited visibility – Limited Visibility
Recommendation	6	Marine Safety Zone	1.1 LNGC entering the bay struck by another ship – LNGC during entry; LNGC Enters Harbor and Moors 3.1 Another Ship strikes the shuttle carrier at the jetty – LNGC is collided in Jetty head 5.1 Mooring system failure (shuttle carrier) – Mooring System Fairlure of LNGC 8.1 Another ship strickes the LNGC at its mooring location – Another ship strickes the LNGC at its mooring location (Phase I) 32.1 LNGC struck by another ship during departure – LNGC struck bay another ship during emergency departure 38.1 Limited visibility – Limited Visibility
Recommendation	7	LNG Emergency Plan	4.1 Onboard Emergency (fire) on the shuttle carrier – Onboard Emergency (fire) on LNGC

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Type	No.	Recommendations	References
Recommendation	23		9.1 Large release of LNG from transfer arms on the jetty head – Large leak of the LNG equipment on the jetty head 11.1 Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) – Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) 12.1 Large leak of LNG storage tank contents – Large leak of LNG storage tank contents
Recommendation	8	Comprehensive Safety Management System	6.1 Rupture of hydraulic system for the all LNG transfer arms and gangway – Rupture of hydraulic system for the all LNG transfer arms and gangway 9.1 Large release of LNG from transfer arms on the jetty head – Large leak of the LNG equipment on the jetty head 10.1 Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve – Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve 11.1 Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) – Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) 12.1 Large leak of LNG storage tank contents – Large leak of LNG storage tank contents 13.1 Rollover Occurs – Rollover Occurs 15.1 Leak in roof of LNG storage tank – Leak in roof of LNG storage tank 21.1 Large leak of LNG storage tank outlet low pressure line to the vaporization area – Large leak of LNG storage tank outlet low pressure line to the vaporization area 22.1 Large leak of high pressure LNG pump and outlet line – Large leak of high pressure LNG pump and outlet line 23.1 Large leak of vaporizer – Large leak in the vaporizer 24.1 Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve – Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve 25.1 Large leak of vaporizer high pressure natural gas outlet line – Large leak of vaporizer high pressure natural gas outlet line 36.1 Accident in adjacent facility – Accident in adjacent facility
Recommendation	9	LNGC Cargo Tank Rollover Evaluation	7.1 Rollover of LNGC cargo tank contents occurs Phase I – Rollover of LNGC cargo tank contents occurs
Recommendation	10	LNGC Cargo Tank Rollover Prevention	7.1 Rollover of LNGC cargo tank contents occurs Phase I – Rollover of LNGC cargo tank contents occurs
Recommendation	11	Inspection, Testing and Preventive Maintenance Program	5.1 Mooring system failure (shuttle carrier) – Mooring System Failure of LNGC 6.1 Rupture of hydraulic system for the all LNG transfer arms and gangway – Rupture of hydraulic system for the all LNG transfer arms and gangway 9.1 Large release of LNG from transfer arms on the jetty head – Large leak of the LNG equipment on the jetty head 10.1 Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve – Large leak of the LNG

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Type	No.	Recommendations	References
Recommendation	12	Hydraulic System Failure Alarm	transfer line on the jetty trestle to onshore ESD Valve 11.1 Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) – Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber)  12.1 Large leak of LNG storage tank contents – Large leak of LNG storage tank contents 13.1 Rollover Occurs – Rollover Occurs 23.1 Large leak of vaporizer – Large leak in the vaporizer 24.1 Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve – Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve 25.1 Large leak of vaporizer high pressure natural gas outlet line – Large leak of vaporizer high pressure natural gas outlet line
Recommendation	13	Construction Safety Management Plan	6.1 Rupture of hydraulic system for the all LNG transfer arms and gangway – Rupture of hydraulic system for the all LNG transfer arms and gangway  10.1 Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve – Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve 11.1 Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) – Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber)  15.1 Leak in roof of LNG storage tank – Leak in roof of LNG storage tank 21.1 Large leak of LNG storage tank outlet low pressure line to the vaporization area – Large leak of LNG storage tank outlet low pressure line to the vaporization area 22.1 Large leak of high pressure LNG pump and outlet line – Large leak of high pressure LNG pump and outlet line 23.1 Large leak of vaporizer – Large leak in the vaporizer 24.1 Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve – Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve 25.1 Large leak of vaporizer high pressure natural gas outlet line – Large leak of vaporizer high pressure natural gas outlet line
Recommendation	14	Warning System for Regional Tsunami	10.1 Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve – Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve 43.1 Tsunami generated by regional seismic event – Tsunami generated by regional seismic event 44.1 Tsunami generated by distant seismic event – Tsunami generated by distant seismic event
Recommendation	15	Emergency Departure Procedure for the LNGC	32.1 LNGC struck by another ship during departure – LNGC struck bay another ship during emergency departure 33.1 LNGC runs aground during emergency departure – LNGC runs aground during emergency departure

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Type	No.	Recommendations	References
Recommendation	16	Pre-Planning for Post-Earthquake Conditions if it is Necessary	34.1 Sloshing due to severe weather during emergency departure conditions – LNGC exposed to severe weather when partially loaded due weather-related departure 44.1 Tsunami generated by distant seismic event – Tsunami generated by distant seismic event
Recommendation	17	Assure the Use of Very Reliable Instrumented System	14.1 Overfilling of LNG storage tank – Overfilling of LNG storage tank
Recommendation	18	Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned	27.1 Leakages of NG in flow controlers – Flow Controlers 28.1 NG Leakages in gas Turbine – Gas Turbine
Recommendation	19	Consider Isolation Barrier for Flue Gas Leaks in Expansion Joints	29.1 NG Leakage (assuming NG burner) – Heat Recovery Steam generator
Recommendation	20	Consider Emergency and Mutual Aid Plans	36.1 Accident in adjacent facility – Accident in adjacent facility 42.1 External Fire or explosion – External fire or explosion
Recommendation	21	AES Will Subscribe a Weather Service Information Defining the Actions in an Emergency Plan	36.1 Accident in adjacent facility – Accident in adjacent facility 40.1 Electrical storm – Electrical Storm
Recommendation	22	Consider to Develop a Joined Emergency Plan Among Local Companies	42.1 External Fire or explosion – External fire or explosion
Recommendation	23	Develop a Plan of Pruning Weeds in the Area of Plant Safety	42.1 External Fire or explosion – External fire or explosion
Recommendation	24	Develop Evacuation Routes According to Plant or Neighbors Emergencies	36.1 Accident in adjacent facility – Accident in adjacent facility 42.1 External Fire or explosion – External fire or explosion
Recommendation	25	Establish Security Zones for each Potential Emergencies related to Neighbors Facilities	36.1 Accident in adjacent facility – Accident in adjacent facility 42.1 External Fire or explosion – External fire or explosion
Recommendation	26	Develop an Emergency Tsunami Plan	43.1 Tsunami generated by regional seismic event – Tsunami generated by regional seismic event 44.1 Tsunami generated by distant seismic event – Tsunami generated by distant seismic event
Recommendation	27	Consider, Based in a Study, if it is Necessary to Install Seismic Motion Detection and respectives integration with ESD	45.1 Seismic event damages the onshore portion of the plant – Seismic Event Damage onshore portion of the plant 45.2 Seismic event damages the plant – Seismic Event Damage onshore portion of the plant 45.3 Seismic event damages the offshore portion of the plant – Seismic Event Damage onshore portion of the plant 45.4 Ground movement or landslide damages the plant – Seismic Event Damage onshore portion of the plant

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Type	No.	Recommendations	References
Recommendation	28	Develop a Risk Analysis in Lifting Activities	<p>9.1 Large release of LNG from transfer arms on the jetty head – Large leak of the LNG equipment on the jetty head</p> <p>10.1 Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve – Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve</p> <p>11.1 Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber) – Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber)</p> <p>12.1 Large leak of LNG storage tank contents – Large leak of LNG storage tank contents</p> <p>21.1 Large leak of LNG storage tank outlet low pressure line to the vaporization area – Large leak of LNG storage tank outlet low pressure line to the vaporization area</p> <p>22.1 Large leak of high pressure LNG pump and outlet line – Large leak of high pressure LNG pump and outlet line</p> <p>25.1 Large leak of vaporizer high pressure natural gas outlet line – Large leak of vaporizer high pressure natural gas outlet line</p>

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**Table 4 List of Nodos**

No.	Tipo	Nombre	Descripción	Comment 1	Comment 2	Comment 3	Folder	Planos
1		LNGC during entry; LNGC Enters Harbor and Moors	LNGC during entry; LNGC Enters Harbor and Moors	Damage to the shuttle carrier is not expected due to collisions in the bay because ships do not operate at high speeds and non- LNG traffic is not oriented at right angle to the LNG vessel.	Frequency Basis: This type event has not occurred in the LNG industry history. It would require violation of maritime rules by a large ship at the time an LNG carrier was transiting the bay.		Section 1 LNGC during the entry	
2		LNGC collides with Jetty head	Shuttle Carrier collides with Jetty head	Damage to the carrier severe enough to cause cargo loss is not considered to result.			Section 1 LNGC during the entry	
3		LNGC is collided in Jetty head	Shuttle Carrier collides with Jetty head	Release of LNG cargo associated with this event is not considered credible. For an impact that results in cargo containment damage, it would require a high speed collision with a large vessel at a sharp angle to the vessel moored at the jetty.	No other large vessels should approach the LNG jetty with a shuttle carrier present and speeds of large vessels within the bay are controlled by pilot supervision.	There is just one large vessel authorized to approach the jetty, LNGC. Its speed and handling will be under the control of a pilot and will involve the use of docking tugs.	Section 2 LNGC is Moore at the Jetty for Unloading	
4		Onboard Emergency (fire) on LNGC	Onboard Emergency (fire) on the shuttle carrier	Frequency basis: In the more than 3 decades of LNG carrier experience, very few onboard fires have occurred and none have involved LNG.			Section 2 LNGC is Moore at the Jetty for Unloading	
5		Mooring System Fairlure of LNGC	Mooring System Fairlure (Shuttle carrier)	He mooring point of the shuttle carrier is more than 700m from the shore. This distance would exceed the flammable and thermal radiation hazard distances for most events (i.e., other than very large releases in worst case weather conditions).	Damage to the shuttle carrier would only be expected if a large ship traveling above the speeds normal within the bay were to strike the LNG shuttle amidships at a severe angle.		Section 2 LNGC is Moore at the Jetty for Unloading	

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No.	Tipo	Nombre	Descripción	Comment 1	Comment 2	Comment 3	Folder	Planos
6		Rupture of hydraulic system for the all LNG transfer arms and gangway	Rupture of hydraulic system for the all LNG transfer arms and gangway				Section 2 LNGC is Moore at the Jetty for Unloading	
7		Rollover of LNGC cargo tank contents occurs	Rollover of FSU cargo tank contents occurs	The potential release points for this is at least 500m from the shore.			Section 2 LNGC is Moore at the Jetty for Unloading	
8		Another ship strikes the LNGC at its mooring location (Phase I)	Another ship strikes the FSU at its mooring location	Release of LNG cargo associated with this event is not considered credible.	For an impact that results in cargo containment damage, it would require a high speed collision with a large vessel at a sharp angle to the vessel moored at the jetty.	There is just one large vessel authorized to approach the jetty, LNGC. Its speed and handling will be under the control of a pilot and will involve the use of docking tugs.	Section 2 LNGC is Moore at the Jetty for Unloading	
9		Large leak of the LNG equipment on the jetty head	Large leak of the LNG equipment on the jetty head	LNG equipment other than the unloading arms on the jetty head is more than 700m from the shore. This distance would exceed the flammable and thermal radiation hazard distances for all LNG events analyzed for that equipment.	Current structural design information does not allow evaluation of potential for congestion.	However, previous evaluations by ABS Consulting and Tractebel Engineering have not indicated potential for significant overpressure/damage.	Section 3 Transfer of LNG from LNGC to Absorber Inlet	
10		Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve	Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve	This event does include tsunami as a cause of the large leak. That leak is addressed in specific tsunami events for Phase I and II.			Section 3 Transfer of LNG from LNGC to Absorber Inlet	
11		Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber)	Large leak of the XX "LNG from the ESD Valve to the high pressure pump suction (including absorber)	LNG transfer lines are all welded construction on the jetty where no impoundment area is practical.			Section 3 Transfer of LNG from LNGC to Absorber Inlet	
12		Large leak of LNG storage tank contents	Large leak of LNG storage tank contents	Vapor releases from storage tank evaluated as other events. This event does include earthquake as a			Section 4 LNG Storage tank	

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				cause of the large leak. That leak is addressed in specific earthquake events for Phase I and II.				
13		Rollover Occurs	Rollover Occurs	Rollover relief rate (i.e., 100 times the rate for boiloff) does not have any adverse safety impact at ground level.			Section 4 LNG Storage tank	
14		Overfilling of LNG storage tank	Overfilling of LNG storage tank				Section 4 LNG Storage tank	
15		Leak in roof of LNG storage tank	Leak in roof of LNG storage tank	Vapor release at the tank roof level is not expected to have offsite consequences.			Section 4 LNG Storage tank	
16		Release from PSV of LNG storage tank	Fire at PSV outlet				Section 4 LNG Storage tank	
17		Fire at PSV outlet	Fire at PSV outlet				Section 4 LNG Storage tank	
18		Vacuum inside LNG storage tank	Vacuum inside LNG storage tank				Section 4 LNG Storage tank	
19		High pressure within the LNG storage tank	High pressure within the LNG storage tank	Relief System Philosophy and Vapor Control documents relief capacity for these events Vapor release at the tank roof to have offsite consequences should be demonstrated by QRA study.	Vapor release at the tank roof level is not expected to have offsite consequences		Section 4 LNG Storage tank	
20		Catastrophic failure of internal containment shell, releasing the contents to the secondary containment tank	Catastrophic failure of internal containment shell, releasing the contents to the secondary containment tank	Even if a leak from the internal tank shell was to occur, there is no identified mechanism for concurrent failure of the roof of the secondary containment shell.			Section 4 LNG Storage tank	
21		Large leak of LNG storage tank outlet low pressure line to the vaporization area	Large leak of LNG storage tank outlet low pressure line to the vaporization area				Section 5 LNG storage tank outlet low pressure Line to High pressure Pump suction (Absorber inlet)	

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No.	Tipo	Nombre	Descripción	Comment 1	Comment 2	Comment 3	Folder	Planos
22		Large leak of high pressure LNG pump and outlet line	Large leak of high pressure LNG pump and outlet line				Section 6 High Pressure Sendout equipment	
23		Large leak in the vaporizer	Large leak of vaporizer				Section 6 High Pressure Sendout equipment	
24		Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve	Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve				Section 6 High Pressure Sendout equipment	
25		Large leak of vaporizer high pressure natural gas outlet line	Large leak of vaporizer high pressure natural gas outlet line				Section 6 High Pressure Sendout equipment	
26		Feed GN Pipeline	Alimentacion GN				Section 7 Power plant operations	
27		Flow Controlers	Control Flujo				Section 7 Power plant operations	
28		Gas Turbine	Turbina Gas				Section 7 Power plant operations	
29		Heat Recovery Steam generator	Heat Recovery Steam generator				Section 7 Power plant operations	
30		Steam Turbine	Turbina vapor				Section 7 Power plant operations	
31		Diesel Tanks	Tanques Diesel				Section 7 Power plant operations	
32		LNGC struck bay another ship during emergency departure	Shuttle Carrier struck bay another ship during emergency departure	Damage to the shuttle carrier is not expected due to collisions in the bay because ships do not operate at high speeds and non-LNG traffic is not oriented at right angle to the LNG vessel. (See further discussion in Section 6).	Departure includes normal departure (e.g., vessel leaves as part of normal operations), precautionary departure (e.g., vessel leaves prior to arrival of severe weather), and emergency departure (e.g. fire on the jetty head may require emergency departure).		Section 8 LNGC During Departure	
33		LNGC runs aground during emergency departure	FSU runs aground during emergency departure	Only high speed grounding on hard bottom would be likely to cause structural damage and even then, cargo release is not expected.			Section 8 LNGC During Departure	
34		LNGC exposed to severeweather	LNGC exposed to severeweather	Not all carriers would be	Departure includes normal		Section 8 LNGC During	

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		when partially loaded due weather-related departure	when partially loaded due weather-related departure	susceptible to sloshing damage.	departure (e.g., vessel leaves as part of normal operations), precautionary departure (e.g., vessel leaves prior to arrival of severe weather), and emergency departure (e.g. fire on the jetty head may require emergency departure).		Departure	
35		Loss of telecommunications network	Loss of telecommunications network				Section 9 Loss of Utilities	
36		Accident in adjacent facility	Accident in adjacent facility				Section 9 Loss of Utilities	
37		Loss of offsite electrical power	Accident in adjacent facility				Section 9 Loss of Utilities	
38		Limited Visibility	Severe Weather/Other External Event				Section 10 Severe weather/Othes External Event	
39		High Temperatures	High Temperatures				Section 10 Severe weather/Othes External Event	
40		Electrical Storm	Eleectrical Storm				Section 10 Severe weather/Othes External Event	
41		Sabotaje Terrorism acts	Severe Weather/Other External Event				Section 10 Severe weather/Othes External Event	
42		External fire or explosion	Incendios externos				Section 10 Severe weather/Othes External Event	
43		Tsunami generated by regional seismic event	Tsunami due to local Event	The offshore portions of the facility up to the last 50 m can be exposed to 4.5 m waves. Within the last 50 m offshore, the maximum tsunami wave is 9.6 m.	The frequency of a tsunami that would cause the worst case wave height for the facility is uncertain. However, the consequences based on the release calculations are not severe.		Section 11 Tsunami	
44		Tsunami generated by distant seismic event	Tsunami generated by distant sesimic event	The offshore portions of the facility up to the last 50 m can be exposed to 4.5	The frequency of a tsunami that would cause the worst case wave height for the		Section 11 Tsunami	

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				m waves. Within the last 50 m offshore, the maximum tsunami wave is 9.6 m.	facility is uncertain. However, the consequences based on the release calculations are not severe.			
45		Seismic Event Damage onshore portion of the plant	Seismic Event Damage onshore portion of the plant	We assessed this event for Phase I due to the larger inventories and flow rates involved.	The level of damage assumed here would only occur if a landslide/ground motion damaged the LNG transfer line on the jetty. The frequency assumed is less likely than the OBE frequency but is highly uncertain.		Section 12 Seismic Events	
46		Aircraft Crash Phase I/II	Aircraft Crash Phase I/II	No Airport is located nearby the facility location. No specific evaluation of aircraft crash probability was performed.	However, based on evaluations performed for U.S. nuclear power plants and U.S. Department of Energy facilities the frequency of this event is considered less than $1 \times 10^{-6}$ .		Section 13 Aircraft Crash	

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**Table 5 Health & Safety Risk Matrix Used in Analysis**

	Timely first aid or medical treatment	Injury or serious effect on health. Hospitalization or temporary disability	Multiple serious injuries, temporary or partial permanent disability	A fatality or many persons disabling injuries	More than one fatality not external person involved	More than one fatality and external person involved
Frequent 1 to 10-1 event/year	Medium	Medium High	High	High	High	High
Very probable 10-1 to 10-2 event/year	Alarp	Medium	Medium High	High	High	High
Probable 10-2 to 10-3 event/year	Low	Medium	Medium	Medium High	High	High
Very improbable 10-3 to 10-4 events/year	Low	Low	Medium	Medium	Medium High	High
Improbable 10-4 to 10-5 events/year	Low	Low	Low	Medium	Medium	Medium High
Remote 10-5 to 10-6 events/year	Low	Low	Low	Low	Medium	Medium
Unknown less than 10-6 event/year	Low	Low	Low	Low	Low	Medium

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**Table 6 Environmental Risk Matrix Used in Analysis**

	No impact or low release	Release less 0.1 Tons	Release between 0.1 and less of 1 Tons of NG or NGL	Release between 1.01 and less of 10 Tons of NG or NGL	Release between 10.01 and less of 100 Tons of NG or NGL	Release of 100 or more NG or NGL
Frequent 1 to 10-1 event/year	Medium	Medium High	High	High	High	High
Very Probable 10-1 to 10-2 event/year	Medium	Medium	Medium High	High	High	High
Probable 10-2 to 10-3 event/year	Low	Medium	Medium	Medium High	High	High
Improbable 10-3 to 10-4 event/year	Low	Low	Medium	Medium	Medium High	High
Very Improbable 10-4 to 10-5 event/year	Low	Low	Low	Medium	Medium	Medium High
Remote 10-5 to 10-6 event/year	Low	Low	Low	Low	Medium	Medium
Unknown less than 10-6 event/year	Low	Low	Low	Low	Low	Medium

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**Table 7 Financial Risk Matrix Used in Analysis**

	< 10 KUSD	> 10 KUSD less than 500 KUSD	> 500 KUSD less than 1 MUSD	> 1 MUSD less than 50 MUSD	> 50 MUSD less than 100 MUSD	> More than 100 MUSD
Frequent 1 to 10-1 event/year	Medium	Medium High	High	High	High	High
Very Probable 10-1 to 10-2 event/year	Medium	Medium	Medium High	High	High	High
Probable 10-2 to 10-3 event/year.	Low	Medium	Medium	Medium High	High	High
Improbable 10-3 to 10-4 event/year	Low	Low	Medium	Medium	Medium High	High
Very improbable 10-4 to 10-5 event/year	Low	Low	Low	Medium	Medium	Medium High
Remote 10-5 to 10-6 event/year	Low	Low	Low	Low	Medium	Medium
Unknown less than 10-6 event/year	Low	Low	Low	Low	Low	Medium

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**Table 8 Used in Analysis**

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Generic	Frequency Basis: This type event has not occurred in the LNG industry history. It would require violation of maritime rules by a large ship at the time an LNG carrier was transiting the bay.		
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No.: 1		LNGC during entry; LNGC Enters Harbor and Moors							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
1.1	LNGC entering the bay struck by another ship	Pilot or helmsman error for a non LNG ship	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Carrier docking simulation (Manouvre studies) Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head. They can also assist by helping prevent disabled ships from striking the LNG shuttle carrier Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Ship movements in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay	Rec 1. LNGC Reliability Rec 2. Carrier Docking Simulation Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone
			Release of LNG cargo is not credible	E	S5	P1	P1-S5		
		Severe weather could be a contributor	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Carrier docking simulation (Manouvre studies) Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head. They can also assist by	Rec 1. LNGC Reliability Rec 2. Carrier Docking Simulation Rec 3. Tug Fleet Requirements



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No.: 1		LNGC during entry; LNGC Enters Harbor and Moors						Safeguards		Recomendaciones
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
Mar 24, 2016 13:23								helping prevent disabled ships from striking the LNG shuttle carrier Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Ship movements in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay	Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone	
				Release of LNG cargo is not credible	E	S5	P1	P1-S5		
		Loss of propulsion or steering	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Carrier docking simulation (Manouvre studies) Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head. They can also assist by helping prevent disabled ships from striking the LNG shuttle carrier Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Ship movements in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time Large ship transits in the bay	Rec 1. LNGC Reliability Rec 2. Carrier Docking Simulation Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone	

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No.: 1 confidential LNGC during entry; LNGC Enters Harbor and Moors confidential									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								require pilot supervision Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay	
			Release of LNG cargo is not credible	E	S5	P1	P1-S5		

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No.: 2		Shuttle Carrier collides with Jetty head							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
2.1	LNGC collides with jetty head	Pilot or helmsman error for the LNG shuttle carrier	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	<p>Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned</p> <p>Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head.</p> <p>Mooring of the shuttle carrier will require pilot supervision</p> <p>Transit planning in coordination with the maritime authority will occur prior to LNG shuttle carrier entry</p> <p>Mooring of the carrier under various wind and wave conditions will be planned using simulation studies</p> <p>Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay.</p> <p>LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time</p>	<p>Rec 1. LNGC Reliability</p> <p>Rec 2. Carrier Docking Simulation</p> <p>Rec 3. Tug Fleet Requirements</p> <p>Rec 5. Integrated LNG Operation Plan</p>
		Severe weather could be a contributor	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	<p>Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned</p> <p>Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head.</p>	<p>Rec 1. LNGC Reliability</p> <p>Rec 2. Carrier Docking Simulation</p> <p>Rec 3. Tug Fleet Requirements</p> <p>Rec 5. Integrated LNG Operation Plan</p>

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No.: 2		Shuttle Carrier collides with Jetty head							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								Mooring of the shuttle carrier will require pilot supervision Transit planning in coordination with the maritime authority will occur prior to LNG shuttle carrier entry Mooring of the carrier under various wind and wave conditions will be planned using simulation studies Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay. LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time	
		Loss of propulsion or steering by LNG shuttle carrier	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head. Mooring of the shuttle carrier will require pilot supervision Transit planning in coordination with the maritime authority will occur prior to LNG shuttle carrier entry Mooring of the carrier under various wind and wave conditions will be planned using simulation studies Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay. LNG Shuttle movement in the bay are controlled by the	Rec 1. LNGC Reliability Rec 2. Carrier Docking Simulation Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan

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No.: 2		Shuttle Carrier collides with Jetty head							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								maritime authorities who allow movement of only one large ship at a time		

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Generic	No other large vessels should approach the LNG jetty with a shuttle carrier present and speeds of large vessels within the bay are controlled by pilot supervision.		
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No.: 3		Shuttle Carrier collides with Jetty head							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
3.1	Another Ship strikes the shuttle carrier at the jetty	Pilot or helmsman error for non LNG ship that is passing the LNG Terminal location	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Environmental monitoring system gives real-time weather data Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision	Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone
		Large ship adrift in the bay in a manner that strikes one side of the mooring location while the shuttle is moored there	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Environmental monitoring system gives real-time weather data	Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone

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No.: 3 Shuttle Carrier collides with Jetty head									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								<p>Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned</p> <p>There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location</p> <p>LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time</p> <p>Large ship transits in the bay require pilot supervision</p>	
		Severe weather could be a contributor	Release of LNG cargo is not credible	H&S	S6	P1	P1-S6	<p>Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping</p> <p>Environmental monitoring system gives real-time weather data</p> <p>Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned</p> <p>There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location</p> <p>LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time</p> <p>Large ship transits in the bay require pilot supervision</p>	<p>Rec 3. Tug Fleet Requirements</p> <p>Rec 5. Integrated LNG Operation Plan</p> <p>Rec 6. Marine Safety Zone</p>

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<b>No.:</b> 4		Onboard Emergency (fire) on the shuttle carrier							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
4.1	Onboard Emergency (fire) on the shuttle carrier	Cargo Leak and ignition	Threats to onboard cargo and area surrounding shuttle carrier	H&S	S5	P3	P3-S5	Ship Certification (ABS; Lloyd) Extensive firefighting capabilities (equipment and training) on the shuttle carrier Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Shipboard emergency response plan	Rec 7. LNG Emergency Plan
		Acommodation or engine room fire	Threats to onboard cargo and area surrounding shuttle carrier	H&S	S5	P3	P3-S5		Rec 7. LNG Emergency Plan

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Generic	Damage to the shuttle carrier would only be expected if a large ship traveling above the speeds normal within the bay were to strike the LNG shuttle amidships at a severe angle.		
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<b>No.:</b> 5	Mooring System Fairlure (Shuttle carrier)
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Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
5.1	Mooring system failure (shuttle carrier)	Severe weather or swell	Potential to damage unloading arms	H&S	S5	P2	P2-S5	Unloading arms include powered emergency release couplings Environmental monitoring system gives real-time weather data Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned Weather forecast would allow shutdown, disconnection, or precautionary departure before arrival of severe weather Movement of the carrier such that the mooring system or unloading arms are exposed to conditions outside their design parameters will result in an unloading shutdown Mooring instrumentation and management system	Rec 4. Mooring System Design and Limits Rec 6. Marine Safety Zone Rec 11. Inspection, Testing and Preventive Maintenance Program
			Potential for release of LNG to the water if event occurs during unloading.	FI	S5	P2	P2-S5		
		Impact by another vessel	Potential to damage unloading arms	H&S	S5	P2	P2-S5	Unloading arms include powered emergency release couplings Environmental monitoring system gives real-time weather data	Rec 4. Mooring System Design and Limits Rec 6. Marine Safety Zone Rec 11. Inspection, Testing and Preventive Maintenance Program

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No.: 5 Mooring System Fairlure (Shuttle carrier)									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned  Weather forecast would allow shutdown, disconnection, or precautionary departure before arrival of severe weather  Movement of the carrier such that the mooring system or unloading arms are exposed to conditions outside their design parameters will result in an unloading shutdown  Mooring instrumentation and management system	
			Potential for release of LNG to the water if event occurs during unloading.	FI	S5	P2	P2-S5		
		Vessel wake	Potential to damage unloading arms	H&S	S5	P2	P2-S5	Unloading arms include powered emergency release couplings  Environmental monitoring system gives real-time weather data  Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned  Weather forecast would allow shutdown, disconnection, or precautionary departure before arrival of severe weather  Movement of the carrier such that the mooring system or unloading arms are exposed to conditions outside their design parameters will result in an unloading shutdown	Rec 4. Mooring System Design and Limits  Rec 6. Marine Safety Zone  Rec 11. Inspection, Testing and Preventive Maintenance Program

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No.: 5 Mooring System Fairlure (Shuttle carrier)									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
			Potential for release of LNG to the water if event occurs during unloading.	FI	S5	P2	P2-S5	Mooring instrumentation and management system	

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<b>No.:</b> 6		Rupture of hydraulic system for the all LNG transfer arms and gangway									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones		
6.1	Rupture of hydraulic system for the all LNG transfer arms and gangway	Corrosion	Fire on the jetty head posing a threat to onboard cargo and area surrounding shuttle carrier;	H&S	S6	P2	P2-S6	Local pans to collect leakage Control of activities (e.g. use of cranes) during LNG transfers Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Transfer shutdown and arm disconnection	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 12. Hydraulic System Failure Alarm Rec 13. Construction Safety Management Plan		
			Potential to release hydraulic oil to the ocean	E	S3	P5	P5-S3				
			Interruption to LNG transfer due to administrative shutdown when hydraulic system is not functional	FI	S3	P5	P5-S3				
			Inability of Powered Emergency Release Couplings (PERCs) to operate	FI	S1	P6	P6-S1				
		Erosion	Fire on the jetty head posing a threat to onboard cargo and area surrounding shuttle carrier;	H&S	S6	P2	P2-S6			Local pans to collect leakage Control of activities (e.g. use of cranes) during LNG transfers Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Transfer shutdown and arm disconnection	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 12. Hydraulic System Failure Alarm Rec 13. Construction Safety Management Plan
			Potential to release hydraulic oil to the ocean	E	S3	P5	P5-S3				
			Interruption to LNG transfer	FI	S3	P5	P5-S3				



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No.: 6		Rupture of hydraulic system for the all LNG transfer arms and gangway							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
Mar 24, 2016 13:23			due to administrative shutdown when hydraulic system is not functional						
			Inability of Powered Emergency Release Couplings (PERCs) to operate	FI	S1	P6	P6-S1		
		Object dropped during material handling	Fire on the jetty head posing a threat to onboard cargo and area surrounding shuttle carrier;	H&S	S6	P2	P2-S6	Local pans to collect leakage Control of activities (e.g. use of cranes) during LNG transfers Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Transfer shutdown and arm disconnection	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 12. Hydraulic System Failure Alarm Rec 13. Construction Safety Management Plan
			Potential to release hydraulic oil to the ocean	E	S3	P5	P5-S3		
			Interruption to LNG transfer due to administrative shutdown when hydraulic system is not functional	FI	S3	P5	P5-S3		
			Inability of Powered Emergency Release Couplings (PERCs) to operate	FI	S1	P6	P6-S1		
		Maintenance errors	Fire on the jetty head posing a threat to onboard cargo and area surrounding shuttle carrier;	H&S	S6	P2	P2-S6	Local pans to collect leakage Control of activities (e.g. use of cranes) during LNG transfers Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Transfer shutdown and arm disconnection	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 12. Hydraulic System Failure Alarm Rec 13. Construction Safety Management Plan
			Potential to release hydraulic oil to the ocean	E	S3	P5	P5-S3		
			Interruption to LNG transfer due to administrative shutdown when hydraulic	FI	S3	P5	P5-S3		

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No.: 6		Rupture of hydraulic system for the all LNG transfer arms and gangway							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
			system is not functional							
			Inability of Powered Emergency Release Couplings (PERCs) to operate	FI	S1	P6	P6-S1			
		Hose or connection failure	Fire on the jetty head posing a threat to onboard cargo and area surrounding shuttle carrier;	H&S	S6	P2	P2-S6	Local pans to collect leakage Control of activities (e.g. use of cranes) during LNG transfers Firefighting equipment (e.g. monitors, firewater headers, and foam capability on the jetty) Transfer shutdown and arm disconnection	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 12. Hydraulic System Failure Alarm Rec 13. Construction Safety Management Plan	
			Potential to release hydraulic oil to the ocean	E	S3	P5	P5-S3			
			Interruption to LNG transfer due to administrative shutdown when hydraulic system is not functional	FI	S3	P5	P5-S3			
			Inability of Powered Emergency Release Couplings (PERCs) to operate	FI	S1	P6	P6-S1			

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<b>No.:</b> 7		Rollover of FSU cargo tank contents occurs							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
7.1	Rollover of LNGC cargo tank contents occurs Phase I	Boiloff during long term storage resulting in tank stratification	Not credible scenary (not variability in cargo density)	FI	S5	P2	P2-S5		Rec 9. LNGC Cargo Tank Rollover Evaluation Rec 10. LNGC Cargo Tank Rollover Prevention

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Generic	For an impact that results in cargo containment damage, it would require a high speed collision with a large vessel at a sharp angle to the vessel moored at the jetty.		
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**No.: 8** Another ship strikes the FSU at its mooring location

Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
8.1	Another ship strikes the LNGC at its mooring location	Pilot or helmsman error	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto)  The mooring point of the LNG ship distance.  There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location  LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time  Large ship transits in the bay require pilot supervision	Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone
		Severe weather could be a contributor	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto)  The mooring point of the LNG ship distance.	Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone

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No.: 8		Another ship strikes the FSU at its mooring location							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision	
		Loss of propulsion or steering	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto) The mooring point of the LNG ship distance. There should be an administrative safety zone defined by the maritime authorities around the LNG mooring location LNG Shuttle movement in the bay are controlled by the maritime authorities who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision	Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone

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Generic		Current structural design information does not allow evaluation of potential for congestion.	
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No.: 9		Large leak of the LNG equipment on the jetty head							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
9.1	Large release of LNG from transfer arms on the jetty head	Corrosion	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Operating Procedures for shutdown and startup Control of activities (e.g. use of cranes) during LNG transfers Emergency shutdown system actuates on excessive arm motion Monitoring by plant personnel and ability to manually initiate shutdown LNG equipment is AISI 304 with low carbon content LNG equipment is coated and insulated to minimize contact with air Inspection program for LNG equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Potential for erosion is address by design limits on fluid velocities This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Operating Procedures for shutdown and startup Control of activities (e.g. use	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System

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No.: 9		Large leak of the LNG equipment on the jetty head							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								of cranes) during LNG transfers Emergency shutdown system actuates on excessive arm motion Monitoring by plant personnel and ability to manually initiate shutdown LNG equipment is AISI 304 with low carbon content LNG equipment is coated and insulated to minimize contact with air Inspection program for LNG equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Potential for erosion is address by design limits on fluid velocities This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage	Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities
		Hydraulic Hammer	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Operating Procedures for shutdown and startup Monitoring by plant personnel and ability to manually initiate shutdown LNG equipment is AISI 304 with low carbon content LNG equipment is coated and insulated to minimize contact with air Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 9		Large leak of the LNG equipment on the jetty head						Safeguards		Recomendaciones
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								valve isolation This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage		
		Object dropped during material handling	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Control of activities (e.g. use of cranes) during LNG transfers LNG equipment is AISI 304 with low carbon content LNG equipment is coated and insulated to minimize contact with air Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Potential for erosion is address by design limits on fluid velocities This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities	
		Ship movement	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Operating Procedures for shutdown and startup Control of activities (e.g. use of cranes) during LNG transfers Emergency shutdown system actuates on excessive arm motion Monitoring by plant personnel and ability to manually initiate shutdown LNG equipment is AISI 304 with low carbon content LNG equipment is coated and insulated to minimize contact with air Inspection program for LNG	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities	

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No.: 9		Large leak of the LNG equipment on the jetty head							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Potential for erosion is address by design limits on fluid velocities This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage		
		Vehicle impact	Damage to the shuttle carrier loading arm and release of LNG to the ocean	H&S	S5	P4	P4-S5	Emergency shutdown system actuates on excessive arm motion Monitoring by plant personnel and ability to manually initiate shutdown Inspection program for LNG equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road)	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities	
		Hurricane								
		Earthquake								

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No.: 10		Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
10.1	Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve	Corrosion	Release of LNG to the ocean	H&S	S5	P4	P4-S5	LNG transfer line is AISI 304 with low carbon content LNG transfer line is coated and insulated to minimize contact with air LNG transfer lines are all welded construction Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road)	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 14. Warning System for Regional Tsunami Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Release of LNG to the ocean	H&S	S5	P4	P4-S5	LNG transfer line is AISI 304 with low carbon content LNG transfer lines are all welded construction Potential for erosion is address by design limits on fluid velocities Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 14. Warning System for Regional Tsunami Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 10		Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation  Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road)	
		Hydraulic hammer	Release of LNG to the ocean	H&S	S5	P4	P4-S5	LNG transfer line is AISI 304 with low carbon content LNG transfer lines are all welded construction Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Operating Procedures for shutdown and startup	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 14. Warning System for Regional Tsunami Rec 28. Develop a Risk Analysis in Lifting Activities
		Vehicle impact	Release of LNG to the ocean	H&S	S5	P4	P4-S5	LNG transfer lines are all welded construction Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Line is protected at the road crossing from vehicle impact (below ground grated culvert	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 14. Warning System for Regional Tsunami Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 10		Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve							confidential	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
	Mar 24, 2016 13:23							extending beyond both sides of the road)	13:23	
		Object dropped during material handling	Release of LNG to the ocean	H&S	S5	P4	P4-S5	LNG transfer lines are all welded construction Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Operating Procedures for shutdown and startup	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 14. Warning System for Regional Tsunami Rec 28. Develop a Risk Analysis in Lifting Activities	

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**No.:** 11 Large leak of the XX "LNG from the ESD Valve to the high pressure pump suction (including absorber)

Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
11.1	Large leak of the LNG pipeline from the ESD Valve to the high pressure pump suction (including absorber)	Corrosion	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road) LNG transfer line is AISI 304 with low carbon content LNG transfer line is coated and insulated to minimize contact with air LNG transfer lines are all welded construction	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety

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No.: 11		Large leak of the XX "LNG from the ESD Valve to the high pressure pump suction (including absorber)							Recommendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recommendaciones	
								detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage LNG transfer line is AISI 304 with low carbon content LNG transfer lines are all welded construction Potential for erosion is address by design limits on fluid velocities	Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities	
		Vehicle impact	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road) LNG transfer lines are all welded construction	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities	
		Object dropped during material handling	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance	

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No.: 11		Large leak of the XX "LNG from the ESD Valve to the high pressure pump suction (including absorber)							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Program	
								Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation  This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage  Line is protected at the road crossing from vehicle impact (below ground grated culvert extending beyond both sides of the road)  LNG transfer line is AISI 304 with low carbon content  LNG transfer lines are all welded construction  Operating Procedures for shutdown and startup	Rec 13. Construction Safety Management Plan  Rec 28. Develop a Risk Analysis in Lifting Activities	
		Hurricane								
		Earthquake								

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No.: 12		Large leak of LNG storage tank contents							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
12.1	Large leak of LNG storage tank contents	Corrosion	No events identified that threaten the integrity of inner liquid containment wall.	H&S	S5	P1	P1-S5	Full containment tank (2 selfsupporting walls) Outer tank provides impact protection and containment of inner tank leaks Leak detection in the annular space and bottom plate of the tank	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	No events identified that threaten the integrity of inner liquid containment wall.	H&S	S5	P1	P1-S5	Full containment tank (2 selfsupporting walls) Outer tank provides impact protection and containment of inner tank leaks Leak detection in the annular space and bottom plate of the tank	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities
		Object dropped during material handling	No events identified that threaten the integrity of inner liquid containment wall.	H&S	S5	P1	P1-S5	Full containment tank (2 selfsupporting walls) Outer tank provides impact protection and containment of inner tank leaks Leak detection in the annular space and bottom plate of the tank	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities
		Failure of primary and secondary membrane	No events identified that threaten the integrity of inner liquid containment wall.	H&S	S5	P1	P1-S5	Full containment tank (2 selfsupporting walls) Outer tank provides impact protection and containment of inner tank leaks Leak detection in the annular space and bottom plate of the tank	Rec 7. LNG Emergency Plan Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 13		Rollover Occurs							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
13.1	Rollover Occurs	Long term storage resulting in tank stratification	Generation high BOG Potential release of large release quantity of NG	H&S	S6	P2	P2-S6	Linear temperature and density (LTD) measurement system for rollover protection Specific procedures for preventing, monitoring, and controlling tank stratification Monitoring by plant personnel and ability to manually initiate shutdown Provision of relief valve meeting NFPA 59A standard	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program
			If even exceeds release capacity, potential for roof damage	FI	S6	P2	P2-S6		
			High pressure within the LNG storage tank - High pressure within the LNG storage tank (linked to 19.1)						
			Release from PSV of LNG storage tank - Release from PSV of LNG storage tank (linked to 16.1)						
		Loading LNG at different temperature or density of tank contents	Generation high BOG Potential release of large release quantity of NG	H&S	S6	P2	P2-S6	Linear temperature and density (LTD) measurement system for rollover protection Specific procedures for preventing, monitoring, and controlling tank stratification Monitoring by plant personnel and ability to manually initiate shutdown Provision of relief valve meeting NFPA 59A standard	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program

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No.: 13		Rollover Occurs							Safeguards		Recomendaciones
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk				
			If even exceeds release capacity, potential for roof damage	FI	S6	P2	P2-S6				
			High pressure within the LNG storage tank - High pressure within the LNG storage tank (linked to 19.1)								
			Release from PSV of LNG storage tank - Release from PSV of LNG storage tank (linked to 16.1)								

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<b>No.:</b> 14		Overfilling of LNG storage tank							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
14.1	Overfilling of LNG storage tank	Human error in the tank filling operation	Gas vaporization and increased tank pressure	H&S	S5	P1	P1-S5	Redundant high level detection and high level switch (minimum SIL 2); unloading shutdown with pump trip and valve closure on high level  Outer container designed for collection of inner tank overflow (Outer container designed for - 162°C)	Rec 17. Assure the Use of Very Reliable Instrumented System

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<b>No.:</b> 15		Leak in roof of LNG storage tank							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
15.1	Leak in roof of LNG storage tank	Objet dropped during material handling							Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan
		Overpressure beyond storage tank relief capacity							Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan

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<b>No.:</b> 16		Fire at PSV outlet							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
16.1	Release from PSV of LNG storage tank	PSV Leaks through	Potential release of NG	H&S	S6	P2	P2-S6	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Fire protection system	
			Fire at PSV outlet - Fire at PSV outlet (linked to 17.1)						
		Rollover Occurs - Rollover Occurs (linked from 13.1)	Potential release of NG	H&S	S6	P2	P2-S6	Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Fire protection system	
			Fire at PSV outlet - Fire at PSV outlet (linked to 17.1)						

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No.: 17		Fire at PSV outlet							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
17.1	Fire at PSV outlet	Lightning or other ignition of relief valve vapor release	Potential damage to tank roof	H&S	S5	P2	P2-S5	Safety spacing of equipment Direction of PSV tailpipe chosen to minimize impact of fire Snuffing system at PSV outlet with capacity for 2 actuations Fireproofing on area of tank roof that could be affected	
		Release from PSV of LNG storage tank - Release from PSV of LNG storage tank (linked from 16.1)	Potential damage to tank roof	H&S	S5	P2	P2-S5	Safety spacing of equipment Direction of PSV tailpipe chosen to minimize impact of fire Snuffing system at PSV outlet with capacity for 2 actuations Fireproofing on area of tank roof that could be affected	

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<b>No.:</b> 18	Vacuum inside LNG storage tank								
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
18.1	Vacuum inside LNG storage tank	Vacuum inside LNG storage tank	Damage to the LNG storage tank roof and release of LNG vapor	FI	S5	P1	P1-S5	Cover gas system Air vacuum breaker Air vacuum breaker desinged according to NFPA 59A	

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Generic	Vapor release at the tank roof level is not expected to have offsite consequences		
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No.: 19		High pressure within the LNG storage tank							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
19.1	High pressure within the LNG storage tank	Rapid atmospheric pressure drop	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank	
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5		
		Flashing during tank filling	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame	

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No.: 19		High pressure within the LNG storage tank							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5	detection), and automatic valve isolation Pressure control system in the tank	
		Pressure control system failure	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5		
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5		
		Excessive unloading rate into the tank	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation	

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No.: 19		High pressure within the LNG storage tank							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
Mar 24, 2016 13:23								Pressure control system in the tank		
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5			
		Boiloff handling system failure	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank		
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5			
	External and Internal fire	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank			

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No.: 19		High pressure within the LNG storage tank							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards		
Mar 24, 2016 13:23			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5			
		Excessive boiloff or heat input from process lines	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank		
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5			
		Cover gas system failure (control valve)	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank		
Mar 24, 2016 13:23			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5			

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No.: 19 High pressure within the LNG storage tank									
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
		Rollover Occurs - Rollover Occurs (linked from 13.1)	Vapor release to the atmosphere through the relief valve	H&S	S5	P2	P2-S5	Relief valve Fire protection system Ability to manually vent the tank Inspection program for LNG equipment and piping Monitoring by plant personnel and ability to manually initiate shutdown Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Pressure control system in the tank	
			Potential for leak in roof of LNG storage tank	H&S	S5	P1	P1-S5		

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<b>No.:</b> 20		Catastrophic failure of internal containment shell, releasing the contents to the secondary containment tank							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
20.1	Mayor leakage of internal containment shell, releasing the contents to the secondary containment tank	There are no credible causes for such an event							

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<b>No.:</b> 21		Large leak of LNG storage tank outlet low pressure line to the vaporization area							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
21.1	Large leak of LNG storage tank outlet low pressure line to the vaporization area	Corrosion	Release of LNG to the impoundment area	H&S	S5	P2	P2-S5	Inspection program for LNG equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency response plan	Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Release of LNG to the impoundment area	H&S	S5	P2	P2-S5	Inspection program for LNG equipment and piping Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency response plan	Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Object dropped during material handling	Release of LNG to the impoundment area	H&S	S5	P2	P2-S5	Inspection program for LNG equipment and piping	Rec 8. Comprehensive Safety Management System



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No.: 21		Large leak of LNG storage tank outlet low pressure line to the vaporization area							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation  Monitoring by plant personnel and ability to manually initiate shutdown  This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage  Emergency response plan	Rec 13. Construction Safety Management Plan  Rec 28. Develop a Risk Analysis in Lifting Activities	

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<b>No.:</b> 22		Large leak of high pressure LNG pump and outlet line							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
22.1	Large leak of high pressure LNG pump and outlet line	Corrosion	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan Entire vaporization is paved and curbed for impoundment. Leakage is routed to an impoundment area. High pressure pump of canned type, minimizing the risk of leakage Pump are located in pit with individual spill detector	Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency shutdown system including LNG release detection (LNG spill,	Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 22		Large leak of high pressure LNG pump and outlet line							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards		
								flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan Entire vaporization is paved and curbed for impoundment. Leakage is routed to an impoundment area. High pressure pump of canned type, minimizing the risk of leakage Pump are located in pit with individual spill detector		
		Object dropped during material handling	Release of LNG	H&S	S5	P4	P4-S5	Inspection program for LNG equipment and piping This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan High pressure pump of canned type, minimizing the risk of leakage Pump are located in pit with individual spill detector	Rec 8. Comprehensive Safety Management System Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities	

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No.: 23		Large leak of vaporizer							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
23.1	Large leak of vaporizer	Corrosion	Release of LNG from shell ant tube vaporizer. NG out to the atmosphere	H&S	S6	P3	P3-S6	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency response plan Entire vaporization is paved and curbed for impoundment. Leakage is routed to an impoundment area.	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan
		Erosion	Release of LNG from shell ant tube vaporizer. NG out to the atmosphere	H&S	S6	P3	P3-S6	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown This location includes impoundment areas and	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan

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No.: 23		Large leak of vaporizer							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								impoundment basin to collect any accidental LNG spillage Emergency response plan Entire vaporization is paved and curbed for impoundment. Leakage is routed to an impoundment area.	
		Stress in tube heat exchanger due to large temperature difference						Heat hechanger design and supply made by international and qualified vendors	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan

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No.: 24		Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
24.1	Vaporizer blocked in (inlet and outlet valves both closed) resulting in release through the relief valve	Inlet and outlet valves closed during operation due to human error or ESD activation (fail closed)	Potencial overpressure in to the vaporizer with potential damage	H&S	S4	P1	P1-S4	This location includes impoundment areas and impoundment basin to collect any accidental LNG spillage Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan Inlet and outlet valves are interlocked to avoid simultaneous closure (Check estrategy that will be used) Very small material involved in this scenario	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan
			NG release trough vaporizer PRV	H&S	S4	P2	P2-S4		

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<b>No.:</b> 25	Large leak of vaporizer high pressure natural gas outlet line								
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
25.1	Large leak of vaporizer high pressure natural gas outlet line	Corrosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Erosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		Object dropped during material handling	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk

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No.: 25		Large leak of vaporizer high pressure natural gas outlet line							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan	Analysis in Lifting Activities
		Cold breakthrough	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Very robust Temperature control at the vaporizer Section of pipeline provided in stainless steel downstream the vaporizer to prevent cold embrittlement	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities
		GN leak through flanged metering station	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for arms, piping, pump, vaporizer, and LNG storage tank. Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan Section of pipeline provided in stainless steel downstream the vaporizer to prevent cold embrittlement	Rec 8. Comprehensive Safety Management System Rec 11. Inspection, Testing and Preventive Maintenance Program Rec 13. Construction Safety Management Plan Rec 28. Develop a Risk Analysis in Lifting Activities

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No.: 26		Alimentacion GN							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
26.1	GN feed Pipeline	Corrosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan Design considers welded line, built and tested according to international standards	
		Erosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan Design considers welded line, built and tested according to international standards	
		Vehicle impact	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan Design considers welded line, built and tested according to international standards	
		Object dropped during material handling	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan	

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No.: 26		Alimentacion GN							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								Design considers welded line, built and tested according to international standards	

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No.: 27		Control Flujo							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
27.1	Leakages of NG in flow controlers	Corrosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Erosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Vehicle impact	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned

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No.: 27 Control Flujo		confidential							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
		Object dropped during material handling	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Flange NG loss	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Abnormal operation (Overpressure)	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Deterioration or failure of components	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned

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No.: 27		Control Flujo		confidential						
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								filtración de gas (detector de gas, detector de humo, temperatura) Sistema de Fire & Gas (CO2)		

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No.: 28		Turbina Gas							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
28.1	NG Leakages in gas Turbine	Corrosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Erosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Vehicle impact	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the

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No.: 28		Turbina Gas								
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	safeguards here Mentioned	
		Object dropped during material handling	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned	
		Flange NG loss	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned	

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No.: 28		Turbina Gas							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
		Deterioration or failure of components	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned
		Abnormal operation (Overpressure)	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD por detección de filtración de gas (detector de gas, detector de humo, temperatura) Fire & Gas (CO2) system Fuel leak check system prior to ignition (pressurized with inert nitrogen) Shut off in operation due to lack of flame combustion chamber (flame detectors)	Rec 18. Assure the Incorporation into the Design of Prevention and Mitigation Systems Emergency, the safeguards here Mentioned

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<b>No.:</b> 29	Heat Recovery Steam generator
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Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
29.1	NG Leakage (assuming NG burner)	Corrosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD for NG gas leak detection (gas detector, smoke detector, temperature sensors) Fire & Gas (CO2) system Especificación de diseño acorde NFPA 850 y valvulas fire safe segun API 607 Preventive Maintenance Boiler design according to manufacturer standard	Rec 19. Consider Isolation Barrier for Flue Gas Leaks in Expansion Joints
			Injuries to people due to flue gas filtration	H&S	S3	P5	P5-S3		
		Erosion	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD for NG gas leak detection (gas detector, smoke detector, temperature sensors) Fire & Gas (CO2) system Especificación de diseño acorde NFPA 850 y valvulas fire safe segun API 607	

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No.: 29 Heat Recovery Steam generator		confidential								
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones	
								Preventive Maintenance Boiler design according to manufacturer standard		
		Injuries to people due to flue gas filtration	H&S	S3	P5	P5-S3				
		Flange NG loss	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD for NG gas leak detection (gas detector, smoke detector, temperature sensors) Fire & Gas (CO2) system Especificación de diseño acorde NFPA 850 y valvulas fire safe segun API 607 Preventive Maintenance Boiler design according to manufacturer standard		
		Injuries to people due to flue gas filtration	H&S	S3	P5	P5-S3				
	Abnormal operation (Overpressure)	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD for NG gas leak detection (gas detector, smoke detector, temperature sensors) Fire & Gas (CO2) system Especificación de diseño acorde NFPA 850 y valvulas fire safe segun API 607 Preventive Maintenance Boiler design according to	Rec 19. Consider Isolation Barrier for Flue Gas Leaks in Expansion Joints		

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No.: 29		Heat Recovery Steam generator							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
								manufacturer standard	
			Injuries to people due to flue gas filtration	H&S	S3	P5	P5-S3		
		Deterioration or failure of components	Release of NG to the atmosphere	H&S	S4	P5	P5-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan ESD for NG gas leak detection (gas detector, smoke detector, temperature sensors) Fire & Gas (CO2) system Especificación de diseño acorde NFPA 850 y valvulas fire safe segun API 607 Preventive Maintenance Boiler design according to manufacturer standard	Rec 19. Consider Isolation Barrier for Flue Gas Leaks in Expansion Joints
			Injuries to people due to flue gas filtration	H&S	S3	P5	P5-S3		

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<b>No.:</b> 30		Turbina vapor							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
30.1	Desviaciones durante la operación		No further consequences in safety						

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<b>No.:</b> 31		Tanques Diesel							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
31.1	Ignition of Diesel in Diesel Tank zone	Leakages in diesel piping	Diesel spill Fire	H&S	S4	P4	P4-S4	Inspection programs for piping Monitoring by plant personnel and ability to manually initiate shutdown from Control Room Emergency response plan Fire system (Foam and water) Design specification in accordance to related NFPA Impoundment system for diesel tank according to international standards Preventive Maintenance	

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Generic	Departure includes normal departure (e.g., vessel leaves as part of normal operations), precautionary departure (e.g., vessel leaves prior to arrival of severe weather), and emergency departure (e.g. fire on the jetty head may require emergency departure).		
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No.: 32		Shuttle Carrier struck bay another ship during emergency departure							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
32.1	LNGC struck by another ship during departure	Pilot or helmsman error	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned Procedures for departure of shuttle carrier will be developed to address specific requirements (e.g., pilot involvement, use of tugs) Large ship transits in the bay require pilot supervision Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto) LNG Shuttle movement in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time	Rec 1. LNGC Reliability Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone Rec 15. Emergency Departure Procedure for the LNGC
			Release of LNG cargo is not credible	E	S5	P1	P1-S5		
		Severe weather could be a contributor	Release of LNG cargo is not credible	H&S	S5	P1	P1-S5	Forecasts can give warning days in advance of the arrival of severe weather so departures can be well	Rec 1. LNGC Reliability Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG



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No.: 32		Shuttle Carrier struck bay another ship during emergency departure							Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards		
								planned Procedures for departure of shuttle carrier will be developed to address specific requirements (e.g., pilot involvement, use of tugs) Large ship transits in the bay require pilot supervision Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto) LNG Shuttle movement in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time	Operation Plan Rec 6. Marine Safety Zone Rec 15. Emergency Departure Procedure for the LNGC	
			Release of LNG cargo is not credible	E	S5	P1	P1-S5			

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<b>No.:</b> 33		FSU runs aground during emergency departure							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
33.1	LNGC runs aground during emergency departure	Pilot or helmsman error	Release of LNG cargo is not credible					Procedures for emergency departure of FSU will be developed to address specific requirements (e.g., pilot involvement, use of tugs) LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto) Speeds during bay transits are not considered high enough to cause cargo containment damage by grounding Ability to drop anchor if necessary due to loss of propulsion	Rec 1. LNGC Reliability Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 15. Emergency Departure Procedure for the LNGC
		Loss of steering or propulsion						Procedures for emergency departure of FSU will be developed to address specific requirements (e.g., pilot involvement, use of tugs) LNG shuttle movement in the bay is controlled by the port authority (Capitanía de Puerto) Speeds during bay transits are not considered high enough to cause cargo containment damage by grounding Ability to drop anchor if necessary due to loss of propulsion	Rec 1. LNGC Reliability Rec 3. Tug Fleet Requirements Rec 5. Integrated LNG Operation Plan Rec 15. Emergency Departure Procedure for the LNGC

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Generic	Departure includes normal departure (e.g., vessel leaves as part of normal operations), precautionary departure (e.g., vessel leaves prior to arrival of severe weather), and emergency departure (e.g. fire on the jetty head may require emergency departure).		
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<b>No.:</b> 34		LNGC exposed to severeweather when partially loaded due weather-related departure							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
34.1	Sloshing due to severe weather during emergency departure conditions	Severe weather resulting in the need for departure and potential severe weather transit conditions	Potential damage to the cargo containment	FI	S4	P3	P3-S4	Environmental monitoring system gives real-time weather data Forecasts can give warning days in advance of the arrival of severe weather so departures can be well planned, including requirements for tugs and pilots (when possible) FSU will be built to the IGC code that requires membrane ships to accommodate minor leakage via drip pans Procedures for departure of FSU will be developed to address specific requirements (e.g., pilot involvement, use of tugs) LNGC design based on International Standards	Rec 15. Emergency Departure Procedure for the LNGC

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<b>No.:</b> 35		Loss of telecommunications network							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
35.1	Loss of telecommunications network	Loss of telecommunications system	No potential LNG release issues identified					Redundant emergency communications systems Ring network communication system for data Ring network communication system for critical signals	

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<b>No.:</b> 36		Accident in adjacent facility							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
36.1	Accident in adjacent facility	Bleve in Adjacent Facility	Injuries to AES personnel	H&S	S5	P3	P3-S5	Separation distances by plant layout	Rec 8. Comprehensive Safety Management System Rec 20. Consider Emergency and Mutual Aid Plans Rec 21. AES Will Subscribe a Weather Service Information Defining the Actions in an Emergency Plan Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities
		External or Internal Fire	Injuries to AES personnel	H&S	S5	P3	P3-S5	Separation distances by plant layout	Rec 8. Comprehensive Safety Management System Rec 20. Consider Emergency and Mutual Aid Plans Rec 21. AES Will Subscribe a Weather Service Information Defining the Actions in an Emergency Plan Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities

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<b>No.:</b> 37		Accident in adjacent facility							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
37.1	Accident in adjacent facility	Blackout	No LNG risk issued identified					Emergency diesel generator	

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<b>No.:</b> 38		Severe Weather/Other External Event							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
38.1	Limited visibility	Loss of telecommunications system	Closed circuit television system is ineffective; limited visibility may impact operations; Increased potential for low speed ship collisions issues	H&S	S4	P3	P3-S4	Environmental monitoring system gives real-time weather data Docking tugs will meet the shuttle carrier and assist it in mooring at the jetty head. They can also assist by helping prevent disabled ships from striking the LNG shuttle carrier Navigation rules and communications equipment to allow coordination are part of international and national requirements for shipping Ship movements in the bay are controlled by the maritime authorities (Capitanía de Puerto) who allow movement of only one large ship at a time Large ship transits in the bay require pilot supervision Specific wind and wave conditions will be established under which a carrier will not be allowed to enter the bay	Rec 5. Integrated LNG Operation Plan Rec 6. Marine Safety Zone

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<b>No.:</b> 39		High Temperatures							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
39.1	High Temperatures	High ambient Temperatures	No safety consequences of interest					Environmental monitoring system gives real-time weather data	
		Tires burning in nearby landfill	No safety consequences of interest					Environmental monitoring system gives real-time weather data	

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<b>No.:</b> 40		Electrical Storm							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
40.1	Electrical storm	Lightning protection system	Potential damage to electrical equipment and instrumentation. Potential to ignite relief valve release					Environmental monitoring system gives real-time weather data Lightning protection system	Rec 21. AES Will Subscribe a Weather Service Information Defining the Actions in an Emergency Plan

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<b>No.:</b> 41		Severe Weather/Other External Event							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
41.1	Terrorism Acts	Loss of telecommunications system							
		Ingreso del personas externas al terminalñ							

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No.: 42		Incendios externos							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
42.1	External Fire or explosion	LPG spheres explosion	AES equipment damage	FI	S4	P3	P3-S4		Rec 20. Consider Emergency and Mutual Aid Plans Rec 22. Consider to Develop a Joined Emergency Plan Among Local Companies Rec 23. Develop a Plan of Pruning Weeds in the Area of Plant Safety Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities
			AES personnel injuries or deaths	H&S	S4	P5	P5-S4		
	Fire in diesel tank zone	AES equipment damage	FI	S4	P3	P3-S4			
		AES personnel injuries or	H&S	S4	P5	P5-S4			



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No.: 42		Incendios externos							Safeguards		Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk					
Mar 24, 2016	13:23	Fire or explosion in propano external piping	deaths					Mar 24, 2016		13:23		
			AES equipment damage	FI	S4	P3	P3-S4			Rec 20. Consider Emergency and Mutual Aid Plans Rec 22. Consider to Develop a Joined Emergency Plan Among Local Companies Rec 23. Develop a Plan of Pruning Weeds in the Area of Plant Safety Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities		
		AES personnel injuries or deaths	H&S	S4	P5	P5-S4						
	Incinerator malfunction	AES equipment damage	FI	S4	P3	P3-S4			Rec 20. Consider Emergency and Mutual Aid Plans Rec 22. Consider to Develop a Joined Emergency Plan Among Local Companies Rec 23. Develop a Plan of Pruning Weeds in the Area of Plant Safety Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities			
		AES personnel injuries or deaths	H&S	S4	P5	P5-S4						
		Tires burning in nearby landfill	AES equipment damage	FI	S4	P3	P3-S4			Rec 20. Consider Emergency and Mutual Aid Plans Rec 22. Consider to Develop a Joined Emergency Plan Among Local Companies		

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No.: 42		Incendios externos							Safeguards		Recomendaciones	
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones			
									Rec 23. Develop a Plan of Pruning Weeds in the Area of Plant Safety  Rec 24. Develop Evacuation Routes According to Plant or Neighbors Emergencies  Rec 25. Establish Security Zones for each Potential Emergencies related to Neighbors Facilities			
		AES personnel injuries or deaths	H&S	S4	P5	P5-S4						
		Forest fires	AES equipment damage	FI	S4	P3	P3-S4					
		AES personnel injuries or deaths	H&S	S4	P5	P5-S4						

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Generic	The frequency of a tsunami that would cause the worst case wave height for the facility is uncertain. However, the consequences based on the release calculations are not severe.		
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<b>No.:</b> 43		Tsunami due to local Event							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
43.1	Tsunami generated by regional seismic event	Offshores earthquake in Panama Region	Damage to the equipment on the jetty including the potential for transfer line leaks. other than the jetty no impact is expected on remaining plant facilities	FI	S4	P3	P3-S4	Emergency shutdown system including seismic detectors, NG or LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant ground personnel and ability to manually initiate shutdown Emergency response plan Historical Tsunami Study Filled terrain elevation (3.5m)	Rec 14. Warning System for Regional Tsunami Rec 26. Develop an Emergency Tsunami Plan

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AES Panamá	Telfers Island	Panamá City	confidential
Generic	The frequency of a tsunami that would cause the worst case wave height for the facility is uncertain. However, the consequences based on the release calculations are not severe.		
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<b>No.:</b> 44		Tsunami generated by distant seismic event							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
44.1	Tsunami generated by distant seismic event	Tsunami generated by offshore earthquake in Pacific - Atlantic outside Panama region	Damage to the equipment on the jetty including the potential for transfer line leaks	H&S	S2	P3	P3-S2	<p>The plant will participate in the Pacific Wide tsunami warning network. For tsunamis that arise from distant earthquake sources, this will allow warning to implement a tsunami emergency plan (should be confirmed)</p> <p>Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation</p> <p>Monitoring by plant personnel and ability to manually initiate shutdown prior to tsunami arrival</p> <p>Emergency response plan</p> <p>Filled terrain elevation (3.5m)</p> <p>Historical Tsunami Study</p>	<p>Rec 14. Warning System for Regional Tsunami</p> <p>Rec 15. Emergency Departure Procedure for the LNGC</p> <p>Rec 26. Develop an Emergency Tsunami Plan</p>

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Generic	The level of damage assumed here would only occur if a landslide/ground motion damaged the LNG transfer line on the jetty. The frequency assumed is less likely than the OBE frequency but is highly uncertain.		
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No.: 45		Seismic Event Damage onshore portion of the plant							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
45.1	Seismic event damages the onshore portion of the plant	Seismic event of less than the design basis earthquake	No LNG related consequences for an earthquake of this magnitude	H&S	S4	P3	P3-S4	Plant design meets NFPA criteria for OBE and SSE Emergency response plan	Rec 16. Pre-Planning for Post-Earthquake Conditions if it is Necessary  Rec 27. Consider, Based in a Study, if it is Necessary to Install Seismic Motion Detection and respectives integration with ESD
45.2	Seismic event damages the plant	Seismic event of intensity greater than to the Chilean design basis earthquake and of intensity less than the OBE	Damage, including possible permanent deformation, to the portions of the plant built only to the Chilean standard; the portions of the plant meeting the NFPA criteria for OBE and SSE will remain operable and/or maintain containment integrity	H&S	S4	P3	P3-S4	Plant design meets NFPA criteria for OBE and SSE Emergency response plan	Rec 16. Pre-Planning for Post-Earthquake Conditions if it is Necessary  Rec 27. Consider, Based in a Study, if it is Necessary to Install Seismic Motion Detection and respectives integration with ESD
45.3	Seismic event damages the offshore portion of the plant	Seismic event of intensity greater than to the OBE and of intensity less than the SSE	Damage, including possible deformation, to the portions of the plant built only to the Chilean standard or the NFPA criteria for OBE	H&S	S4	P3	P3-S4	Plant design meets NFPA criteria for OBE and SSE Plant will meet any additional Chilean requirements for seismic events Shutdown based on seismic motion detection Emergency response plan	Rec 16. Pre-Planning for Post-Earthquake Conditions if it is Necessary  Rec 27. Consider, Based in a Study, if it is Necessary to Install Seismic Motion Detection and respectives integration with ESD
45.4	Ground movement or landslide damages the plant	Seismic event	Plant and release of LNG and NG	H&S	S4	P3	P3-S4	Plant design meets NFPA criteria for OBE and SSE Emergency response plan	Rec 16. Pre-Planning for Post-Earthquake Conditions if it is Necessary  Rec 27. Consider, Based in a Study, if it is Necessary to Install Seismic Motion Detection and respectives integration with ESD

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Generic	However, based on evaluations performed for U.S. nuclear power plants and U.S. Department of Energy facilities the frequency of this event is considered less than 1x10 <sup>-6</sup> .		
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No.: 46		Aircraft Crash Phase I/II							
Item	Deviation	Causes	Consequences	Risk Matrix	Severity	Mitigated Likelihood	Mitigated Risk	Safeguards	Recomendaciones
46.1	Aircraft crash damages the plant	Pilot error	Aircraft impact on specific LNG equipment is considered very unlikely	H&S	S5	P1	P1-S5	Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan	
		Engine failure(s) during takeoff	Aircraft impact on specific LNG equipment is considered very unlikely	H&S	S5	P1	P1-S5	Emergency shutdown system including LNG release detection (LNG spill, flammable gas, and flame detection), and automatic valve isolation Monitoring by plant personnel and ability to manually initiate shutdown Emergency response plan LNG tank design against plane crashes	
		Event not credible. No flights of helicopters and airplanes over this area		H&S	S5	P1	P1-S5		

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	CLIENT:	Costa Norte LNG Terminal S. de R.L.		PAGE: B-1
	TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>		PID:

# APPENDIX C

## PLOTS OF SELECTED SCENARIO CONSEQUENCES

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	CLIENT:	Costa Norte LNG Terminal S. de R.L.			PAGE:	B-2
	TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>			PID:	

**Table B.1 List of Scenario Numbers and Titles for Which Plots are Provided in Appendix B**

Scenario	HAZID Node Origin	H&S Matrix Risk Evaluation	Methane State	Node Description		
S-1	10.1	P4-S5	LNG	Large leak of the LNG transfer line on the jetty trestle to onshore ESD Valve	Gas Dispersion Pool Fire VCE	Not Credible
S-2	9.1	P5-S4	LNG	Large release of LNG from transfer arms on the jetty head	Gas Dispersion Pool Fire VCE	Credible
S-5	23.1	P3-S6	LNG/NG	Large leak of vaporizer	Gas Dispersion VCE	Credible
S-11	47.1/36.1	P5-S4/P3-S5	LPG	External Fire or explosion (LPG BLEVE)	Events 11.1,11.2, Fire Ball, VCE	Credible

Notes:

In this appendix, some of the worst scenarios are selected. This selection is for the worst events that could be credible. It should be emphasized that the risk considers the probability or frequency of occurrence of an event and the consequences of this. The accepted criterion, in general, is that an event is credible when its frequency of occurrence is less than  $1 \times 10^{-6}$

For the dispersion calculations, they were not considered control systems for LNG spill retention (Impounding systems). If these are considered, the dispersion of NG is reduced (in proportion to the evaporation rate and surface evaporation basin – Impounding system, design)

It should be noted that although some high-impact scenarios, this does not mean they should be considered credible. Herein illustrated some of the scenarios described in detail.

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**VCE Scenario S1B: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response**

**VCE Scenario S1.B**

VCE Scenario: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response

Description:

Overpressure distance (radius) in [m]

- 84 m Overpressure 87 mbar
- 169 m Overpressure 170 mbar
- 271 m Overpressure 483 mbar

Notes:

Reference Images from Google Earth, 01/01/2016  
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**Dispersion Scenario S1B: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response**

**Dispersion Scenario S1.B**

Dispersion Scenario: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response

Description:

Pool fire distance (radius) in [m]

- 138 m dispersion UFL
- 357 m dispersion UFL

Notes:

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**Pool Fire Scenario S1B: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves.  
(Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response**

**Pool Fire Scenario S1.B**

Pool fire scenario: Large leak of the LNG transfer Lines on the jetty trestle to onshore ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response

**Description:**

Pool fire distance (radius) in [m]

- 138 m dispersion UFL
- 357 m dispersion UFL

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**VCE Scenario S2B: Large release of LNG from transfer arms on the jetty head PERC fails but ESD succeeds - two minute isolation time**



**Pool Fire scenario S2B: Large release of LNG from transfer arms on the jetty head PERC fails but ESD succeeds - two minute isolation time**



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### Dispersion scenario S2B: Large release of LNG from transfer arms on the jetty head PERC fails but ESD succeeds - two minute isolation time

**Dispersion Scenario S2.B**

Dispersion Scenario: **Large release of LNG from transfer arms on the jetty head PERC fails but ESD succeeds - two minute isolation time**

Description:

Pool fire distance (radius) in [m]

- 459 m dispersion UFL
- 1217 m dispersion UFL

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### Scenario Dispersion Large leak from vaporizer. Operator acts in 10 minute. Manual isolation

**Dispersion Scenario S5.B**

Dispersion Scenario: Large leak from of vaporizer.  
Operator acts in 10 minutes for manual isolation

Description:

Pool fire distance (radius) in [m]

- 93 m dispersion UFL
- 233 m dispersion UFL

Notes:

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### Scenario Overpressure S5B: Large leak from vaporizer. Operator acts in 10 minute for manual isolation

**VCE Scenario 5.B**

VCE scenario: Large leak from of vaporizer.  
Operator acts in 10 minutes for manual isolation

Description:

Cloud Dispersion distance (radius) in [m]

- 164 m Overpressure 87 mbar
- 102 m Overpressure 170 mbar
- 51 m Overpressure 483 mbar

Notes:

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## External Sceneries

### Sphere Bleve (Considered LPG 1000 m<sup>3</sup>) (Radiation)

#### External Scenario S 11.1

Fire Ball radiation scenario: Bleve Happens, for a 1000 m<sup>3</sup> LPG sphere. S 11.1

**Description:**

Horizontal cylinder tank explosion occurs. LPG tank 1000 m<sup>3</sup> is assumed to characterize the event. Petroport facilities

Distance (radius) Radiation [meters]

- 1424 m Radiation for 5 kW/m<sup>2</sup>
- 1071 m Radiation for 9 kW/m<sup>2</sup>
- 580 m Radiation for 30 kW/m<sup>2</sup>

Notes:

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### Sphere Bleve (Considered LPG 1000 m<sup>3</sup>) (Overpressure)

#### External Scenario S 11.1

BLEVE Sphere scenario: Bleve Happens, for a 1000 m<sup>3</sup> LPG sphere. S 11.1

**Description:**

Horizontal cylinder tank explosion occurs. LPG tank 1000 m<sup>3</sup> is assumed to characterize the event. Petroport facilities

Distances (radius) for overpressure caused by Bleve [metros]

- 108 m Overpressure 87 mbar
- 217 m Overpressure 170 mbar
- 349 m Overpressure 483 mbar

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### Scenario BLEVE LPG Horizontal Tank Bleve (Estimated LPG 100 m<sup>3</sup>) (Radiation)

**External Scenario S11.2**

BLEVE radiation scenario: Bleve Happens, for a 100 m3 LPG cylinder horizontal tank.

**Description:**

Horizontal cylinder tank explosion occurs. LPG tank 100 m3 is assumed to characterize the event

Radiation Ball Fire Distance Radius [m]

- 688 m Radiation for 5 kW/m<sup>2</sup>
- 518 m Radiation for 9 kW/m<sup>2</sup>
- 281 m Radiation for 30 kW/m<sup>2</sup>

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### Scenario BLEVE LPG Horizontal Tank Bleve (Estimated LPG 100 m<sup>3</sup>) (Overpressure)

**External Scenario S 11.2**

Bleve overpressure scenario: Bleve happens, for a 100 m3 LPG horizontal cylinder tank.

**Description:**

Horizontal cylinder tank explosion occurs. LPG tank 100 m3 is assumed to characterize the event

Distances (radius) for overpressure caused by Bleve [meters]

- 349 m Overpressure 87 mbar
- 217 m Overpressure 170 mbar
- 108 m Overpressure 483 mbar

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# **APPENDIX D**

## **FREQUENCY ANALYSIS**

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### D.1 Generic Failure Rates

Table C.1 shows the failure rates for the types of equipment considered in this study. The generic failure rates include several probable causes such as operational failures, material failures, external impacts, etc. Frequencies of occurrence are expressed in occurrence/year and established for average operational conditions of pressure, flow, temperature, composition, etc.

The adopted generic failure rates for equipment are based on references.<sup>1,2</sup> This reference presents a table of equipment failure rates and severity/hole size distribution for events occurred in LNG ships and offshore process that were voluntarily reported to HSE. Frequency data were grouped for the main categories of equipment considering the total number of incidents and total equipment-years, for each equipment subclass given these references. Hole size distribution data were averaged for the main categories of equipment, by comparing the hole size distribution with the total number of incidents for each equipment subclass.

The frequency  $f$  of occurrence of each initiating event was estimated through the following equation:

$$f_k = \sum_i \lambda_{ik} N_i \quad (C.1)$$

where:

- $f_k$  = frequency of occurrence type k of the initiating event (year<sup>-1</sup>);
- $\lambda_{ik}$  = generic failure rate type k of the equipment type i, according to Table 1 (year<sup>-1</sup>);
- $N_i$  = number of equipment type i in the considered section;
- k = medium hole and large hole

The above equation is equivalent to a fault tree, whose top event is the considered initiating event linked through an **OR** gate to all identified causes of occurrence of that event. The calculations are summarized on Table D.2 where it presents the description of the selected initiating events and their associated frequencies.

<sup>1</sup> CENTER OF CHEMICAL PROCESS SAFETY – USA, 2010. “LNG Risk Based Safety Book”

<sup>2</sup> HSE – HEALTH AND SAFETY EXECUTIVE – UK 2012. “Failure Rate and Data for use within Risk Assessment”

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**Table D.1 Frequencies of full leaks for process equipment (CCPS, 2010)**

Equipment	Failure Rate	
	(frequency of full leaks >= 1 mm diameter)	(frequency of full leaks >= 50 mm diameter)
Manual Valve (2")	1.4 E-05	2.2 E-07
Manual Valve (6")	4.8 E-05	4.9 E-07
Manual Valve (18")	2.2 E-05	2.3 E-06
Actuated Valves (6" non pipeline)	2.6 E-04	1.9 E-06
Flanged Joints (2")	3.2 E-05	0.0 e +00
Flanged Joints(6")	4.3 E-05	3.6 E-07
Flanged Joints (18")	1.2 E-04	1.1 E-06
Instrument (0.5")	2.3 E-04	0.0 E +00
Steel pipes (2") 1m length	5.7E-05	0.0 E +00
Steel pipes (6") 1m length	2.0E-05	7.7E-08
Steel pipes (18") 1 m length	1.1E-05	4.2E-08
Centrifugal Compressor	2.0 E-03	2.0 E-06
Reciprocating compressor	2.7 E-02	1.1 E-05
Centrifugal Pump	1.8 E-03	2.4 E-05
Reciprocating Pump	3.7 E-03	5.2 E-04
Heat Exchanger (h/c in tube)	1.0E-03	4.9E-05
Heat Exchanger (plate)	6.0E-03	3.6E-04

**D.2 Frequencies of scenario outcome**

As previously explained in section 4, the Event Tree Analysis consists on the application of a systematic probabilistic tool, graphically represented by a diagram which is able to describe the logical sequence of facts, or events, that may result from the initiating event. The analysis made through the event tree approach is intuitive, starting with an initiating event and then developing sequences of posterior chronological events, which are typically characterized as conditions during the occurrence of the accident. These sequences are determinant of the possible accident evolutions, defining distinct consequence typologies and magnitudes associated to them.

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**Table D.2 Estimated Frequencies of the Initiating Events**

	Scenario	IE Freq (per Year)	Notes
S.1.A	Large leak of the LNG transfer Lines on the jetty trestle to onshores ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD success with two minute isolation time	5,43E-07	Assumes 7 downloads from LNG Carrier for a line of 250 meters long 36 ", and a pressure of 6 bar (12,000 m3 / hr). The download time is 16.2 hr. It assumes that the ESD is effective and insulates discharge in 2 minutes
S.1.B	Large leak of the LNG transfer Lines on the jetty trestle to onshores ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response	5,43E-07	Assumes 7 downloads from LNG Carrier for a line of 250 meters long 36 ", and a pressure of 6 bar (12,000 m3 / hr). The download time is 16.5 hr. It assumes ESD failure and operator insulates discharge in 10 minutes
S.2.A	Rupture of an LNG transfer arm at the FSU during LNG transfer from LNGC – PERC succeeds (no significant release of LNG)	1,74E-04	An unloading arm is disconnected with a frequency of failure 6e-5 /year/arm /12 hrs. The annual operation corresponds to 7 downloads, from 170000 m3 LNG Carrier. Each download has a duration of 16.5 hrs, which determines a total annual time of 116 hours per year. PERC actuates in 10 seg. The leakage is negligible is 10 s.
S.2.B	Full rupture of an LNG transfer arm at the FSU during at LNG transfer from the LNGC – PERC fails but ESD succeeds - two minute isolation time	1,74E-04	The same conditions as above but the PERC system is failed.

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S.2.C	Full rupture of a LNG transfer arm during LNG carrier transfer with PERC and ESD failure - Operator manual isolation in 10 minutes	1,74E-04	The same conditions as above but the PERC system is failed and ESD (emergency shut down system is failed).
S.3.A	Large leak of the LNG pipeline from the ESD valve to the high pressure pump suction (including absorber) ESD succeeds - two minute isolation time	1,13E-05	It is a great loss in the input line to the high pressure pump. The line has a length of 200 meters. It considers that the pipes has 2 flanges. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.3.B	Large leak of the LNG pipeline from the ESD valve to the high pressure pump suction (including absorber) Operator manual isolation in 10 minutes	3,39E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes
S.4.A	Large leak of LNG of high pressure LNG pump and outlet line. ESD succeeds in 2minute for manual isolation.	8,13E-05	It involves loss of LNG in the discharge line of the high pressure pump. The line is 10 ", and generates a loss of 10% of its diameter. The system pressure is 35 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.4.B	Large leak of LNG of high pressure LNG pump and outlet line. Operator acts in 10 minute for manual isolation.	4,07E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes

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S.5.A	Large leak of vaporizer. Assumes ESD success with two minute isolation time	9,80E-05	A great loss occurs from the vaporizer. a loss of 2 "diameter is assumed. Operación pressure in this scenario is 35 bar. The ESD loss stops after 2 minutes.
S.5.B	Large leak of vaporizer. Operator acts in 10 minute for manual isolation	9,80E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes
S.6.A	Large leak of vaporizer, high pressure natural gas outlet line. Assumes ESD success with two minute isolation time	5,03E-05	It involves loss of LNG in the discharge line of the high pressure pump. The line is 10 ", and generates a loss of 10% of its diameter. The system pressure is 30.5 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.6.B	Large leak of vaporizer, high pressure natural gas outlet line Operator acts in 10 minute for manual isolation	5,03E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes
S.7.A	Large leak of vaporizer, NG feed Pipeline to power plant Assumes ESD success with two minute isolation time	1,80E-04	It involves loss of LNG in the discharge line of the high pressure pump. The line is 18 ", and generates a loss of 10% of its diameter. The system pressure is 30.5 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.7.B	Large leak of vaporizer, NG feed Pipeline to power plant Operator acts in 10 minute for manual isolation	1,80E-04	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes

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S.8.A	Leakages of NG in flow controlers. Assumes ESD success with two minute isolation time	9,08E-05	It involves loss of LNG in the discharge line of the high pressure pump. The line is 18 ", and generates a loss of 10% of its diameter. The system pressure is 30.5 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.8.B	Leakages of NG in flow controlers Operator acts in 10 minute for manual isolation	9,08E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes
S.9.A	NG Leakages in Gas Turbine  Assumes ESD success with two minute isolation time	2,45E-05	It involves loss of LNG in the discharge line of the high pressure pump. The line is 18 ", and generates a loss of 10% of its diameter. The system pressure is 30.5 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.9.B	NG Leakages in Gas Turbine Operator acts after 10 minute for manual isolation	2,45E-05	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes
S.10.A	NG Leakages (assuming NG burner boiler system) Assumes ESD success with two minute isolation time	1,47E-04	It involves loss of LNG in the discharge line of the high pressure pump. The line is 6", and generates a loss of full bore diameter. The system pressure is 30.5 bar. The action of the emergency system (ESD Prob=0.01) acting in two minutes limits the loss.
S.10.B	NG Leakages (assuming NG burner boiler system) Operator acts in 10 minute for manual isolation	1,47E-04	The same conditions as above but the ESD fails. The operator stops the loss after 10 minutes

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S.11	External Fire or explosion	2,00E-02	Forest fire in the surrounding area
S.11.1	Propane sphere Bleve Petroport	1,00E-05	Propane sphere explodes. LPG sphere tank 1000 m3 is assumed to characterize the event. Petroport facilities
S.11.2	LPG cylinder Bleve (Terminal Petroport)	1,00E-05	Horizontal cylinder tank explosion occurs. LPG tank 100 m3 is assumed to characterize the event
S.11.3	Propane Jet fire from pipeline	2,83E-05	Jet fire caused by breaking propane line
S.11.4	External Tank roof fire	1,20E-04	Fire in fuel storage tanks at Telfers Tanks Inc. Assumed
S.12	LNGC strucks by another ship during entry	3,11E-04	Major LNG storage tank leakage. Assume a 15 m heigh storage tank, and a 750 mm hole diameter
S.13	Large leak of Storage tank contents	1,00E-06	Major LNG storage tank leakage. Assume a 30 m heigh storage tank, and a 500 mm hole diameter

### Interim Cases

In a first stage, the FSU, will remain permanently in the dock. The duration of this will be one year. The probabilities of occurrence of a scene of fire, explosion and dispersal, change, becoming more frequent, but the process conditions, the amounts resulting from leaks in the arms of load loss is reduced.


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	Scenario	IE Freq (per Year)	Notes
S.2.A(1)	Large release of LNG from transfer arms on the jetty head – PERC succeeds (no significant release of LNG)	1.31E-02	the FSU, will remain permanently in the dock for one year.
S.2.B(2)	FLarge release of LNG from transfer arms on the jetty head PERC fails but ESD succeeds - two minute isolation time	1.31E-02	The same conditions as above but the PERC system is failed.
S.2.C(3)	Large release of LNG from transfer arms on the jetty head with PERC and ESD failure - Operator manual isolation in 10 minutes	1.31E-02	The same conditions as above but the PERC system is failed and ESD (emergency shut down system is failed).

The construction of sequences of potential accidents initiates at the left side of the tree, through the initiating event (just one), progressing to the right in the form of “branches”. For each conditioning event, it is considered the superior branch as being the realization of this event, and the inferior branch as the non-realization of it. When the sequence is independent of a conditional intermediary event, the sequence simply does not ramify at that point. The process goes on until the resulting consequences may be clearly defined for each branch.

After defining the heading of the event tree, it is assigned (conditional) probabilities to the conditional intermediary events. The multiplication of these probabilities by the frequency of the initiating event allows the estimation of the resulting frequency for each consequence.

The calculation of the occurrence frequency for each accidental scenario was estimated through the event tree technique. The event trees considered the frequency of the initiating event and the conditional probabilities of immediate and delayed ignition and probability of an explosion occurring (if the vapor cloud was capability of reaching one of the area in the terminal that were

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considered to provide congestion/confinement that could lead to an explosion). The areas deemed at least partially congested were:

- The area under the jetty head ('box' between the sea level and the jetty structure during LNG transfers).

The jetty top sides as well as the service platform are not confined spaces because they are well ventilated and they are 'open to the sky'.

If a vapor cloud from a postulated release could reach on of these areas, the assessment assumed that an explosion could results (using the explosion likelihood discussed below).

### Approach for addressing ignition/explosion likelihood

In the preliminary risk assessment, likelihoods were assumed for immediate ignition, delayed ignition, and probability of an explosion (assuming a delayed ignition occurred). Figure C.1 illustrates the basic logic developed, for the representation of the accidental scenarios. This figure illustrates the various event sequences starting at the initiating event and ending at a determined type of consequence outcome.

### ASSUMPTIONS

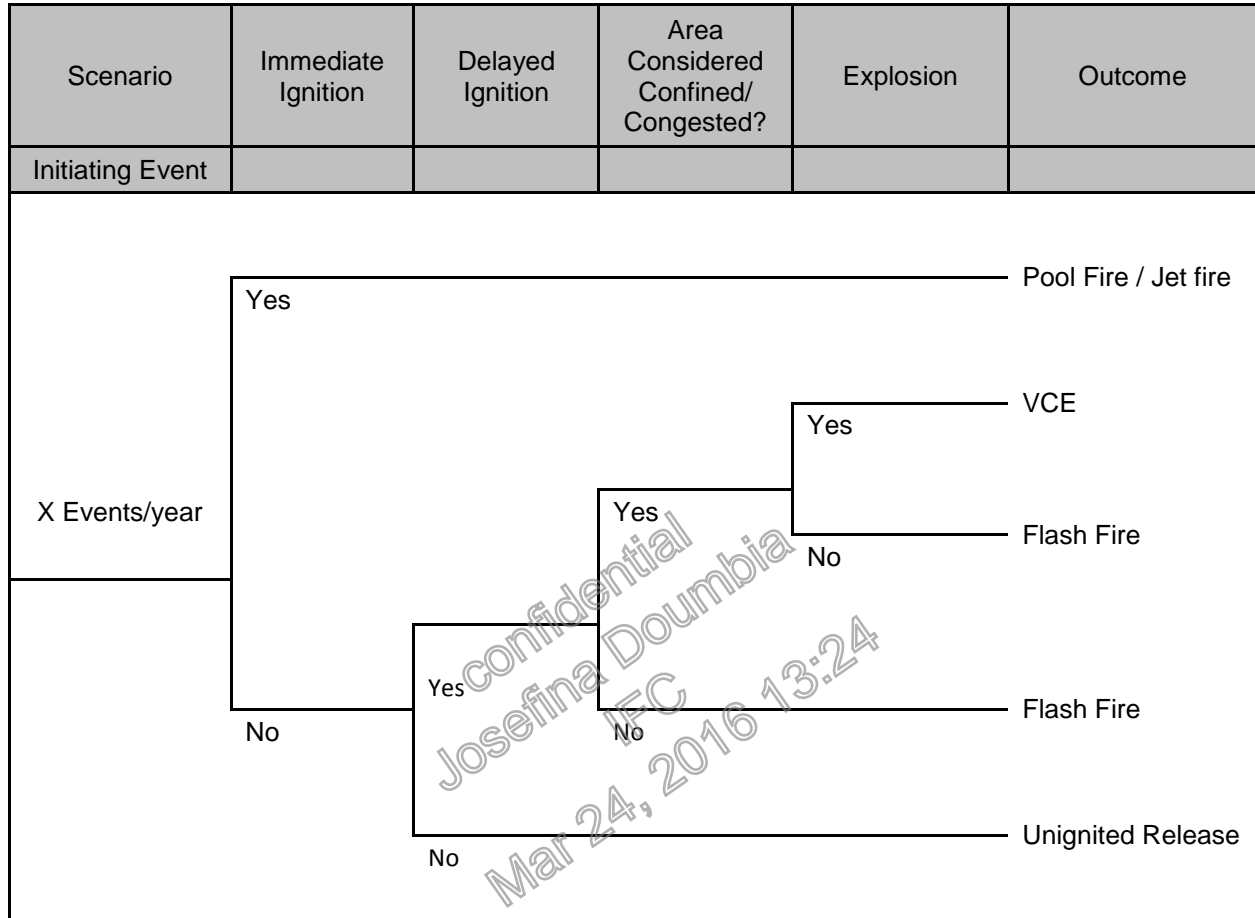
The relevant premises considered in this analysis are presented below:

- Ignition Probability:** Given the occurrence of a release of natural gas (either as LNG or vaporized gas), an ignition may occur relatively immediately due to (1) the energy involved in the release event (e.g., external impact), (2) ignition source nearby in the environment (e.g., static discharge, or (3) contacting equipment that ignites it (e.g., combustion engines, improperly installed electrical equipment). If such an "immediate ignition" does not occur, the cloud of flammable vapor can then spread, finding an ignition source at a later point (i.e., a "delayed ignition") or it disperse without ever igniting.

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**Figure D.1 Illustrative Event Tree Diagram for Flammable Releases**

- b) **Confinement and Congestion Probability:** In this study, the likelihood that a cloud released was ignited in a confined space, and resulted in a VCE was assumed based on assessment of the type of release and assessment of the various structures expected in the terminal layout.
- c) **Shipboard Events.** This study primarily addressed events that were initiated by significant size releases of LNG or natural gas. Because LNG is stored in a low energy state (i.e., at its boiling point of -159°C and at near atmospheric pressure), the initiating events almost exclusively involved in failures during LNG transfer and natural gas supply to the pipeline. There are other potential events on shipboard that could cause release of natural gas vapor (e.g., long term loss of power, pressure control failure, leaks in fuels systems) however, LNG

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vessels are designed to deal with such events and historically those type of events have not resulted in large flammable releases and are not considered likely to do so. As such, they are not considered in this assessment nor are they typically addressed in terminal studies.

**Data Used for Ignition Probabilities**

In this updated risk assessment, the data used for defining ignition probabilities was adapted from an approach used in a QRA for the LNG terminal proposed in Hong Kong (ERM 2006). It was based on a report regarding electrical classification of hazardous locations written by Cox, Lees, and Ang. (ICChemE 1990). Table C.3 presents the probabilities as implemented in this assessment. They reflect that longer releases periods before isolation lead to higher delayed ignition probabilities. Also, the approach provides a likelihood of explosion given ignition that reflects the fact that not all ignitions (even in congested places) result in explosions.


**Table D.3 Ignition and Explosion Probabilities**

Case	Immediate Ignition Probability	Delayed Ignition Probability	Total Ignition Probability	Explosion Probability (Given Ignition)
Large LNG leaks (isolation within 5 minutes)	0.08	0.2	0.264	0.3
Large LNG leaks (isolation time greater than 5 minutes)	0.16	0.4	0.496	0.3
Large NG leaks (isolation within 5 minutes)	0.1	0.22	0.298	0.3
Large NG leaks (isolation greater than 5 minutes)	0.2	0.44	0.552	0.3

**FREQUENCIES OF THE OUTCOMES**

The frequency results based on the assumptions and data described in this appendix are presented in Table E.1. It presents the frequency for each of the scenario outcomes (I.e., pool fire, explosion, flash fire, and unignited releases).

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## **APPENDIX E**

### **DETAILED CONSEQUENCE ANALYSIS RESULTS**

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**Table E-1 Consequence Analysis Results for Each Scenario Analyzed**

	Description	Data	Material Released	Normal Flow rate	Total LNG/NG Released (Inventory)	Outcome	Maximum Distance (m)								
							Thermal Radiation (kW/m <sup>2</sup> )			Overpressure (mbar)			½LFL	LFL	UFL
							5	9	30	87	170	483			
S.1.A	Large leak of the LNG transfer Lines on the jetty trestle to onshores ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD success with two minute isolation time	Leak size = 10% pipeline diameter Diam. = 36" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 120	LNG	5278 kg/min	10556 kg	Gas Dispersion							539	324	126
						Pool Fire	31	21	0						
						VCE				110	69	34			
S.1.B	Large leak of the LNG transfer Lines on the jetty trestle to onshores ESD Valves. (Transfer from LNGC to ESD transfer at 12,000 m3/h). Assumes ESD failure and 10 minute manual isolation response	Leak size = 10% pipeline diameter Diam. = 36" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 600	LNG	5278 kg/min	52780 kg	Gas Dispersion							601	357	138
						Pool Fire	31	21	0						
						VCE				271	169	84			
S.2.A	Rupture of an LNG transfer arm at the FSU during LNG transfer from LNGC – PERC succeeds (no significant release of LNG)	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 10 Leakage to sea water	LNG	104423 kg/min	17404 Kg	Gas Dispersion							1274	798	319
						Pool Fire	62	42.6	0						
						VCE				318	198	98			
S.2.B	Full rupture of an LNG transfer arm at the FSU during at LNG transfer from the LNGC – PERC fails but ESD succeeds - two minute isolation time	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 120 Leakage to sea water	LNG	104423 kg/min	208846 Kg	Gas Dispersion							2023	1217	459
						Pool Fire	120	85	0						
						VCE				770	479	238			
S.2.C	Full rupture of a LNG transfer arm during LNG carrier transfer with PERC and ESD failure - Operator manual isolation in 10 minutes	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 600 Leakage to sea water	LNG	104423 kg/min	1044230 Kg	Gas Dispersion							3027	1750	707
						Pool Fire	120	85	0						
						VCE				818	508	253			
S.3.A	Large leak of the LNG pipeline from the ESD valve to the high pressure pump suction (including absorber) ESD succeeds - two minute isolation time	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 120	LNG	407 kg/min	814 kg	Gas Dispersion									
						Pool Fire	21	14	6						
						VCE				NFG	NFG	NFG			
S.3.B	Large leak of the LNG pipeline from the ESD valve to the high pressure pump suction (including absorber) Operator manual isolation in 10 minutes	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 120	LNG	407 kg/min	4070 kg	Gas Dispersion							142.3	88.9	48.3
						Pool Fire	21	14	6						
						VCE				64.5	40.2	20			

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	Description	Data	Material Released	Normal Flow rate	Total LNG/ NG Released (Inventory)	Outcome	Maximum Distance (m)										
							Thermal Radiation (kW/m <sup>2</sup> )			Overpressure (mbar)			½LFL	LFL	UFL		
							5	9	30	87	170	483					
S.4.A	Large leak of LNG of high pressure LNG pump and outlet line. ESD succeeds in 2minute for manual isolation.	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = -162 Release time (sec.) = 120	LNG	1063.1kg/min	2126 kg	Gas Dispersion											
						Pool Fire	24	16	8								
						VCE											
S.4.B	Large leak of LNG of high pressure LNG pump and outlet line. Operator acts in 10 minute for manual isolation.	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = -162 Pressure (barg) =35 Release time (sec.) = 120	LNG	1063.1kg/min	10630kg	Gas Dispersion						271	166	67			
						Pool Fire	24	16	8								
						VCE				124	77	38					
S.5.A	Large leak of vaporizer. Assumes ESD success with two minute isolation time	Leak size = 1" Orifice. Diam. = na Temperature (°C) = -150 Pressure (barg) = 35 Release time (sec.) = 120	LNG	1567 kg/min	3134 kg	Gas Dispersion						326	202	81			
						Pool Fire	26	17	10								
						VCE				32	20	10					
S.5.B	Large leak of vaporizer. Operator acts in 10 minute for manual isolation	Leak size = 1" Orifice. Diam. = na Temperature (°C) = -150 Pressure (barg) = 35 Release time (sec.) = 600	LNG	1567 kg/min	15670 kg	Gas Dispersion						379	233	93			
						Pool Fire	26	17	10								
						VCE				164	102	51					
S.6.A	Large leak of vaporizer, high pressure natural gas outlet line. Assumes ESD success with two minute isolation time	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = 2 Pressure (barg) = 35 Release time (sec.) = 120	LNG	161,9 kg/min	323,8 kg	Gas Dispersion											
						Jet Fire 0°	30	27	23								
						VCE				64	40	20					
S.6.B	Large leak of vaporizer, high pressure natural gas outlet line Operator acts in 10 minute for manual isolation	Leak size = 10% pipeline diameter Diam. = 10" Temperature (°C) = 2 Pressure (barg) = 35 Release time (sec.) = 600	LNG	161,9 kg/min	1619 kg	Gas Dispersion						93	46	0.2			
						Jet Fire 0°	30	27	23								
						VCE				109	68	34					
S.7.A	Large leak of vaporizer, NG feed Pipeline to power plant Assumes ESD success with two minute isolation time	Leak size = 10% pipeline diameter Diam. = 6" Temperature (°C) = 20 Pressure (barg) = 30.5 Release time (sec.) = 120	NG	56,4 kg/min	112,8 kg	Gas Dispersion						46	15	0.1			
						Jet Fire 0°	19	17	15								
						VCE				46	28	14					
S.7.B	Large leak of vaporizer, NG feed Pipeline to power plant Operator acts in 10 minute for manual isolation	Leak size = 10% pipeline diameter Diam. = 6" Temperature (°C) = 20 Pressure (barg) = 30.5 Release time (sec.) = 600	NG	56,4 kg/min	564 kg	Gas Dispersion						173	99	27			
						Jet Fire 0°	19	17	15								
						VCE				77	48	24					

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	Description	Data	Material Released	Normal Flow rate	Total LNG/NG Released (Inventory)	Outcome	Maximum Distance (m)								
							Thermal Radiation (kW/m <sup>2</sup> )			Overpressure (mbar)			½LFL	LFL	UFL
							5	9	30	87	170	483			
S.8.A	Leakages of NG in flow controlers. Assumes ESD success with two minute isolation time	Leak size = 10% of normal flow Diam. = 18" Temperature (°C) = 35 Pressure (barg) = 30.5 Release time (sec.) = 120	NG	496 kg/min	992 kg	Gas Dispersion							169	97	26
						Jet Fire 0°	49	45	38						
						VCE				92	58	29			
S.8.B	Leakages of NG in flow controlers Operator acts in 10 minute for manual isolation	Leak size = 10% of normal flow Diam. = 18" Temperature (°C) = 35 Pressure (barg) = 30.5 Tiempo fuga (s) = 600	NG	496 kg/min	4960 kg	Gas dispersion							169	97	26
						Jet Fire 0°	49	45	38						
						VCE				158	98	49			
S.9.A	NG Leakages in Gas Turbine Assumes ESD success with two minute isolation time	Leak size = 1" Orifice. Diam. = na Temperature (°C) = 35 Pressure (barg) = 30.5 Release time (sec.) = 120	NG	152 kg/min	304 kg	Gas Dispersion							89	43	0.2
						Jet Fire 0°	29	26	22						
						VCE	no			62	39	19			
S.9.B	NG Leakages in Gas Turbine Operator acts after 10 minute for manual isolation	Leak size = 1" Orifice. Diam. = na Temperature (°C) = 35 Pressure (barg) = 30.5 Release time (sec.) = 120	NG	152 kg/min	1520 kg	Gas Dispersion							169	97	26
						Jet Fire 0°	29	26	22						
						VCE				158	98	49			
S.10.A	NG Leakages (assuming NG burner boiler system) Assumes ESD success with two minute isolation time	Leak size = 100% of normal flow Diam. = 6" Temperature (°C) = 35 Pressure (barg) = 30.5 Release time (sec.) = 120	NG	612 kg/min	1224 kg	Gas Dispersion									
						Jet Fire 0°	29	26	22						
						VCE				99	62	31			
S.10.B	NG Leakages (assuming NG burner boiler system) Operator acts in 10 minute for manual isolation	Leak size = 100% of normal flow Diam. = 6" Temperature (°C) = 35 Pressure (barg) = 30.5 Release time (sec.) = 600	NG	612 kg/min	6120 kg	Gas Dispersion									
						Jet Fire 0°	29	26	22						
						VCE				169	105	52			

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	Description	Data	Material Released	Normal Flow rate	Total LNG/NG Released (Inventory)	Outcome	Maximum Distance (m)								
							Thermal Radiation (kW/m <sup>2</sup> )			Overpressure (mbar)			½LFL	LFL	UFL
							5	9	30	87	170	483			
S.11	External Events						5	9	30	87	170	483		LFL	UFL
S.11.1	Propane sphere Bleve Petroport	Leak size = na Storage Vol = 1000 m3 Pressure (barg) =8 Release time (sec.) = na	Propane	1000 m3		Fire Ball	1424	1071	580						
						VCE				753	468	232			
S.11.2	LPG cylinder Bleve (Terminal Petroport)	Leak size = na Storage Vol = 100 m3 Pressure (barg) =8 Release time (sec.) = na	Propane	100 m3		Fire Ball	688	518	281						
						VCE				349	217	108			
S.11.3	Propane Jet fire from pipeline	Leak size = 10% of pipeline flow Diam. = 12" Temperature (°C) = 35 Pressure (barg) =8 Release time (sec.) = 600	Propane	95 kg/min	950 kg	Jet Fire 0°	25	23	20					34	0
						VCE				116	81	29			
S.11.4	External Tank roof fire	Leak size = na Storage Vol = 100 m3 Pressure (barg) =8 Release time (sec.) = na				Jet Fire 0°									
						VCE									
S.12	LNGC strucks by another ship during entry	Leak size = 500 mm Storage Vol = 32000 m3 Temperature (°C) = -162 Pressure (barg) =8 Release time (sec.) = 3600s	LNG	max 108178 kg/min	6490680 kg	Gas Dispersion							2669	1481.8	575.2
						Pool Fire	123.4	87.8	0						
						VCE				720	448	223			
S.13	Large leak of Storage tank contents	Leak size = 500 mm Storage Vol = 180000 m3 Temperature (°C) = -162 Pressure (mbarg) = 170 Release time (sec.) = na	LNG	max 308291 kg/min	1109847,6 kg	Gas Dispersion							4009	2406,4	909,3
						Pool Fire									
						Flash fire	782	487	242						

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	Description	Data	Material Released	Normal Flow rate	Total LNG/ NG Released (Inventory)	Outcome	Maximum Distance (m)								
							Thermal Radiation (kW/m <sup>2</sup> )			Overpressure (mbar)			½LFL	LFL	UFL
							5	9	30	87	170	483			
S2A(1)	Large release of LNG from transfer arms on the jetty head – PERC succeeds (no significant release of LNG)	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 10 Leakage to sea water	LNG	587.4 kg/min	98 Kg	Gas Dispersion							nd	nd	nd
						Pool Fire	22.5	17.2	8.2						
						VCE				318	198	98			
S2B(1)	Large release of LNG from transfer arms on the jetty head – PERC fails but ESD succeeds - two minute isolation time	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 120 Leakage to sea water	LNG	587.4 kg/min	1175 Kg	Gas Dispersion							159.8	99	42
						Pool Fire	29.8	21.2	10.1						
						VCE				770	479	238			
S2C(1)	Large release of LNG from transfer arms on the jetty head with PERC and ESD failure - Operator manual isolation in 10 minutes	Leak size = 100% Diam. = 16" Temperature (°C) = -162 Pressure (barg) = 6 Release time (sec.) = 600 Leakage to sea water	LNG	587.4 kg/min	5874 Kg	Gas Dispersion							234	140	53
						Pool Fire	120	85	0						
						VCE				818	508	253			

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Scenario	Description	Leak size = 100% Diam. = 16"	Temperature (°C) = -162	Pressure (barg) = 6	Release time (sec.) = 10	Leakage to sea water	LNG	587,4 kg/min	98 Kg	Gas Dispersion	Pool Fire	VCE	nd	nd	nd		
S2A(1)	Large release of LNG from transfer arms on the jetty head – PERC succeeds (no significant release of LNG)										22.5	17.2	8.2				
													318	198	98		
S2B(1)	Large release of LNG from transfer arms on the jetty head – PERC fails but ESD succeeds - two minute isolation time														159.8	99	42
											29.8	21.2	10.1				
													770	479	238		
S2C(1)	Large release of LNG from transfer arms on the jetty head with PERC and ESD failure - Operator manual isolation in 10 minutes														234	140	53
											120	85	0				
													818	508	253		

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# **APPENDIX F**

## **TERMINAL RISK**

### **ASSESSMENT RESULTS**

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**Table F.1 Detailed Risk Results for the LNG Terminal Scenario, Profiler Entire Final Report**

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**Profiler - Risk Integration Tool  
 (C) 2002 Sereno Sistemas Ltda**

**Input file: C:\Users\meraddatz\Desktop\AES TELFERS\AES PANAMA.pro**

**Project:**

**Company:**

**Author:**

**Comments:**

**Results for Site 'Site 1'**

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**Input Data**

====

**Wind Directions**

====

**Wind directions considered: 16**

**Population Situations**

=====

**Population situations considered: 2**

**Situation: Day**

**Fraction of time: 4.00e-01**

<b>Population Area</b>	<b>Area [m2]</b>	<b>Population</b>	<b>Indoor fraction</b>	<b>Pop. Density [ha/m2]</b>
<b>Population 1</b>	<b>2.56e+05</b>	<b>8.00e+01</b>	<b>0.00</b>	<b>3.13e-04</b>
<b>Population 2</b>	<b>3.42e+05</b>	<b>6.00e+01</b>	<b>0.00</b>	<b>1.75e-04</b>
<b>Population 3</b>	<b>2.35e+05</b>	<b>3.00e+01</b>	<b>0.00</b>	<b>1.28e-04</b>
<b>Population 4</b>	<b>4.87e+06</b>	<b>1.50e+04</b>	<b>0.00</b>	<b>3.08e-03</b>
<b>Population 5</b>	<b>2.20e+05</b>	<b>2.00e+00</b>	<b>0.00</b>	<b>9.10e-06</b>

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Population 8	3.66e+05	1.50e+01	0.00	4.10e-05
Population 9	4.13e+05	5.00e+00	0.00	1.21e-05
Population 11	1.06e+05	9.00e+01	0.00	8.53e-04
Population 12	4.81e+05	7.00e+01	0.00	1.45e-04
Population 13	4.96e+05	5.00e+00	0.00	1.01e-05
Population 14	2.30e+06	4.00e+03	0.00	1.74e-03
Population 15	8.91e+05	1.00e+02	0.00	1.12e-04
Population 16	2.05e+05	2.50e+02	0.00	1.22e-03
Population 17	5.11e+05	1.00e+02	0.00	1.96e-04
Population 18	2.95e+05	1.50e+02	0.00	5.08e-04

-----  
**TOTAL**                      **1.20e+07**      **2.00e+04**                      **1.66e-03**  
 -----

**Wind directions probability:**

North (N)	: 1.48e-01
Northeastnorth (NEN)	: 2.34e-01
Northeast (NE)	: 2.20e-01
Northeasteast (NEE)	: 1.00e-03
East (E)	: 1.00e-03
Southeasteast (SEE)	: 1.30e-02
Southeast (SE)	: 2.50e-02
Southeastsouth (SES)	: 4.60e-02
South (S)	: 6.50e-02
Southwestsouth (SWS)	: 3.10e-02
Southwest (SW)	: 1.90e-02
Southwestwest (SWW)	: 1.10e-02
West (W)	: 2.80e-02
Northwestwest (NWW)	: 4.70e-02
Northwest (NW)	: 5.40e-02
Northwestnorth (NWN)	: 5.80e-02

**Situation: Night**


**Fraction of time: 1.00e+00**

Population Area	Area [m2]	Population	Indoor fraction	Pop. Density [ha/m2]
Population 1	2.56e+05	0.00e+00	0.00	0.00e+00
Population 2	3.42e+05	0.00e+00	0.00	0.00e+00

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	<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.		
TITLE:	<b>RISK ASSESSMENT REPORT FOR          Costa Norte LNG Terminal &amp;          Atlantico Power Generation Plant</b>			PID: 13:24

Population 3	2.35e+05	0.00e+00	0.00	0.00e+00
Population 4	4.87e+06	1.00e+00	0.00	2.05e-07
Population 5	2.20e+05	0.00e+00	0.00	0.00e+00
Population 8	3.66e+05	0.00e+00	0.00	0.00e+00
Population 9	4.13e+05	0.00e+00	0.00	0.00e+00
Population 11	1.06e+05	0.00e+00	0.00	0.00e+00
Population 12	4.81e+05	0.00e+00	0.00	0.00e+00
Population 13	4.96e+05	0.00e+00	0.00	0.00e+00
Population 14	2.30e+06	0.00e+00	0.00	0.00e+00
Population 15	8.91e+05	0.00e+00	0.00	0.00e+00
Population 16	2.05e+05	0.00e+00	0.00	0.00e+00
Population 17	5.11e+05	0.00e+00	0.00	0.00e+00
Population 18	2.95e+05	0.00e+00	0.00	0.00e+00
-----				
<b>TOTAL</b>	<b>1.20e+07</b>	<b>1.00e+00</b>		<b>8.34e-08</b>
-----				

Wind directions probability:

North (N)	: 1.48e-01
Northeastnorth (NEN)	: 2.34e-01
Northeast (NE)	: 2.20e-01
Northeasteast (NEE)	: 1.00e-03
East (E)	: 1.00e-03
Southeasteast (SEE)	: 1.30e-02
Southeast (SE)	: 2.50e-02
Southeastsouth (SES)	: 4.60e-02
South (S)	: 6.50e-02
Southwestsouth (SWS)	: 3.10e-02
Southwest (SW)	: 1.90e-02
Southwestwest (SWW)	: 1.10e-02
West (W)	: 2.80e-02
Northwestwest (NWW)	: 4.70e-02
Northwest (NW)	: 5.40e-02
Northwestnorth (NWN)	: 5.80e-02

Events

=====

confidential  
 Josefina Doumbia  
 Initial Event 3  
 IFC  
 Mar 24, 2016 13:24

confidential  
 Josefina Doumbia  
 IFC  
 Mar 24, 2016 13:24

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Josefina Doumbia  
IFC  
Mar 24, 2016 13:24



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-----  
**Description:**  
**S1AFF**

**Simulation applicable to all situations**  
**Frequency: 6.90e-08 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00004**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 4**  
-----

**Description:**  
**S1A.POOL.FIRE**

**Simulation applicable to all situations**  
**Frequency: 4.30e-08 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00021**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 5**  
-----

**Description:**  
**S1B.FF**

**Simulation applicable to all situations**  
**Frequency: 9.20e-10 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00005**

confidential  
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<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 6**  
-----

**Description:**  
**S1B.PF**

**Simulation applicable to all situations**  
**Frequency: 8.70e-10 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00030**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 8**  
-----

**Description:**  
**S2A.FF**

**Simulation applicable to all situations**  
**Frequency: 2.30e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00006**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 9**  
-----

**Description:**

confidential  
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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
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**S2A.POOL.FIRE**

Simulation applicable to all situations  
Frequency: 1.40e-05 /year

Type: Pool Fire

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00031

Exposure factor for Day situation: 0.4000  
Exposure factor for Night situation: 1.0000

**Initial Event 10**  
-----

Description:  
S2B.FF S16

Simulation applicable to all situations  
Frequency: 2.30e-07 /year

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00016

Exposure factor for Day situation: 0.4000  
Exposure factor for Night situation: 1.0000

**Initial Event 11**  
-----

Description:  
S2B.POOL.FIRE S32

Simulation applicable to all situations  
Frequency: 1.40e-07 /year

Type: Pool Fire

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00032

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confidential  
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IFC  
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IFC  
Mar 24, 2016 13:24

<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 12**

-----

**Description:**  
**S2C.FF**

**Simulation applicable to all situations**  
**Frequency: 2.90e-09 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00019**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 13**

-----

**Description:**  
**S2C.POOL.FIRE**

**Simulation applicable to all situations**  
**Frequency: 2.80e-09 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00033**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 14**

-----

**Description:**  
**S3A.FF**

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Josefina Doumbia  
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Mar 24, 2016 13:24

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Josefina Doumbia  
IFC  
Mar 24, 2016 13:24



<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
CLIENT:	Costa Norte LNG Terminal S. de R.L.		PAGE: F-10
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Simulation applicable to all situations  
Frequency: 1.50e-06 /year

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00003

Exposure factor for Day situation: 0.4000  
Exposure factor for Night situation: 1.0000

Initial Event 15  
-----

Description:  
S3A.POOL.FIRE

Simulation applicable to all situations  
Frequency: 8.90e-07 /year

Type: Pool Fire

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00029

Exposure factor for Day situation: 0.4000  
Exposure factor for Night situation: 1.0000

Initial Event 16  
-----

Description:  
S3B.FF

Simulation applicable to all situations  
Frequency: 5.70e-08 /year

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00017

Exposure factor for Day situation: 0.4000  
Exposure factor for Night situation: 1.0000

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confidential  
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IFC  
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confidential  
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IFC  
Mar 24, 2016 13:24

<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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**Initial Event 17**  
-----

**Description:**  
**S3B.POOL.FIRE**

**Simulation applicable to all situations**  
**Frequency: 5.40e-08 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00041**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 18**  
-----

**Description:**  
**SA4.FF**

**Simulation applicable to all situations**  
**Frequency: 1.10e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00020**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 19**  
-----

**Description:**  
**S4A.PF.**

**Simulation applicable to all situations**  
**Frequency: 6.40e-06 /year**

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Mar 24, 2016 13:24

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Mar 24, 2016 13:24



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**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00034**

**Exposition factor for Day situation: 0.4000**  
**Exposition factor for Night situation: 1.0000**

**Initial Event 20**  
-----

**Description:**  
**S4B.FF**

**Simulation applicable to all situations**  
**Frequency: 6.90e-08 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00027**

**Exposition factor for Day situation: 0.4000**  
**Exposition factor for Night situation: 1.0000**

**Initial Event 21**  
-----

**Description:**  
**S4B.PF**

**Simulation applicable to all situations**  
**Frequency: 6.50e-08 /year**


**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00035**

**Exposition factor for Day situation: 0.4000**  
**Exposition factor for Night situation: 1.0000**

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IFC  
Mar 24, 2016 13:24

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**Initial Event 22**

-----

**Description:**  
**S5A.FF**

**Simulation applicable to all situations**  
**Frequency: 1.30e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00007**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 23**

-----

**Description:**  
**S5APF**

**Simulation applicable to all situations**  
**Frequency: 9.70e-06 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00043**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 24**

-----

**Description:**

**Simulation applicable to all situations**  
**Frequency: 0.00e+00 /year**

<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**TRACE File:**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 25**  
-----

**Description:**  
**S5B.PF**

**Simulation applicable to all situations**  
**Frequency: 2.00e-07 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00043**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 26**  
-----


**Description:**  
**S6.A.FF**

**Simulation applicable to all situations**  
**Frequency: 6.90e-06 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00009**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 27**  
-----

	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>		PAGE: F-15 <b>PID:</b>

**Description:**  
**S6B.FF**

**Simulation applicable to all situations**  
**Frequency: 5.00e-06 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00018**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 28**  
-----

**Description:**  
**S7A**

**Simulation applicable to all situations**  
**Frequency: 2.50e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00010**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**


**Initial Event 29**  
-----

**Description:**  
**S7.B.FF**

**Simulation applicable to all situations**  
**Frequency: 2.80e-07 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00022**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

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**Initial Event 30**

-----

**Description:**

**S8.A.FF.S11**

**Simulation applicable to all situations**

**Frequency: 1.10e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00011**

**Exposure factor for Day situation: 0.4000**

**Exposure factor for Night situation: 1.0000**

**Initial Event 31**

-----

**Description:**

**S1A.VCE**

**Simulation applicable to all situations**

**Frequency: 3.00e-08 /year**

**Type: Overpressure Explosion**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00004**

**Exposure factor for Day situation: 0.4000**

**Exposure factor for Night situation: 1.0000**

**Initial Event 32**

-----

**Description:**

**S1B.VCE**

**Simulation applicable to all situations**

**Frequency: 9.10e-10 /year**

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<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00005**

**Exposition factor for Day situation: 1.0000**  
**Exposition factor for Night situation: 1.0000**

**Initial Event 33**  
-----

**Description:**  
**S2A.VCE**

**Simulation applicable to all situations**  
**Frequency: 8.40e-06 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00006**

**Exposition factor for Day situation: 1.0000**  
**Exposition factor for Night situation: 1.0000**

**Initial Event 34**  
-----

**Description:**  
**S2A-VCE**

**Simulation applicable to all situations**  
**Frequency: 8.40e-08 /year**

**Type: Explosion (Multi-Energy)**


**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00016**

**Exposition factor for Day situation: 0.4000**  
**Exposition factor for Night situation: 1.0000**

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IFC  
Mar 24, 2016 13:24

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**Initial Event 35**  
-----

**Description:**  
**S2C.VCE**

**Simulation applicable to all situations**  
**Frequency: 2.90e-09 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00019**

**Exposure factor for Day situation: 0.5000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 36**  
-----

**Description:**  
**S12.FF**

**Simulation applicable to all situations**  
**Frequency: 0.00e+00 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00071**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 37**  
-----

**Description:**  
**S12.PF**


**Simulation applicable to all situations**

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confidential  
Josefina Doumbia  
IFC  
Mar 24, 2016 13:24

confidential  
Josefina Doumbia  
IFC  
Mar 24, 2016 13:24

	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Frequency: 0.00e+00 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00072**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 38**  
-----

**Description:**  
**S12.VCE**

**Simulation applicable to all situations**  
**Frequency: 0.00e+00 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00071**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 39**  
-----

**Description:**  
**S13.FF**

**Simulation applicable to all situations**  
**Frequency: 1.70e-07 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00074**

**Exposure factor for Day situation: 0.4000**  
**Exposure factor for Night situation: 1.0000**

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confidential  
Josefina Doumbia  
IFC  
Mar 24, 2016 13:24

confidential  
Josefina Doumbia  
IFC  
Mar 24, 2016 13:24

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**Initial Event 40**  
-----

**Description:**

**S13.PF**

**Simulation applicable to all situations**

**Frequency: 1.60e-07 /year**

**Type: Pool Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00073**

**Exposure factor for Day situation: 0.4000**

**Exposure factor for Night situation: 1.0000**

**Initial Event 41**  
-----

**Description:**

**S13.VCE**

**Simulation applicable to all situations**

**Frequency: 1.70e-07 /year**

**Type: Overpressure Explosion**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00074**

**Exposure factor for Day situation: 0.4000**

**Exposure factor for Night situation: 1.0000**

=====

**Output Data**

=====

**Mean Social Risk: 3.18e-05 deaths/year**

confidential  
Josefina Doumbia  
IFC  
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confidential  
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IFC  
Mar 24, 2016 13:24

<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
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**FN Curve:**

**Number of Fatalities      Accumulated Frequency (/year)**

1.00e-01	2.34e-05
3.20e-01	1.54e-05
1.00e+00	5.49e-06
3.20e+00	3.32e-06
1.00e+01	6.59e-08
3.20e+01	1.70e-08
1.00e+02	6.11e-09
3.20e+02	6.06e-09
9.00e+02	7.47e-10
9.00e+02	7.47e-10
9.00e+02	7.47e-10
9.00e+02	7.47e-10

**Risk per accident type: n**

<b>Accident Type</b>	<b>Mean Social Risk</b>	<b>Percent of Total</b>
Explosion (Multi-Energy)	1.61e-09	5.05e-03
Flash Fire	2.96e-05	9.30e+01
BLEVE	0.00e+00	0.00e+00
Pool Fire	1.66e-06	5.22e+00
Jet Fire	0.00e+00	0.00e+00
Toxic Cloud	0.00e+00	0.00e+00
Overpressure Explosion	5.82e-07	1.83e+00
UVCE	0.00e+00	0.00e+00
<b>TOTAL</b>	<b>3.18e-05</b>	<b>1.00e+02</b>

**Top 10 accidents per mean social risk:**

confidential  
Josefina Doumbia  
IFC  
Mar 24, 2016 13:24

<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
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**Initial Event 8 - Result - Day - North (N) - Outdoor**

Frequency (/year): 1.36e-06  
Deaths: 4.01e+00  
Mean Social Risk: 5.46e-06

**Initial Event 8 - Result - Day - Northeastnorth (NEN) - Outdoor**

Frequency (/year): 2.15e-06  
Deaths: 2.36e+00  
Mean Social Risk: 5.07e-06

**Initial Event 8 - Result - Day - Northwest (NW) - Outdoor**

Frequency (/year): 4.96e-07  
Deaths: 6.95e+00  
Mean Social Risk: 3.45e-06

**Initial Event 8 - Result - Day - Northwestnorth (NWN) - Outdoor**

Frequency (/year): 5.33e-07  
Deaths: 4.33e+00  
Mean Social Risk: 2.31e-06

**Initial Event 8 - Result - Day - Northwestwest (NWW) - Outdoor**

Frequency (/year): 4.32e-07  
Deaths: 4.05e+00  
Mean Social Risk: 1.75e-06

**Initial Event 8 - Result - Day - West (W) - Outdoor**

Frequency (/year): 2.57e-07  
Deaths: 5.62e+00  
Mean Social Risk: 1.45e-06

**Initial Event 39 - Result - Day - West (W) - Outdoor**

Frequency (/year): 1.90e-09  
Deaths: 6.32e+02  
Mean Social Risk: 1.20e-06

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**Initial Event 39 - Result - Day - Southwest (SW) - Outdoor**

Frequency (/year): 1.29e-09  
Deaths: 6.90e+02  
Mean Social Risk: 8.91e-07

**Initial Event 39 - Result - Day - Southwestsouth (SWS) - Outdoor**

Frequency (/year): 2.11e-09  
Deaths: 3.57e+02  
Mean Social Risk: 7.52e-07

**Initial Event 39 - Result - Day - Southwestwest (SWW) - Outdoor**

Frequency (/year): 7.47e-10  
Deaths: 9.00e+02  
Mean Social Risk: 6.73e-07

**Top 10 accidents per frequency:**

**Initial Event 33 - Result - Night - Indoor**

Frequency (/year): 8.40e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 33 - Result - Night - Outdoor**

Frequency (/year): 8.40e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 28 - Result - Night - Northeastnorth (NEN) - Indoor**

Frequency (/year): 5.84e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

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**Initial Event 28 - Result - Night - Northeastnorth (NEN) - Outdoor**

Frequency (/year): 5.84e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 28 - Result - Night - Northeast (NE) - Indoor**

Frequency (/year): 5.49e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 28 - Result - Night - Northeast (NE) - Outdoor**

Frequency (/year): 5.49e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 8 - Result - Night - Northeastnorth (NEN) - Indoor**

Frequency (/year): 5.38e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 8 - Result - Night - Northeastnorth (NEN) - Outdoor**

Frequency (/year): 5.38e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 8 - Result - Night - Northeast (NE) - Indoor**

Frequency (/year): 5.05e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

**Initial Event 8 - Result - Night - Northeast (NE) - Outdoor**

Frequency (/year): 5.05e-06  
Deaths: 0.00e+00  
Mean Social Risk: 0.00e+00

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**Top 10 accidents per deaths:**

**Initial Event 39 - Result - Day - Southwestwest (SWW) - Outdoor**

Frequency (/year): 7.47e-10  
Deaths: 9.00e+02  
Mean Social Risk: 6.73e-07

**Initial Event 39 - Result - Day - Southwest (SW) - Outdoor**

Frequency (/year): 1.29e-09  
Deaths: 6.90e+02  
Mean Social Risk: 8.91e-07

**Initial Event 39 - Result - Day - West (W) - Outdoor**

Frequency (/year): 1.90e-09  
Deaths: 6.32e+02  
Mean Social Risk: 1.20e-06

**Initial Event 39 - Result - Day - Southwestsouth (SWS) - Outdoor**

Frequency (/year): 2.11e-09  
Deaths: 3.57e+02  
Mean Social Risk: 7.52e-07

**Initial Event 12 - Result - Day - Southwestwest (SWW) - Outdoor**

Frequency (/year): 1.27e-11  
Deaths: 3.25e+02  
Mean Social Risk: 4.14e-09

**Initial Event 12 - Result - Day - West (W) - Outdoor**

Frequency (/year): 3.24e-11  
Deaths: 2.98e+02  
Mean Social Risk: 9.67e-09

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**Initial Event 12 - Result - Day - Southwest (SW) - Outdoor**

**Frequency (/year): 2.20e-11**  
**Deaths: 2.63e+02**  
**Mean Social Risk: 5.80e-09**

**Initial Event 36 - Result - Day - Southwestwest (SWW) - Outdoor**

**Frequency (/year): 0.00e+00**  
**Deaths: 2.24e+02**  
**Mean Social Risk: 0.00e+00**

**Initial Event 12 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Frequency (/year): 3.59e-11**  
**Deaths: 7.66e+01**  
**Mean Social Risk: 2.75e-09**

**Initial Event 39 - Result - Day - Northwest (NW) - Outdoor**

**Frequency (/year): 3.67e-09**  
**Deaths: 6.24e+01**  
**Mean Social Risk: 2.29e-07**

**Listing of accidents:**

**Initial Event 3 - Result - Day - North (N) - Outdoor**

**Deaths: 0.00e+00**  
**Frequency: 4.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northeastnorth (NEN) - Outdoor**


**Deaths: 0.00e+00**  
**Frequency: 6.45e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northeast (NE) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 6.07e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.58e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.27e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.79e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 3 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.55e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 5.24e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 3.90e-02**  
**Frequency: 3.03e-10 /year**  
**Mean Social Risk: 1.18e-11 deaths/year**

**Initial Event 3 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.99e-01**  
**Frequency: 7.72e-10 /year**  
**Mean Social Risk: 1.54e-10 deaths/year**

**Initial Event 3 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.02e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.61e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.52e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northeast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.96e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.72e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.17e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.48e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.14e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.31e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 3 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.58e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.93e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.24e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.72e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.08e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.45e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.07e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 3 - Result - Day - Northeast (NEE) - Indoor**

Deaths: 0.00e+00

Frequency: 2.76e-11 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - East (E) - Indoor**

Deaths: 0.00e+00

Frequency: 2.76e-11 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southeast (SEE) - Indoor**

Deaths: 0.00e+00

Frequency: 3.58e-10 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southeast (SE) - Indoor**

Deaths: 0.00e+00

Frequency: 6.89e-10 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southeastsouth (SES) - Indoor**

Deaths: 0.00e+00

Frequency: 1.27e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - South (S) - Indoor**

Deaths: 0.00e+00

Frequency: 1.79e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southwestsouth (SWS) - Indoor**

Deaths: 0.00e+00

Frequency: 8.55e-10 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southwest (SW) - Indoor**

Deaths: 0.00e+00

Frequency: 5.24e-10 /year


Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 3 - Result - Day - Southwestwest (SWW) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 3.03e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.72e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.02e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.61e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 3 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 6.89e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.96e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.17e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.14e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.58e-10 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.93e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.24e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.72e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 3 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - North (N) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 2.54e-09 /year**

**Mean Social Risk: 1.12e-10 deaths/year**

**Initial Event 4 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 4.02e-09 /year**

**Mean Social Risk: 1.76e-10 deaths/year**

**Initial Event 4 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.78e-09 /year**

**Mean Social Risk: 1.66e-10 deaths/year**

**Initial Event 4 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.72e-11 /year**

**Mean Social Risk: 7.54e-13 deaths/year**

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**Initial Event 4 - Result - Day - East (E) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.72e-11 /year**

**Mean Social Risk: 7.54e-13 deaths/year**

**Initial Event 4 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 2.23e-10 /year**

**Mean Social Risk: 9.80e-12 deaths/year**

**Initial Event 4 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 4.30e-10 /year**

**Mean Social Risk: 1.88e-11 deaths/year**

**Initial Event 4 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 7.90e-10 /year**

**Mean Social Risk: 3.47e-11 deaths/year**

**Initial Event 4 - Result - Day - South (S) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.12e-09 /year**

**Mean Social Risk: 4.90e-11 deaths/year**

**Initial Event 4 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 5.33e-10 /year**

**Mean Social Risk: 2.34e-11 deaths/year**

**Initial Event 4 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.26e-10 /year**

**Mean Social Risk: 1.43e-11 deaths/year**

**Initial Event 4 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.89e-10 /year**

**Mean Social Risk: 8.29e-12 deaths/year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Initial Event 4 - Result - Day - West (W) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 4.81e-10 /year**

**Mean Social Risk: 2.11e-11 deaths/year**

**Initial Event 4 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 8.08e-10 /year**

**Mean Social Risk: 3.54e-11 deaths/year**

**Initial Event 4 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 9.28e-10 /year**

**Mean Social Risk: 4.07e-11 deaths/year**

**Initial Event 4 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 9.97e-10 /year**

**Mean Social Risk: 4.37e-11 deaths/year**

**Initial Event 4 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.36e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.01e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.45e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.30e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - East (E) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 4.30e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.58e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.07e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.98e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.79e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.16e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.73e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.20e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.32e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.49e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.54e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.02e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.78e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-11 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.23e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.30e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.90e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.12e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.33e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.26e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.89e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.81e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 4 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.08e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.28e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.97e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.36e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeastnorth (NEN) - indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.01e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.45e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.30e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.30e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 4 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.58e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.07e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.98e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.79e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.33e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.16e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.73e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.20e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwestwest (NWW) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.02e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.32e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 4 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.49e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - North (N) - Outdoor**  
**Deaths: 1.68e+00**  
**Frequency: 5.44e-11 /year**  
**Mean Social Risk: 9.16e-11 deaths/year**

**Initial Event 5 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 1.54e+00**  
**Frequency: 8.60e-11 /year**  
**Mean Social Risk: 1.32e-10 deaths/year**

**Initial Event 5 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 1.49e+00**  
**Frequency: 8.09e-11 /year**  
**Mean Social Risk: 1.21e-10 deaths/year**

**Initial Event 5 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 7.21e-01**  
**Frequency: 3.68e-13 /year**  
**Mean Social Risk: 2.65e-13 deaths/year**

**Initial Event 5 - Result - Day - East (E) - Outdoor**  
**Deaths: 4.29e-01**  
**Frequency: 3.68e-13 /year**  
**Mean Social Risk: 1.58e-13 deaths/year**

**Initial Event 5 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 3.83e-01**

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**Frequency: 4.78e-12 /year**  
**Mean Social Risk: 1.83e-12 deaths/year**

**Initial Event 5 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 3.58e-01**  
**Frequency: 9.19e-12 /year**  
**Mean Social Risk: 3.29e-12 deaths/year**

**Initial Event 5 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 4.15e-01**  
**Frequency: 1.69e-11 /year**  
**Mean Social Risk: 7.03e-12 deaths/year**

**Initial Event 5 - Result - Day - South (S) - Outdoor**  
**Deaths: 5.80e-01**  
**Frequency: 2.39e-11 /year**  
**Mean Social Risk: 1.39e-11 deaths/year**

**Initial Event 5 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 7.69e-01**  
**Frequency: 1.14e-11 /year**  
**Mean Social Risk: 8.76e-12 deaths/year**

**Initial Event 5 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 8.05e-01**  
**Frequency: 6.99e-12 /year**  
**Mean Social Risk: 5.63e-12 deaths/year**

**Initial Event 5 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 2.18e+00**  
**Frequency: 4.04e-12 /year**  
**Mean Social Risk: 8.83e-12 deaths/year**

**Initial Event 5 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.73e+00**  
**Frequency: 1.03e-11 /year**  
**Mean Social Risk: 1.78e-11 deaths/year**

**Initial Event 5 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 1.50e+00**  
**Frequency: 1.73e-11 /year**

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**Mean Social Risk: 2.59e-11 deaths/year**

**Initial Event 5 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 1.48e+00**

**Frequency: 1.99e-11 /year**

**Mean Social Risk: 2.94e-11 deaths/year**

**Initial Event 5 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 1.63e+00**

**Frequency: 2.13e-11 /year**

**Mean Social Risk: 3.48e-11 deaths/year**

**Initial Event 5 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.36e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.15e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.02e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-13 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-13 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.19e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 5 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.23e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.97e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.75e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.01e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.57e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**


**Frequency: 4.32e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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	<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.		PAGE: F-46
TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>			<b>PID:</b>

**Initial Event 5 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.96e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.33e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.44e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.60e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.09e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.68e-13 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.68e-13 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.78e-12 /year**


**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southeast (SE) - Indoor**

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	<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.		PAGE: F-47
TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>			<b>PID:</b>

**Deaths: 0.00e+00**  
**Frequency: 9.19e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.69e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.39e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.14e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.99e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.04e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.03e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.73e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
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**Frequency: 1.99e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.13e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.15e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-13 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-13 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-11 /year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.23e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.97e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.75e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.01e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.57e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.32e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 5 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.96e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Initial Event 5 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.33e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - North (N) - Outdoor**  
**Deaths: 4.01e+00**  
**Frequency: 1.36e-06 /year**  
**Mean Social Risk: 5.46e-06 deaths/year**

**Initial Event 8 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 2.36e+00**  
**Frequency: 2.15e-06 /year**  
**Mean Social Risk: 5.07e-06 deaths/year**

**Initial Event 8 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 8 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.23e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.97e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 7.83e-01**

**Frequency: 1.75e-07 /year**

**Mean Social Risk: 1.37e-07 deaths/year**

**Initial Event 8 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 3.88e+00**

**Frequency: 1.01e-07 /year**

**Mean Social Risk: 3.92e-07 deaths/year**

**Initial Event 8 - Result - Day - West (W) - Outdoor**

**Deaths: 5.62e+00**

**Frequency: 2.57e-07 /year**

**Mean Social Risk: 1.45e-06 deaths/year**

**Initial Event 8 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 4.05e+00**

**Frequency: 4.32e-07 /year**

**Mean Social Risk: 1.75e-06 deaths/year**

**Initial Event 8 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 6.95e+00**

**Frequency: 4.96e-07 /year**

**Mean Social Risk: 3.45e-06 deaths/year**

**Initial Event 8 - Result - Day - Northwestnorth (NWN) - Outdoor**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Deaths: 4.33e+00**  
**Frequency: 5.33e-07 /year**  
**Mean Social Risk: 2.31e-06 deaths/year**

**Initial Event 8 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.40e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.38e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.05e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.99e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 8 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.74e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**

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	CLIENT:	Costa Norte LNG Terminal S. de R.L.		PAGE: F-33
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**Frequency: 1.06e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.12e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.37e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.53e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.43e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.24e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-06 /year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.36e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.15e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.02e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.19e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.23e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 8 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.97e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.01e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.57e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.32e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.96e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.33e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 8 - Result - Night - North (N) - Indoor**

Deaths: 0.00e+00

Frequency: 3.40e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Northeastnorth (NEN) - Indoor**

Deaths: 0.00e+00

Frequency: 5.38e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Northeast (NE) - Indoor**

Deaths: 0.00e+00

Frequency: 5.05e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Northeasteast (NEE) - Indoor**

Deaths: 0.00e+00

Frequency: 2.30e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - East (E) - Indoor**

Deaths: 0.00e+00

Frequency: 2.30e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Southeasteast (SEE) - Indoor**

Deaths: 0.00e+00

Frequency: 2.99e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Southeast (SE) - Indoor**

Deaths: 0.00e+00

Frequency: 5.74e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - Southeastsouth (SES) - Indoor**

Deaths: 0.00e+00

Frequency: 1.06e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 8 - Result - Night - South (S) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.49e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.12e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.37e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.53e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.43e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 8 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.24e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 8 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - North (N) - Outdoor**  
**Deaths: 6.16e-01**

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**Frequency: 1.36e-08 /year**  
**Mean Social Risk: 8.38e-09 deaths/year**

**Initial Event 10 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 3.58e-01**  
**Frequency: 2.15e-08 /year**  
**Mean Social Risk: 7.70e-09 deaths/year**

**Initial Event 10 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.23e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.97e-09 /year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.75e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 3.29e-01**

**Frequency: 1.01e-09 /year**

**Mean Social Risk: 3.32e-10 deaths/year**

**Initial Event 10 - Result - Day - West (W) - Outdoor**

**Deaths: 8.98e-01**

**Frequency: 2.57e-09 /year**

**Mean Social Risk: 2.31e-09 deaths/year**

**Initial Event 10 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 8.37e-01**

**Frequency: 4.32e-09 /year**

**Mean Social Risk: 3.62e-09 deaths/year**

**Initial Event 10 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 8.21e-01**

**Frequency: 4.96e-09 /year**

**Mean Social Risk: 4.07e-09 deaths/year**

**Initial Event 10 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 7.98e-01**

**Frequency: 5.33e-09 /year**

**Mean Social Risk: 4.25e-09 deaths/year**

**Initial Event 10 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.40e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 10 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.38e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.99e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.74e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.06e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - South (S) - Outdoor**


**Deaths: 0.00e+00**

**Frequency: 1.49e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
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**Initial Event 10 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.12e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.37e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.53e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.43e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 10 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.24e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northeastnorth (NEN) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.15e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.23e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 10 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.97e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 2.85e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.75e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.01e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.57e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.32e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.96e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 10 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.33e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.40e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.38e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northeast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.30e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.99e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.74e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.06e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.49e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.12e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 10 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.37e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.53e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.43e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.24e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 10 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 12 - Result - Day - North (N) - Outdoor**  
**Deaths: 1.47e+01**  
**Frequency: 1.72e-10 /year**  
**Mean Social Risk: 2.53e-09 deaths/year**

**Initial Event 12 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 7.92e+00**  
**Frequency: 2.71e-10 /year**  
**Mean Social Risk: 2.15e-09 deaths/year**

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**Initial Event 12 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 1.81e+00**

**Frequency: 2.55e-10 /year**

**Mean Social Risk: 4.61e-10 deaths/year**

**Initial Event 12 - Result - Day - Northeast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.16e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.16e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.51e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.90e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 7.00e-01**

**Frequency: 5.33e-11 /year**

**Mean Social Risk: 3.73e-11 deaths/year**

**Initial Event 12 - Result - Day - South (S) - Outdoor**

**Deaths: 3.90e+00**

**Frequency: 7.53e-11 /year**

**Mean Social Risk: 2.94e-10 deaths/year**

**Initial Event 12 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 7.66e+01**

**Frequency: 3.59e-11 /year**

**Mean Social Risk: 2.75e-09 deaths/year**

**Initial Event 12 - Result - Day - Southwest (SW) - Outdoor**

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**Deaths: 2.63e+02**  
**Frequency: 2.20e-11 /year**  
**Mean Social Risk: 5.80e-09 deaths/year**

**Initial Event 12 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 3.25e+02**  
**Frequency: 1.27e-11 /year**  
**Mean Social Risk: 4.14e-09 deaths/year**

**Initial Event 12 - Result - Day - West (W) - Outdoor**  
**Deaths: 2.98e+02**  
**Frequency: 3.24e-11 /year**  
**Mean Social Risk: 9.67e-09 deaths/year**

**Initial Event 12 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 1.90e+01**  
**Frequency: 5.45e-11 /year**  
**Mean Social Risk: 1.03e-09 deaths/year**

**Initial Event 12 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 5.25e+01**  
**Frequency: 6.26e-11 /year**  
**Mean Social Risk: 3.28e-09 deaths/year**

**Initial Event 12 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 1.73e+01**  
**Frequency: 6.72e-11 /year**  
**Mean Social Risk: 1.16e-09 deaths/year**

**Initial Event 12 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.29e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 12 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.78e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 6.37e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.77e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.24e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.88e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 1.17e-02**  
**Frequency: 8.98e-11 /year**  
**Mean Social Risk: 1.05e-12 deaths/year**

**Initial Event 12 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 4.25e-02**  
**Frequency: 5.50e-11 /year**

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**Mean Social Risk: 2.34e-12 deaths/year**

**Initial Event 12 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 5.08e-02**  
**Frequency: 3.19e-11 /year**  
**Mean Social Risk: 1.62e-12 deaths/year**

**Initial Event 12 - Result - Night - West (W) - Outdoor**  
**Deaths: 4.65e-02**  
**Frequency: 8.11e-11 /year**  
**Mean Social Risk: 3.77e-12 deaths/year**

**Initial Event 12 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.56e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.68e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.71e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.55e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 12 - Result - Day - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.33e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 12 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.53e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.59e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.20e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 12 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.27e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.24e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.45e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.26e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.72e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.29e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.78e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.37e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northeasteast (NEE) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.90e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.77e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.24e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.33e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.88e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.98e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 12 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.50e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.19e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.11e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.56e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 12 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.68e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.66e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.62e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.46e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.12e-12 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.12e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.45e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.15e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.27e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.47e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.13e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.23e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 13 - Result - Day - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.13e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.26e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.04e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.49e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.14e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.55e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.15e-10 /year**


**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 13 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.64e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.99e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.29e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.82e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.67e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.31e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwestwest (SWW) - Outdoor**


**Deaths: 0.00e+00**

**Frequency: 3.08e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - West (W) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 7.83e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.66e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.62e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.46e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.12e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.12e-12 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.45e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.80e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.15e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.27e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.47e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.13e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.23e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.13e-11 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.26e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.04e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.49e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.14e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.55e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.15e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-12 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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	CLIENT:	Costa Norte LNG Terminal S. de R.L.	
	TITLE:	<b>RISK ASSESSMENT REPORT FOR Costa Norte LNG Terminal &amp; Atlantico Power Generation Plant</b>	<b>PAGE: F-80</b> <b>PID: 13:24</b>

**Initial Event 13 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.64e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.99e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.29e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.82e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.67e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.31e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.08e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.83e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 13 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 13 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - North (N) - Outdoor**  
**Deaths: 2.13e-01**  
**Frequency: 8.87e-08 /year**  
**Mean Social Risk: 1.89e-08 deaths/year**

**Initial Event 14 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 8.77e-02**  
**Frequency: 1.40e-07 /year**  
**Mean Social Risk: 1.23e-08 deaths/year**

**Initial Event 14 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 3.22e-02**  
**Frequency: 1.32e-07 /year**  
**Mean Social Risk: 4.24e-09 deaths/year**

**Initial Event 14 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 4.09e-02**  
**Frequency: 5.99e-10 /year**  
**Mean Social Risk: 2.45e-11 deaths/year**


**Initial Event 14 - Result - Day - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.99e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Southeasteast (SEE) - Outdoor**

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	<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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**Deaths: 0.00e+00**  
**Frequency: 7.79e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 4.09e-02**  
**Frequency: 2.76e-08 /year**  
**Mean Social Risk: 1.13e-09 deaths/year**

**Initial Event 14 - Result - Day - South (S) - Outdoor**  
**Deaths: 3.80e-02**  
**Frequency: 3.90e-08 /year**  
**Mean Social Risk: 1.48e-09 deaths/year**

**Initial Event 14 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.86e-08 /year**  
**Mean Social Risk: 8.15e-10 deaths/year**

**Initial Event 14 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 1.26e-01**  
**Frequency: 1.14e-08 /year**  
**Mean Social Risk: 1.43e-09 deaths/year**

**Initial Event 14 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 6.59e-09 /year**  
**Mean Social Risk: 2.89e-10 deaths/year**


**Initial Event 14 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.17e-01**  
**Frequency: 1.68e-08 /year**  
**Mean Social Risk: 1.96e-09 deaths/year**

**Initial Event 14 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 3.80e-02**

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	<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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**Frequency: 2.82e-08 /year**  
**Mean Social Risk: 1.07e-09 deaths/year**

**Initial Event 14 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 7.31e-02**  
**Frequency: 3.24e-08 /year**  
**Mean Social Risk: 2.37e-09 deaths/year**

**Initial Event 14 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 3.48e-08 /year**  
**Mean Social Risk: 1.52e-09 deaths/year**

**Initial Event 14 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.22e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.51e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.95e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.75e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.74e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.65e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.85e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.65e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.20e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.04e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 14 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.09e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.69e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.87e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Northeastnorth (NEN) - indoor**

**Deaths: 0.00e+00**

**Frequency: 1.40e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.32e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.99e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.99e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**


**Frequency: 7.79e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 14 - Result - Day - Southeast (SE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.50e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - Southeastsouth (SES) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.76e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - South (S) - Indoor**  
Deaths: 0.00e+00  
Frequency: 3.90e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - Southwestsouth (SWS) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.86e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - Southwest (SW) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.14e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - Southwestwest (SWW) - Indoor**  
Deaths: 0.00e+00  
Frequency: 6.59e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - West (W) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.68e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year


**Initial Event 14 - Result - Day - Northwestwest (NWW) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.82e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 14 - Result - Day - Northwest (NW) - Indoor**

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	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Deaths: 0.00e+00**  
**Frequency: 3.24e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.48e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.22e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.51e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 14 - Result - Night - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.95e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.75e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.74e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.65e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.85e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.65e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.20e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.04e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.09e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 14 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.69e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - North (N) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 5.26e-08 /year**

**Mean Social Risk: 2.31e-09 deaths/year**

**Initial Event 15 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 8.32e-08 /year**

**Mean Social Risk: 3.65e-09 deaths/year**

**Initial Event 15 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 7.82e-08 /year**

**Mean Social Risk: 3.43e-09 deaths/year**

**Initial Event 15 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.56e-10 /year**

**Mean Social Risk: 1.56e-11 deaths/year**

**Initial Event 15 - Result - Day - East (E) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.56e-10 /year**

**Mean Social Risk: 1.56e-11 deaths/year**

**Initial Event 15 - Result - Day - Southeasteast (SEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 4.62e-09 /year**

**Mean Social Risk: 2.03e-10 deaths/year**

**Initial Event 15 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 8.89e-09 /year**

**Mean Social Risk: 3.90e-10 deaths/year**

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**Initial Event 15 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.64e-08 /year**  
**Mean Social Risk: 7.18e-10 deaths/year**

**Initial Event 15 - Result - Day - South (S) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 2.31e-08 /year**  
**Mean Social Risk: 1.01e-09 deaths/year**

**Initial Event 15 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.10e-08 /year**  
**Mean Social Risk: 4.84e-10 deaths/year**

**Initial Event 15 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 6.76e-09 /year**  
**Mean Social Risk: 2.96e-10 deaths/year**

**Initial Event 15 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 3.91e-09 /year**  
**Mean Social Risk: 1.72e-10 deaths/year**


**Initial Event 15 - Result - Day - West (W) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 9.96e-09 /year**  
**Mean Social Risk: 4.37e-10 deaths/year**

**Initial Event 15 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.67e-08 /year**  
**Mean Social Risk: 7.33e-10 deaths/year**

**Initial Event 15 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.92e-08 /year**  
**Mean Social Risk: 8.42e-10 deaths/year**

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**Initial Event 15 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 2.06e-08 /year**  
**Mean Social Risk: 9.05e-10 deaths/year**

**Initial Event 15 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.32e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.08e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.96e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.89e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.89e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.22e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeastsouth (SES) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 4.09e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.78e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.76e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.69e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.78e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.18e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 15 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.80e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 5.16e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.26e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.32e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.82e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.56e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.56e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.62e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.89e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.64e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.31e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.76e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.91e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.96e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.67e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.92e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.06e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 15 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.32e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.08e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.96e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.89e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.89e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.16e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.22e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.09e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**



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**Initial Event 15 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.78e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.76e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.69e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.78e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.49e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.18e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.80e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 15 - Result - Night - Northwestnorth (NWN) - Indoor**


**Deaths: 0.00e+00**

**Frequency: 5.16e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - North (N) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 3.37e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 7.90e-02**  
**Frequency: 5.33e-09 /year**  
**Mean Social Risk: 4.21e-10 deaths/year**

**Initial Event 16 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 6.14e-02**  
**Frequency: 5.01e-09 /year**  
**Mean Social Risk: 3.08e-10 deaths/year**

**Initial Event 16 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 2.28e-11 /year**  
**Mean Social Risk: 9.99e-13 deaths/year**

**Initial Event 16 - Result - Day - East (E) - Outdoor**  
**Deaths: 2.02e-01**  
**Frequency: 2.28e-11 /year**  
**Mean Social Risk: 4.60e-12 deaths/year**

**Initial Event 16 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 4.09e-02**  
**Frequency: 2.96e-10 /year**  
**Mean Social Risk: 1.21e-11 deaths/year**

**Initial Event 16 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 1.26e-01**  
**Frequency: 5.69e-10 /year**  
**Mean Social Risk: 7.16e-11 deaths/year**

**Initial Event 16 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 1.05e-09 /year**  
**Mean Social Risk: 4.60e-11 deaths/year**

**Initial Event 16 - Result - Day - South (S) - Outdoor**  
**Deaths: 1.87e-01**

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**Frequency: 1.48e-09 /year**  
**Mean Social Risk: 2.77e-10 deaths/year**

**Initial Event 16 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 4.09e-02**  
**Frequency: 7.06e-10 /year**  
**Mean Social Risk: 2.89e-11 deaths/year**

**Initial Event 16 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 1.64e-01**  
**Frequency: 4.33e-10 /year**  
**Mean Social Risk: 7.09e-11 deaths/year**

**Initial Event 16 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 8.77e-02**  
**Frequency: 2.51e-10 /year**  
**Mean Social Risk: 2.20e-11 deaths/year**

**Initial Event 16 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.49e-01**  
**Frequency: 6.38e-10 /year**  
**Mean Social Risk: 9.51e-11 deaths/year**

**Initial Event 16 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 7.02e-02**  
**Frequency: 1.07e-09 /year**  
**Mean Social Risk: 7.51e-11 deaths/year**

**Initial Event 16 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.23e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 8.77e-02**  
**Frequency: 1.32e-09 /year**  
**Mean Social Risk: 1.16e-10 deaths/year**

**Initial Event 16 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.43e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.33e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.25e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.69e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.69e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.40e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.42e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.62e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.70e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 16 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.77e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.26e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.59e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.68e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.07e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.37e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 16 - Result - Day - Northeastnorth (NEN) - Indoor**  
Deaths: 0.00e+00  
Frequency: 5.33e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - Northeast (NE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 5.01e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - Northeasteast (NEE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.28e-11 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - East (E) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.28e-11 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - Southeasteast (SEE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.96e-10 /year  
Mean Social Risk: 0.00e+00 deaths/year


**Initial Event 16 - Result - Day - Southeast (SE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 5.69e-10 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - Southeastsouth (SES) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.05e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - South (S) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.48e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 16 - Result - Day - Southwestsouth (SWS) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 7.06e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.33e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.51e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.38e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Northwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.07e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.23e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.32e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 16 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.43e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.33e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.25e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.69e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.69e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.40e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.42e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.62e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.70e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.77e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.08e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.26e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.59e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.68e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.07e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 16 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.30e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 17 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.75e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northeast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.16e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.16e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.81e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.39e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.93e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.40e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 17 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.69e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 17 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.10e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.37e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.04e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.01e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.17e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.25e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.98e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 17 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.26e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northeast (NE) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.19e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.39e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.39e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.01e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.35e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 17 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.67e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.02e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.93e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.54e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.91e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.13e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.05e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.75e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northeast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.16e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.16e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.81e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.39e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.93e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.40e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.69e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.10e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 17 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.37e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.04e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.01e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.17e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.25e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 17 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.98e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.26e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 17 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.39e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.39e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.01e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.35e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.67e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.02e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Southwestwest (SWW) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 5.93e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.54e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.91e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 17 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.13e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - North (N) - Outdoor**  
**Deaths: 4.47e-01**  
**Frequency: 6.51e-07 /year**  
**Mean Social Risk: 2.91e-07 deaths/year**

**Initial Event 18 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 1.03e-06 /year**  
**Mean Social Risk: 3.61e-07 deaths/year**

**Initial Event 18 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 3.60e-01**  
**Frequency: 9.67e-07 /year**  
**Mean Social Risk: 3.48e-07 deaths/year**

**Initial Event 18 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 3.95e-01**

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**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 1.74e-09 deaths/year**

**Initial Event 18 - Result - Day - East (E) - Outdoor**  
**Deaths: 3.63e-01**  
**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 1.59e-09 deaths/year**

**Initial Event 18 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 4.09e-01**  
**Frequency: 5.71e-08 /year**  
**Mean Social Risk: 2.34e-08 deaths/year**

**Initial Event 18 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 3.98e-01**  
**Frequency: 1.10e-07 /year**  
**Mean Social Risk: 4.37e-08 deaths/year**

**Initial Event 18 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 4.02e-01**  
**Frequency: 2.02e-07 /year**  
**Mean Social Risk: 8.14e-08 deaths/year**

**Initial Event 18 - Result - Day - South (S) - Outdoor**  
**Deaths: 3.32e-01**  
**Frequency: 2.86e-07 /year**  
**Mean Social Risk: 9.49e-08 deaths/year**

**Initial Event 18 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 4.49e-01**  
**Frequency: 1.36e-07 /year**  
**Mean Social Risk: 6.12e-08 deaths/year**

**Initial Event 18 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 5.16e-01**  
**Frequency: 8.35e-08 /year**  
**Mean Social Risk: 4.31e-08 deaths/year**

**Initial Event 18 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 4.22e-01**  
**Frequency: 4.84e-08 /year**

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**Mean Social Risk: 2.04e-08 deaths/year**

**Initial Event 18 - Result - Day - West (W) - Outdoor**

**Deaths: 4.08e-01**

**Frequency: 1.23e-07 /year**

**Mean Social Risk: 5.02e-08 deaths/year**

**Initial Event 18 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 2.98e-01**

**Frequency: 2.07e-07 /year**

**Mean Social Risk: 6.17e-08 deaths/year**

**Initial Event 18 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 2.65e-01**

**Frequency: 2.37e-07 /year**

**Mean Social Risk: 6.28e-08 deaths/year**

**Initial Event 18 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 4.04e-01**

**Frequency: 2.55e-07 /year**

**Mean Social Risk: 1.03e-07 deaths/year**

**Initial Event 18 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.63e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.57e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.42e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 18 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.43e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.14e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.41e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.09e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.21e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 18 - Result - Night - West (W) - Outdoor**

Deaths: 0.00e+00

Frequency: 3.08e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Night - Northwestwest (NWW) - Outdoor**

Deaths: 0.00e+00

Frequency: 5.16e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Night - Northwest (NW) - Outdoor**

Deaths: 0.00e+00

Frequency: 5.93e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Night - Northwestnorth (NWN) - Outdoor**

Deaths: 0.00e+00

Frequency: 6.37e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Day - North (N) - Indoor**

Deaths: 0.00e+00

Frequency: 6.51e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Day - Northeastnorth (NEN) - Indoor**

Deaths: 0.00e+00

Frequency: 1.03e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Day - Northeast (NE) - Indoor**

Deaths: 0.00e+00

Frequency: 9.67e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Day - Northeasteast (NEE) - Indoor**

Deaths: 0.00e+00

Frequency: 4.40e-09 /year


Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 18 - Result - Day - East (E) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.71e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.86e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.35e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 18 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.84e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.23e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.07e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.37e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.55e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.63e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.57e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.42e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.43e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.14e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.41e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.09e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.21e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.08e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 18 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.16e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.93e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 18 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.37e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - North (N) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 3.79e-07 /year**  
**Mean Social Risk: 2.08e-08 deaths/year**

**Initial Event 19 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 5.98e-07 /year**  
**Mean Social Risk: 3.29e-08 deaths/year**

**Initial Event 19 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 5.63e-07 /year**  
**Mean Social Risk: 3.10e-08 deaths/year**

**Initial Event 19 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 2.56e-09 /year**  
**Mean Social Risk: 1.41e-10 deaths/year**

**Initial Event 19 - Result - Day - East (E) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 2.56e-09 /year**  
**Mean Social Risk: 1.41e-10 deaths/year**

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**Initial Event 19 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 3.32e-08 /year**

**Mean Social Risk: 1.83e-09 deaths/year**

**Initial Event 19 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 6.39e-08 /year**

**Mean Social Risk: 3.52e-09 deaths/year**

**Initial Event 19 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 1.18e-07 /year**

**Mean Social Risk: 6.48e-09 deaths/year**

**Initial Event 19 - Result - Day - South (S) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 1.66e-07 /year**

**Mean Social Risk: 9.15e-09 deaths/year**

**Initial Event 19 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 7.93e-08 /year**

**Mean Social Risk: 4.36e-09 deaths/year**

**Initial Event 19 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 4.86e-08 /year**

**Mean Social Risk: 2.67e-09 deaths/year**

**Initial Event 19 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 2.81e-08 /year**

**Mean Social Risk: 1.55e-09 deaths/year**

**Initial Event 19 - Result - Day - West (W) - Outdoor**

**Deaths: 5.50e-02**

**Frequency: 7.16e-08 /year**

**Mean Social Risk: 3.94e-09 deaths/year**

**Initial Event 19 - Result - Day - Northwestwest (NWW) - Outdoor**

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**Deaths: 5.50e-02**  
**Frequency: 1.20e-07 /year**  
**Mean Social Risk: 6.62e-09 deaths/year**

**Initial Event 19 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 1.38e-07 /year**  
**Mean Social Risk: 7.60e-09 deaths/year**

**Initial Event 19 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 5.50e-02**  
**Frequency: 1.48e-07 /year**  
**Mean Social Risk: 8.17e-09 deaths/year**

**Initial Event 19 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.46e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.41e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.39e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 19 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.39e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 8.31e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.94e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.16e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.98e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.21e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.03e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.79e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.00e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.45e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.71e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.79e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.98e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.63e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.56e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.56e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.32e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 19 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 6.39e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 1.18e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 1.66e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 7.93e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 4.86e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 2.81e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 7.16e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 1.20e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 19 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.38e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.48e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.46e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.50e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.41e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.39e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.39e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.31e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Southeast (SE) - Indoor**

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Deaths: 0.00e+00  
Frequency: 1.60e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Southeastsouth (SES) - Indoor  
Deaths: 0.00e+00  
Frequency: 2.94e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - South (S) - Indoor  
Deaths: 0.00e+00  
Frequency: 4.16e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Southwestsouth (SWS) - Indoor  
Deaths: 0.00e+00  
Frequency: 1.98e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Southwest (SW) - Indoor  
Deaths: 0.00e+00  
Frequency: 1.21e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Southwestwest (SWW) - Indoor  
Deaths: 0.00e+00  
Frequency: 7.03e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - West (W) - Indoor  
Deaths: 0.00e+00  
Frequency: 1.79e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Northwestwest (NWW) - Indoor  
Deaths: 0.00e+00  
Frequency: 3.00e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 19 - Result - Night - Northwest (NW) - Indoor  
Deaths: 0.00e+00

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**Frequency: 3.45e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 19 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.71e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - North (N) - Outdoor**  
**Deaths: 4.01e-01**  
**Frequency: 4.08e-09 /year**  
**Mean Social Risk: 1.63e-09 deaths/year**

**Initial Event 20 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 3.28e-01**  
**Frequency: 6.45e-09 /year**  
**Mean Social Risk: 2.11e-09 deaths/year**

**Initial Event 20 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 3.45e-01**  
**Frequency: 6.07e-09 /year**  
**Mean Social Risk: 2.09e-09 deaths/year**

**Initial Event 20 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 3.57e-01**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 9.84e-12 deaths/year**

**Initial Event 20 - Result - Day - East (E) - Outdoor**  
**Deaths: 1.23e-01**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 3.39e-12 deaths/year**

**Initial Event 20 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 2.92e-01**  
**Frequency: 3.58e-10 /year**  
**Mean Social Risk: 1.05e-10 deaths/year**

**Initial Event 20 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 3.10e-01**  
**Frequency: 6.89e-10 /year**

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**Mean Social Risk: 2.14e-10 deaths/year**

**Initial Event 20 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 3.25e-01**

**Frequency: 1.27e-09 /year**

**Mean Social Risk: 4.12e-10 deaths/year**

**Initial Event 20 - Result - Day - South (S) - Outdoor**

**Deaths: 2.72e-01**

**Frequency: 1.79e-09 /year**

**Mean Social Risk: 4.87e-10 deaths/year**

**Initial Event 20 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 3.71e-01**

**Frequency: 8.55e-10 /year**

**Mean Social Risk: 3.17e-10 deaths/year**

**Initial Event 20 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 2.78e-01**

**Frequency: 5.24e-10 /year**

**Mean Social Risk: 1.46e-10 deaths/year**

**Initial Event 20 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 2.91e-01**

**Frequency: 3.03e-10 /year**

**Mean Social Risk: 8.84e-11 deaths/year**

**Initial Event 20 - Result - Day - West (W) - Outdoor**

**Deaths: 4.07e-01**

**Frequency: 7.72e-10 /year**

**Mean Social Risk: 3.15e-10 deaths/year**

**Initial Event 20 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 2.34e-01**

**Frequency: 1.30e-09 /year**

**Mean Social Risk: 3.03e-10 deaths/year**

**Initial Event 20 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 2.50e-01**

**Frequency: 1.49e-09 /year**

**Mean Social Risk: 3.72e-10 deaths/year**

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**Initial Event 20 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 3.28e-01**  
**Frequency: 1.60e-09 /year**  
**Mean Social Risk: 5.24e-10 deaths/year**

**Initial Event 20 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.02e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.61e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 20 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.96e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 20 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.17e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.14e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.58e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.93e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.24e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.72e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwestnorth (NWN) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 4.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.45e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.07e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.76e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.58e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 20 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.27e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.79e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Southsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.55e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.24e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.03e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.72e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.02e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.61e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.52e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.96e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.72e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.17e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 20 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.48e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.14e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.31e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.58e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.93e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.24e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.72e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 20 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 21 - Result - Day - North (N) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 3.84e-09 /year**

**Mean Social Risk: 4.22e-09 deaths/year**

**Initial Event 21 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 6.08e-09 /year**

**Mean Social Risk: 6.66e-09 deaths/year**

**Initial Event 21 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 5.71e-09 /year**

**Mean Social Risk: 6.27e-09 deaths/year**

**Initial Event 21 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 2.60e-11 /year**

**Mean Social Risk: 2.85e-11 deaths/year**

**Initial Event 21 - Result - Day - East (E) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 2.60e-11 /year**

**Mean Social Risk: 2.85e-11 deaths/year**

**Initial Event 21 - Result - Day - Southeasteast (SEE) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 3.38e-10 /year**

**Mean Social Risk: 3.70e-10 deaths/year**

**Initial Event 21 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 6.49e-10 /year**

**Mean Social Risk: 7.12e-10 deaths/year**

**Initial Event 21 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 1.10e+00**

**Frequency: 1.19e-09 /year**

**Mean Social Risk: 1.31e-09 deaths/year**

**Initial Event 21 - Result - Day - South (S) - Outdoor**

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**Deaths: 1.10e+00**  
**Frequency: 1.69e-09 /year**  
**Mean Social Risk: 1.85e-09 deaths/year**

**Initial Event 21 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 8.05e-10 /year**  
**Mean Social Risk: 8.83e-10 deaths/year**

**Initial Event 21 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 4.94e-10 /year**  
**Mean Social Risk: 5.41e-10 deaths/year**

**Initial Event 21 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 2.86e-10 /year**  
**Mean Social Risk: 3.13e-10 deaths/year**

**Initial Event 21 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 7.27e-10 /year**  
**Mean Social Risk: 7.98e-10 deaths/year**

**Initial Event 21 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 1.22e-09 /year**  
**Mean Social Risk: 1.34e-09 deaths/year**

**Initial Event 21 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 1.40e-09 /year**  
**Mean Social Risk: 1.54e-09 deaths/year**


**Initial Event 21 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 1.10e+00**  
**Frequency: 1.51e-09 /year**  
**Mean Social Risk: 1.65e-09 deaths/year**

**Initial Event 21 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 9.61e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.44e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.99e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.22e-09 /year**

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Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Southwestsouth (SWS) - Outdoor

Deaths: 0.00e+00

Frequency: 2.01e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Southwest (SW) - Outdoor

Deaths: 0.00e+00

Frequency: 1.23e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Southwestwest (SWW) - Outdoor

Deaths: 0.00e+00

Frequency: 7.14e-10 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - West (W) - Outdoor

Deaths: 0.00e+00

Frequency: 1.82e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Northwestwest (NWW) - Outdoor

Deaths: 0.00e+00

Frequency: 3.05e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Northwest (NW) - Outdoor

Deaths: 0.00e+00

Frequency: 3.51e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Night - Northwestnorth (NWN) - Outdoor

Deaths: 0.00e+00

Frequency: 3.77e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

Initial Event 21 - Result - Day - North (N) - Indoor

Deaths: 0.00e+00

Frequency: 3.84e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

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**Initial Event 21 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.71e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.60e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.60e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 21 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.38e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.69e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 21 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.05e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.94e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.86e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.27e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.22e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.40e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.61e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeastnorth (NEN) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.44e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.99e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.22e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 2.01e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.23e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.14e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.82e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.05e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 21 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.77e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - North (N) - Outdoor**  
**Deaths: 1.78e-01**  
**Frequency: 7.69e-07 /year**  
**Mean Social Risk: 1.37e-07 deaths/year**

**Initial Event 22 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 3.71e-01**  
**Frequency: 1.22e-06 /year**

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**Mean Social Risk: 4.51e-07 deaths/year**

**Initial Event 22 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 3.13e-01**

**Frequency: 1.14e-06 /year**

**Mean Social Risk: 3.58e-07 deaths/year**

**Initial Event 22 - Result - Day - Northeast (NEE) - Outdoor**

**Deaths: 3.48e-01**

**Frequency: 5.19e-09 /year**

**Mean Social Risk: 1.81e-09 deaths/year**

**Initial Event 22 - Result - Day - East (E) - Outdoor**

**Deaths: 3.63e-01**

**Frequency: 5.19e-09 /year**

**Mean Social Risk: 1.88e-09 deaths/year**

**Initial Event 22 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 3.83e-01**

**Frequency: 6.75e-08 /year**

**Mean Social Risk: 2.59e-08 deaths/year**

**Initial Event 22 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 3.39e-01**

**Frequency: 1.30e-07 /year**

**Mean Social Risk: 4.41e-08 deaths/year**

**Initial Event 22 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 2.71e-01**

**Frequency: 2.39e-07 /year**

**Mean Social Risk: 6.47e-08 deaths/year**

**Initial Event 22 - Result - Day - South (S) - Outdoor**

**Deaths: 3.06e-01**

**Frequency: 3.38e-07 /year**

**Mean Social Risk: 1.03e-07 deaths/year**

**Initial Event 22 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 4.79e-01**

**Frequency: 1.61e-07 /year**

**Mean Social Risk: 7.72e-08 deaths/year**

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**Initial Event 22 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 4.31e-01**

**Frequency: 9.87e-08 /year**

**Mean Social Risk: 4.26e-08 deaths/year**

**Initial Event 22 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 3.90e-01**

**Frequency: 5.71e-08 /year**

**Mean Social Risk: 2.23e-08 deaths/year**

**Initial Event 22 - Result - Day - West (W) - Outdoor**

**Deaths: 2.52e-01**

**Frequency: 1.45e-07 /year**

**Mean Social Risk: 3.66e-08 deaths/year**

**Initial Event 22 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 2.67e-01**

**Frequency: 2.44e-07 /year**

**Mean Social Risk: 6.51e-08 deaths/year**

**Initial Event 22 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 2.44e-01**

**Frequency: 2.81e-07 /year**

**Mean Social Risk: 6.85e-08 deaths/year**

**Initial Event 22 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 3.19e-01**

**Frequency: 3.01e-07 /year**

**Mean Social Risk: 9.60e-08 deaths/year**

**Initial Event 22 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.92e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.04e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 22 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.86e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.30e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.30e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.69e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.25e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.97e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.44e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southwestsouth (SWS) - Outdoor**


**Deaths: 0.00e+00**

**Frequency: 4.03e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southwest (SW) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.47e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.64e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.10e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.01e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.53e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.69e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 22 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.22e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.14e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.75e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.39e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.38e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.61e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.87e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.71e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.45e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.44e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.81e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.01e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.92e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.04e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.86e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 22 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.69e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.25e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.97e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.44e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.03e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.47e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 22 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.64e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.10e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.01e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 22 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.53e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - North (N) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 5.74e-07 /year**  
**Mean Social Risk: 2.14e-07 deaths/year**

**Initial Event 23 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 9.07e-07 /year**  
**Mean Social Risk: 3.38e-07 deaths/year**


**Initial Event 23 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 8.53e-07 /year**  
**Mean Social Risk: 3.18e-07 deaths/year**

**Initial Event 23 - Result - Day - Northeasteast (NEE) - Outdoor**

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**Deaths: 3.72e-01**  
**Frequency: 3.88e-09 /year**  
**Mean Social Risk: 1.44e-09 deaths/year**

**Initial Event 23 - Result - Day - East (E) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 3.88e-09 /year**  
**Mean Social Risk: 1.44e-09 deaths/year**

**Initial Event 23 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 5.04e-08 /year**  
**Mean Social Risk: 1.88e-08 deaths/year**

**Initial Event 23 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 9.69e-08 /year**  
**Mean Social Risk: 3.61e-08 deaths/year**

**Initial Event 23 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 1.78e-07 /year**  
**Mean Social Risk: 6.64e-08 deaths/year**

**Initial Event 23 - Result - Day - South (S) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 2.52e-07 /year**  
**Mean Social Risk: 9.38e-08 deaths/year**

**Initial Event 23 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 1.20e-07 /year**  
**Mean Social Risk: 4.47e-08 deaths/year**

**Initial Event 23 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 7.36e-08 /year**  
**Mean Social Risk: 2.74e-08 deaths/year**

**Initial Event 23 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 3.72e-01**

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**Frequency: 4.26e-08 /year**  
**Mean Social Risk: 1.59e-08 deaths/year**

**Initial Event 23 - Result - Day - West (W) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 1.09e-07 /year**  
**Mean Social Risk: 4.04e-08 deaths/year**

**Initial Event 23 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 1.82e-07 /year**  
**Mean Social Risk: 6.78e-08 deaths/year**

**Initial Event 23 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 2.09e-07 /year**  
**Mean Social Risk: 7.79e-08 deaths/year**

**Initial Event 23 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 3.72e-01**  
**Frequency: 2.25e-07 /year**  
**Mean Social Risk: 8.37e-08 deaths/year**

**Initial Event 23 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.27e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.13e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.69e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.69e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.26e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.42e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.46e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.30e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.00e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.84e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.07e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 23 - Result - Night - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.71e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.55e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.23e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.62e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.74e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.07e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.53e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.88e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 23 - Result - Day - East (E) - Indoor**

Deaths: 0.00e+00

Frequency: 3.88e-09 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southeast (SEE) - Indoor**

Deaths: 0.00e+00

Frequency: 5.04e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southeast (SE) - Indoor**

Deaths: 0.00e+00

Frequency: 9.69e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southeastsouth (SES) - Indoor**

Deaths: 0.00e+00

Frequency: 1.78e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - South (S) - Indoor**

Deaths: 0.00e+00

Frequency: 2.52e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southwestsouth (SWS) - Indoor**

Deaths: 0.00e+00

Frequency: 1.20e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southwest (SW) - Indoor**

Deaths: 0.00e+00

Frequency: 7.36e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - Southwestwest (SWW) - Indoor**

Deaths: 0.00e+00

Frequency: 4.26e-08 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 23 - Result - Day - West (W) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.09e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.82e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.09e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.25e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.43e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.27e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.13e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 23 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.69e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 9.69e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.26e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.42e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.46e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.00e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.84e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.07e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.71e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.55e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.23e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 23 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.62e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - North (N) - Outdoor**

**Deaths: 3.51e-01**

**Frequency: 1.18e-08 /year**

**Mean Social Risk: 4.15e-09 deaths/year**

**Initial Event 25 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 3.51e-01**

**Frequency: 1.87e-08 /year**

**Mean Social Risk: 6.56e-09 deaths/year**

**Initial Event 25 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 3.51e-01**

**Frequency: 1.76e-08 /year**

**Mean Social Risk: 6.17e-09 deaths/year**

**Initial Event 25 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 3.51e-01**

**Frequency: 7.99e-11 /year**

**Mean Social Risk: 2.80e-11 deaths/year**

**Initial Event 25 - Result - Day - East (E) - Outdoor**

**Deaths: 3.51e-01**

**Frequency: 7.99e-11 /year**

**Mean Social Risk: 2.80e-11 deaths/year**

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**Initial Event 25 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 1.04e-09 /year**  
**Mean Social Risk: 3.65e-10 deaths/year**

**Initial Event 25 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 2.00e-09 /year**  
**Mean Social Risk: 7.01e-10 deaths/year**

**Initial Event 25 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 3.68e-09 /year**  
**Mean Social Risk: 1.29e-09 deaths/year**

**Initial Event 25 - Result - Day - South (S) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 5.19e-09 /year**  
**Mean Social Risk: 1.82e-09 deaths/year**

**Initial Event 25 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 2.48e-09 /year**  
**Mean Social Risk: 8.69e-10 deaths/year**

**Initial Event 25 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 1.52e-09 /year**  
**Mean Social Risk: 5.33e-10 deaths/year**

**Initial Event 25 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 8.79e-10 /year**  
**Mean Social Risk: 3.08e-10 deaths/year**

**Initial Event 25 - Result - Day - West (W) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 2.24e-09 /year**  
**Mean Social Risk: 7.85e-10 deaths/year**

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**Initial Event 25 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 3.76e-09 /year**  
**Mean Social Risk: 1.32e-09 deaths/year**

**Initial Event 25 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 4.32e-09 /year**  
**Mean Social Risk: 1.51e-09 deaths/year**

**Initial Event 25 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 3.51e-01**  
**Frequency: 4.64e-09 /year**  
**Mean Social Risk: 1.63e-09 deaths/year**

**Initial Event 25 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.96e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.68e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.40e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.00e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.00e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southeasteast (SEE) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.60e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.80e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.20e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 25 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.59e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 9.39e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.18e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.87e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.76e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.99e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.99e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.04e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.68e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.48e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.52e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.79e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.24e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.76e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 25 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.32e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.64e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.96e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.68e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.40e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.60e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 25 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.30e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.19e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.80e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.20e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.59e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.39e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwest (NW) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.08e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 25 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - North (N) - Outdoor**  
**Deaths: 3.99e-02**  
**Frequency: 4.08e-07 /year**  
**Mean Social Risk: 1.63e-08 deaths/year**

**Initial Event 26 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 2.79e-02**  
**Frequency: 6.45e-07 /year**  
**Mean Social Risk: 1.80e-08 deaths/year**

**Initial Event 26 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 6.38e-02**  
**Frequency: 6.07e-07 /year**  
**Mean Social Risk: 3.87e-08 deaths/year**

**Initial Event 26 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 4.79e-02**  
**Frequency: 2.76e-09 /year**  
**Mean Social Risk: 1.32e-10 deaths/year**

**Initial Event 26 - Result - Day - East (E) - Outdoor**  
**Deaths: 9.17e-02**  
**Frequency: 2.76e-09 /year**  
**Mean Social Risk: 2.53e-10 deaths/year**


**Initial Event 26 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 5.58e-02**  
**Frequency: 3.58e-08 /year**  
**Mean Social Risk: 2.00e-09 deaths/year**

**Initial Event 26 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 5.58e-02**

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**Frequency: 6.89e-08 /year**  
**Mean Social Risk: 3.85e-09 deaths/year**

**Initial Event 26 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 2.39e-02**  
**Frequency: 1.27e-07 /year**  
**Mean Social Risk: 3.03e-09 deaths/year**

**Initial Event 26 - Result - Day - South (S) - Outdoor**  
**Deaths: 7.98e-02**  
**Frequency: 1.79e-07 /year**  
**Mean Social Risk: 1.43e-08 deaths/year**

**Initial Event 26 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 6.78e-02**  
**Frequency: 8.55e-08 /year**  
**Mean Social Risk: 5.79e-09 deaths/year**

**Initial Event 26 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 9.17e-02**  
**Frequency: 5.24e-08 /year**  
**Mean Social Risk: 4.80e-09 deaths/year**

**Initial Event 26 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 4.79e-02**  
**Frequency: 3.03e-08 /year**  
**Mean Social Risk: 1.45e-09 deaths/year**

**Initial Event 26 - Result - Day - West (W) - Outdoor**  
**Deaths: 3.59e-02**  
**Frequency: 7.72e-08 /year**  
**Mean Social Risk: 2.77e-09 deaths/year**

**Initial Event 26 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 2.79e-02**  
**Frequency: 1.30e-07 /year**  
**Mean Social Risk: 3.62e-09 deaths/year**

**Initial Event 26 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 5.58e-02**

**Frequency: 1.60e-07 /year**

**Mean Social Risk: 8.93e-09 deaths/year**

**Initial Event 26 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.02e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.61e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.52e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 8.96e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.72e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 26 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.17e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.48e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.14e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.58e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.93e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 26 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.24e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.72e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 26 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.00e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.08e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.45e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.07e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.76e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.76e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.58e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.89e-08 /year**


**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southeastsouth (SES) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.27e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.79e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.55e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.24e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.03e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.72e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 1.60e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.02e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.61e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.52e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.89e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.96e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.72e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.17e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.48e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.14e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.31e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.58e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.93e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.24e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.72e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 26 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.00e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 27 - Result - Day - North (N) - Outdoor**

**Deaths: 8.37e-02**

**Frequency: 2.96e-07 /year**

**Mean Social Risk: 2.48e-08 deaths/year**

**Initial Event 27 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 3.19e-02**

**Frequency: 4.68e-07 /year**

**Mean Social Risk: 1.49e-08 deaths/year**

**Initial Event 27 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 6.38e-02**

**Frequency: 4.40e-07 /year**

**Mean Social Risk: 2.80e-08 deaths/year**

**Initial Event 27 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 6.78e-02**

**Frequency: 2.00e-09 /year**

**Mean Social Risk: 1.35e-10 deaths/year**

**Initial Event 27 - Result - Day - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southeasteast (SEE) - Outdoor**

**Deaths: 5.58e-02**

**Frequency: 2.60e-08 /year**

**Mean Social Risk: 1.45e-09 deaths/year**

**Initial Event 27 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.00e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 1.99e-02**

**Frequency: 9.19e-08 /year**

**Mean Social Risk: 1.83e-09 deaths/year**

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**Initial Event 27 - Result - Day - South (S) - Outdoor**

**Deaths: 1.04e-01**

**Frequency: 1.30e-07 /year**

**Mean Social Risk: 1.35e-08 deaths/year**

**Initial Event 27 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 6.38e-02**

**Frequency: 6.19e-08 /year**

**Mean Social Risk: 3.95e-09 deaths/year**

**Initial Event 27 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.80e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 3.59e-02**

**Frequency: 2.20e-08 /year**

**Mean Social Risk: 7.89e-10 deaths/year**

**Initial Event 27 - Result - Day - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.59e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 3.59e-02**

**Frequency: 9.39e-08 /year**

**Mean Social Risk: 3.37e-09 deaths/year**

**Initial Event 27 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 4.79e-02**

**Frequency: 1.08e-07 /year**

**Mean Social Risk: 5.16e-09 deaths/year**

**Initial Event 27 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 6.38e-02**

**Frequency: 1.16e-07 /year**


**Mean Social Risk: 7.39e-09 deaths/year**

**Initial Event 27 - Result - Night - North (N) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 7.39e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.17e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southeasteast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.25e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.30e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.25e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.55e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.40e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.35e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.70e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.96e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.68e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.40e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.00e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.60e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.00e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.19e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.30e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 27 - Result - Day - Southsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.19e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.80e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.20e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.59e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.39e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.08e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.39e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 27 - Result - Night - Northeastnorth (NEN) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.17e-06 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Northeast (NE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.10e-06 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Northeasteast (NEE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 5.00e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - East (E) - Indoor**  
Deaths: 0.00e+00  
Frequency: 5.00e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Southeasteast (SEE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 6.49e-08 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Southeast (SE) - Indoor**  
Deaths: 0.00e+00  
Frequency: 1.25e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Southeastsouth (SES) - Indoor**  
Deaths: 0.00e+00  
Frequency: 2.30e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - South (S) - Indoor**  
Deaths: 0.00e+00  
Frequency: 3.25e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 27 - Result - Night - Southwestsouth (SWS) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 1.55e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.40e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.35e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.70e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 27 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.48e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 2.34e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.20e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.99e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - East (E) - Outdoor**  
**Deaths: 3.99e-03**  
**Frequency: 9.99e-09 /year**  
**Mean Social Risk: 3.98e-11 deaths/year**

**Initial Event 28 - Result - Day - Southeast (SEE) - Outdoor**  
**Deaths: 3.99e-02**  
**Frequency: 1.30e-07 /year**  
**Mean Social Risk: 5.18e-09 deaths/year**

**Initial Event 28 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.50e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 2.39e-02**  
**Frequency: 4.60e-07 /year**  
**Mean Social Risk: 1.10e-08 deaths/year**

**Initial Event 28 - Result - Day - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.49e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 2.39e-02**  
**Frequency: 3.10e-07 /year**

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**Mean Social Risk: 7.41e-09 deaths/year**

**Initial Event 28 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.90e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 3.99e-02**

**Frequency: 1.10e-07 /year**

**Mean Social Risk: 4.38e-09 deaths/year**

**Initial Event 28 - Result - Day - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.70e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.39e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 3.19e-02**

**Frequency: 5.79e-07 /year**

**Mean Social Risk: 1.85e-08 deaths/year**

**Initial Event 28 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.70e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.84e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 28 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.49e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.50e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.50e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.25e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.24e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.15e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.74e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 28 - Result - Night - Southwest (SW) - Outdoor**

Deaths: 0.00e+00

Frequency: 4.75e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Night - Southwestwest (SWW) - Outdoor**

Deaths: 0.00e+00

Frequency: 2.75e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Night - West (W) - Outdoor**

Deaths: 0.00e+00

Frequency: 6.99e-07 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Night - Northwestwest (NWW) - Outdoor**

Deaths: 0.00e+00

Frequency: 1.17e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Night - Northwest (NW) - Outdoor**

Deaths: 0.00e+00

Frequency: 1.35e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Night - Northwestnorth (NWN) - Outdoor**

Deaths: 0.00e+00

Frequency: 1.45e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Day - North (N) - Indoor**

Deaths: 0.00e+00

Frequency: 1.48e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Day - Northeastnorth (NEN) - Indoor**

Deaths: 0.00e+00

Frequency: 2.34e-06 /year

Mean Social Risk: 0.00e+00 deaths/year

**Initial Event 28 - Result - Day - Northeast (NE) - Indoor**

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Deaths: 0.00e+00  
Frequency: 2.20e-06 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - Northeast (NEE) - Indoor  
Deaths: 0.00e+00  
Frequency: 9.99e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - East (E) - Indoor  
Deaths: 0.00e+00  
Frequency: 9.99e-09 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - Southeast (SEE) - Indoor  
Deaths: 0.00e+00  
Frequency: 1.30e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - Southeast (SE) - Indoor  
Deaths: 0.00e+00  
Frequency: 2.50e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - Southeastsouth (SES) - Indoor  
Deaths: 0.00e+00  
Frequency: 4.60e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - South (S) - Indoor  
Deaths: 0.00e+00  
Frequency: 6.49e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year


Initial Event 28 - Result - Day - Southwestsouth (SWS) - Indoor  
Deaths: 0.00e+00  
Frequency: 3.10e-07 /year  
Mean Social Risk: 0.00e+00 deaths/year

Initial Event 28 - Result - Day - Southwest (SW) - Indoor  
Deaths: 0.00e+00

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**Frequency: 1.90e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.80e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.70e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.39e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.79e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.70e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.84e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.49e-06 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northeast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.50e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.50e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.25e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.24e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.15e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.62e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.74e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 28 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.75e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.99e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.17e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.35e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 28 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.45e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - North (N) - Outdoor**  
**Deaths: 1.75e-01**  
**Frequency: 1.66e-08 /year**  
**Mean Social Risk: 2.91e-09 deaths/year**

**Initial Event 29 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 1.52e-01**  
**Frequency: 2.62e-08 /year**  
**Mean Social Risk: 3.97e-09 deaths/year**

**Initial Event 29 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 1.56e-01**  
**Frequency: 2.46e-08 /year**  
**Mean Social Risk: 3.83e-09 deaths/year**

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**Initial Event 29 - Result - Day - Northeast (NEE) - Outdoor**

**Deaths: 1.79e-01**

**Frequency: 1.12e-10 /year**

**Mean Social Risk: 2.01e-11 deaths/year**

**Initial Event 29 - Result - Day - East (E) - Outdoor**

**Deaths: 1.95e-01**

**Frequency: 1.12e-10 /year**

**Mean Social Risk: 2.19e-11 deaths/year**

**Initial Event 29 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 1.32e-01**

**Frequency: 1.45e-09 /year**

**Mean Social Risk: 1.91e-10 deaths/year**

**Initial Event 29 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 1.67e-01**

**Frequency: 2.80e-09 /year**

**Mean Social Risk: 4.68e-10 deaths/year**

**Initial Event 29 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 1.56e-01**

**Frequency: 5.15e-09 /year**

**Mean Social Risk: 8.00e-10 deaths/year**

**Initial Event 29 - Result - Day - South (S) - Outdoor**

**Deaths: 1.16e-01**

**Frequency: 7.27e-09 /year**

**Mean Social Risk: 8.41e-10 deaths/year**

**Initial Event 29 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 1.52e-01**

**Frequency: 3.47e-09 /year**

**Mean Social Risk: 5.26e-10 deaths/year**

**Initial Event 29 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 1.67e-01**

**Frequency: 2.13e-09 /year**

**Mean Social Risk: 3.56e-10 deaths/year**

**Initial Event 29 - Result - Day - Southwestwest (SWW) - Outdoor**

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**Deaths: 1.08e-01**  
**Frequency: 1.23e-09 /year**  
**Mean Social Risk: 1.33e-10 deaths/year**

**Initial Event 29 - Result - Day - West (W) - Outdoor**  
**Deaths: 1.91e-01**  
**Frequency: 3.13e-09 /year**  
**Mean Social Risk: 6.00e-10 deaths/year**

**Initial Event 29 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 1.60e-01**  
**Frequency: 5.26e-09 /year**  
**Mean Social Risk: 8.39e-10 deaths/year**

**Initial Event 29 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 1.24e-01**  
**Frequency: 6.04e-09 /year**  
**Mean Social Risk: 7.47e-10 deaths/year**

**Initial Event 29 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 1.52e-01**  
**Frequency: 6.49e-09 /year**  
**Mean Social Risk: 9.83e-10 deaths/year**


**Initial Event 29 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.14e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.55e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.15e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 2.80e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.80e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.64e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.99e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.29e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.82e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.67e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.31e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.08e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - West (W) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.83e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwestwest (NWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.31e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwest (NW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.51e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.62e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.66e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.62e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.46e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.12e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 29 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.12e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.45e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.15e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.27e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.47e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.13e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**


**Frequency: 1.23e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 29 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.13e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.26e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.04e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.49e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.14e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.55e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.15e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.80e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - East (E) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.80e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.64e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.99e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.29e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.82e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.67e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.31e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 7.83e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.31e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.51e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 29 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.62e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - North (N) - Outdoor**  
**Deaths: 5.18e-02**  
**Frequency: 6.51e-07 /year**  
**Mean Social Risk: 3.37e-08 deaths/year**

**Initial Event 30 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 1.16e-01**  
**Frequency: 1.03e-06 /year**  
**Mean Social Risk: 1.19e-07 deaths/year**

**Initial Event 30 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 1.40e-01**  
**Frequency: 9.67e-07 /year**  
**Mean Social Risk: 1.35e-07 deaths/year**

**Initial Event 30 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 1.32e-01**  
**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 5.78e-10 deaths/year**

**Initial Event 30 - Result - Day - East (E) - Outdoor**  
**Deaths: 4.39e-02**  
**Frequency: 4.40e-09 /year**

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**Mean Social Risk: 1.93e-10 deaths/year**

**Initial Event 30 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 1.56e-01**

**Frequency: 5.71e-08 /year**

**Mean Social Risk: 8.89e-09 deaths/year**

**Initial Event 30 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 1.32e-01**

**Frequency: 1.10e-07 /year**

**Mean Social Risk: 1.45e-08 deaths/year**

**Initial Event 30 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 1.24e-01**

**Frequency: 2.02e-07 /year**

**Mean Social Risk: 2.50e-08 deaths/year**

**Initial Event 30 - Result - Day - South (S) - Outdoor**

**Deaths: 1.48e-01**

**Frequency: 2.86e-07 /year**

**Mean Social Risk: 4.22e-08 deaths/year**

**Initial Event 30 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 1.75e-01**

**Frequency: 1.36e-07 /year**

**Mean Social Risk: 2.39e-08 deaths/year**

**Initial Event 30 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 1.44e-01**

**Frequency: 8.35e-08 /year**

**Mean Social Risk: 1.20e-08 deaths/year**

**Initial Event 30 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 1.28e-01**

**Frequency: 4.84e-08 /year**

**Mean Social Risk: 6.17e-09 deaths/year**

**Initial Event 30 - Result - Day - West (W) - Outdoor**

**Deaths: 1.56e-01**

**Frequency: 1.23e-07 /year**

**Mean Social Risk: 1.91e-08 deaths/year**

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**Initial Event 30 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 1.79e-01**  
**Frequency: 2.07e-07 /year**  
**Mean Social Risk: 3.71e-08 deaths/year**

**Initial Event 30 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 1.44e-01**  
**Frequency: 2.37e-07 /year**  
**Mean Social Risk: 3.41e-08 deaths/year**

**Initial Event 30 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 1.40e-01**  
**Frequency: 2.55e-07 /year**  
**Mean Social Risk: 3.56e-08 deaths/year**

**Initial Event 30 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.63e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.57e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.42e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeasteast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 30 - Result - Night - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.43e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.14e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.41e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwest (SW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.09e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwestwest (SWW) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.21e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - West (W) - Outdoor**


**Deaths: 0.00e+00**

**Frequency: 3.08e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northwestwest (NWW) - Outdoor**

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**Deaths: 0.00e+00**  
**Frequency: 5.16e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.93e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.37e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.51e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.03e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.67e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.40e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 5.71e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.02e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.86e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.36e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.35e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.84e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.23e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.07e-07 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.37e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.55e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.63e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.57e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.42e-06 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.43e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 30 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.75e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.05e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.14e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.41e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.09e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.21e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.08e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.16e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 30 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 5.93e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 30 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.37e-07 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 31 - Result - Day - Outdoor**

**Deaths: 2.96e-01**

**Frequency: 1.20e-08 /year**

**Mean Social Risk: 3.55e-09 deaths/year**

**Initial Event 31 - Result - Night - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.00e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 31 - Result - Day - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.20e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 31 - Result - Night - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.00e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 32 - Result - Day - Outdoor**

**Deaths: 3.48e-03**

**Frequency: 3.64e-10 /year**

**Mean Social Risk: 1.27e-12 deaths/year**

**Initial Event 32 - Result - Night - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 9.10e-10 /year**


**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 32 - Result - Day - Indoor**

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	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Deaths: 0.00e+00**  
**Frequency: 3.64e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 32 - Result - Night - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.10e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 33 - Result - Day - Outdoor**  
**Deaths: 2.86e-04**  
**Frequency: 3.36e-06 /year**  
**Mean Social Risk: 9.60e-10 deaths/year**

**Initial Event 33 - Result - Night - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.40e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 33 - Result - Day - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.36e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 33 - Result - Night - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.40e-06 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 34 - Result - Day - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.36e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 34 - Result - Night - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.40e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 34 - Result - Day - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.36e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 34 - Result - Night - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.40e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 35 - Result - Day - Outdoor**  
**Deaths: 5.57e-01**  
**Frequency: 1.16e-09 /year**  
**Mean Social Risk: 6.47e-10 deaths/year**

**Initial Event 35 - Result - Night - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 35 - Result - Day - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.16e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 35 - Result - Night - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.90e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northeast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 4.85e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 36 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 2.24e+02**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - West (W) - Outdoor**

**Deaths: 3.94e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 3.03e+01**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 2.34e+01**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northeastnorth (NEN) - Outdoor**


**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 36 - Result - Night - Northeast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - South (S) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwestsouth (SWS) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwest (SW) - Outdoor**


**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwestwest (SWW) - Outdoor**

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**Deaths: 1.34e-02**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 36 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Day - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - North (N) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northeastnorth (NEN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northeast (NE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northeasteast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 36 - Result - Night - East (E) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeasteast (SEE) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - South (S) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwest (SW) - Indoor**


**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**  
**Frequency: 0.00e+00 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 36 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 36 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 38 - Result - Day - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 38 - Result - Night - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 38 - Result - Day - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 38 - Result - Night - Indoor**

**Deaths: 0.00e+00**

**Frequency: 0.00e+00 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - North (N) - Outdoor**

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**Deaths: 2.94e+01**  
**Frequency: 1.01e-08 /year**  
**Mean Social Risk: 2.95e-07 deaths/year**

**Initial Event 39 - Result - Day - Northeastnorth (NEN) - Outdoor**  
**Deaths: 2.37e+01**  
**Frequency: 1.59e-08 /year**  
**Mean Social Risk: 3.77e-07 deaths/year**

**Initial Event 39 - Result - Day - Northeast (NE) - Outdoor**  
**Deaths: 2.54e+01**  
**Frequency: 1.49e-08 /year**  
**Mean Social Risk: 3.80e-07 deaths/year**

**Initial Event 39 - Result - Day - Northeasteast (NEE) - Outdoor**  
**Deaths: 1.78e+01**  
**Frequency: 6.79e-11 /year**  
**Mean Social Risk: 1.21e-09 deaths/year**

**Initial Event 39 - Result - Day - East (E) - Outdoor**  
**Deaths: 1.08e+01**  
**Frequency: 6.79e-11 /year**  
**Mean Social Risk: 7.37e-10 deaths/year**

**Initial Event 39 - Result - Day - Southeasteast (SEE) - Outdoor**  
**Deaths: 7.09e+00**  
**Frequency: 8.83e-10 /year**  
**Mean Social Risk: 6.26e-09 deaths/year**

**Initial Event 39 - Result - Day - Southeast (SE) - Outdoor**  
**Deaths: 4.94e+00**  
**Frequency: 1.70e-09 /year**  
**Mean Social Risk: 8.38e-09 deaths/year**

**Initial Event 39 - Result - Day - Southeastsouth (SES) - Outdoor**  
**Deaths: 1.03e+01**  
**Frequency: 3.12e-09 /year**  
**Mean Social Risk: 3.22e-08 deaths/year**

**Initial Event 39 - Result - Day - South (S) - Outdoor**  
**Deaths: 3.00e+01**

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**Frequency: 4.42e-09 /year**  
**Mean Social Risk: 1.32e-07 deaths/year**

**Initial Event 39 - Result - Day - Southwestsouth (SWS) - Outdoor**  
**Deaths: 3.57e+02**  
**Frequency: 2.11e-09 /year**  
**Mean Social Risk: 7.52e-07 deaths/year**

**Initial Event 39 - Result - Day - Southwest (SW) - Outdoor**  
**Deaths: 6.90e+02**  
**Frequency: 1.29e-09 /year**  
**Mean Social Risk: 8.91e-07 deaths/year**

**Initial Event 39 - Result - Day - Southwestwest (SWW) - Outdoor**  
**Deaths: 9.00e+02**  
**Frequency: 7.47e-10 /year**  
**Mean Social Risk: 6.73e-07 deaths/year**

**Initial Event 39 - Result - Day - West (W) - Outdoor**  
**Deaths: 6.32e+02**  
**Frequency: 1.90e-09 /year**  
**Mean Social Risk: 1.20e-06 deaths/year**

**Initial Event 39 - Result - Day - Northwestwest (NWW) - Outdoor**  
**Deaths: 5.85e+01**  
**Frequency: 3.19e-09 /year**  
**Mean Social Risk: 1.87e-07 deaths/year**

**Initial Event 39 - Result - Day - Northwest (NW) - Outdoor**  
**Deaths: 6.24e+01**  
**Frequency: 3.67e-09 /year**  
**Mean Social Risk: 2.29e-07 deaths/year**

**Initial Event 39 - Result - Day - Northwestnorth (NWN) - Outdoor**  
**Deaths: 5.45e+01**  
**Frequency: 3.94e-09 /year**  
**Mean Social Risk: 2.15e-07 deaths/year**

**Initial Event 39 - Result - Night - North (N) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.51e-08 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.97e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeast (NE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.74e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeasteast (NEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.70e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - East (E) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 1.70e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeasteast (SEE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.21e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeast (SE) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 4.25e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeastsouth (SES) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 7.81e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - South (S) - Outdoor**

**Deaths: 1.62e-03**

**Frequency: 1.10e-08 /year**

**Mean Social Risk: 1.79e-11 deaths/year**

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**Initial Event 39 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 5.45e-02**  
**Frequency: 5.26e-09 /year**  
**Mean Social Risk: 2.87e-10 deaths/year**

**Initial Event 39 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 1.10e-01**  
**Frequency: 3.23e-09 /year**  
**Mean Social Risk: 3.56e-10 deaths/year**

**Initial Event 39 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 1.46e-01**  
**Frequency: 1.87e-09 /year**  
**Mean Social Risk: 2.73e-10 deaths/year**

**Initial Event 39 - Result - Night - West (W) - Outdoor**  
**Deaths: 8.68e-02**  
**Frequency: 4.76e-09 /year**  
**Mean Social Risk: 4.13e-10 deaths/year**

**Initial Event 39 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.98e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.17e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 39 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.85e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.01e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 39 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.59e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.49e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Northeasteast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.79e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.79e-11 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southeasteast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.83e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.70e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.12e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.42e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southwestsouth (SWS) - Indoor**

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**Deaths: 0.00e+00**  
**Frequency: 2.11e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.29e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.47e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.90e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Northwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.19e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.67e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.94e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.51e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.97e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.74e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.70e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.70e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.21e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.25e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.81e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.10e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 5.26e-09 /year**

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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 3.23e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Southwestwest (SWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.87e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - West (W) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.76e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northwestwest (NWW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 7.98e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northwest (NW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.17e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 39 - Result - Night - Northwestnorth (NWN) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 9.85e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - North (N) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 9.46e-09 /year**

**Mean Social Risk: 4.15e-10 deaths/year**

**Initial Event 40 - Result - Day - Northeastnorth (NEN) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.50e-08 /year**

**Mean Social Risk: 6.56e-10 deaths/year**

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**Initial Event 40 - Result - Day - Northeast (NE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.41e-08 /year**

**Mean Social Risk: 6.17e-10 deaths/year**

**Initial Event 40 - Result - Day - Northeasteast (NEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 6.39e-11 /year**

**Mean Social Risk: 2.80e-12 deaths/year**

**Initial Event 40 - Result - Day - East (E) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 6.39e-11 /year**

**Mean Social Risk: 2.80e-12 deaths/year**

**Initial Event 40 - Result - Day - Southeasteast (SEE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 8.31e-10 /year**

**Mean Social Risk: 3.65e-11 deaths/year**

**Initial Event 40 - Result - Day - Southeast (SE) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.60e-09 /year**

**Mean Social Risk: 7.01e-11 deaths/year**

**Initial Event 40 - Result - Day - Southeastsouth (SES) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 2.94e-09 /year**

**Mean Social Risk: 1.29e-10 deaths/year**

**Initial Event 40 - Result - Day - South (S) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 4.16e-09 /year**

**Mean Social Risk: 1.82e-10 deaths/year**


**Initial Event 40 - Result - Day - Southwestsouth (SWS) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.98e-09 /year**

**Mean Social Risk: 8.69e-11 deaths/year**

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**Initial Event 40 - Result - Day - Southwest (SW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.21e-09 /year**

**Mean Social Risk: 5.33e-11 deaths/year**

**Initial Event 40 - Result - Day - Southwestwest (SWW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 7.03e-10 /year**

**Mean Social Risk: 3.08e-11 deaths/year**

**Initial Event 40 - Result - Day - West (W) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 1.79e-09 /year**

**Mean Social Risk: 7.85e-11 deaths/year**

**Initial Event 40 - Result - Day - Northwestwest (NWW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.00e-09 /year**

**Mean Social Risk: 1.32e-10 deaths/year**

**Initial Event 40 - Result - Day - Northwest (NW) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.45e-09 /year**

**Mean Social Risk: 1.51e-10 deaths/year**

**Initial Event 40 - Result - Day - Northwestnorth (NWN) - Outdoor**

**Deaths: 4.39e-02**

**Frequency: 3.71e-09 /year**

**Mean Social Risk: 1.63e-10 deaths/year**

**Initial Event 40 - Result - Night - North (N) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 2.37e-08 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northeastnorth (NEN) - Outdoor**

**Deaths: 0.00e+00**

**Frequency: 3.74e-08 /year**


**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northeast (NE) - Outdoor**

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Mar 24, 2016 13:24

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**Deaths: 0.00e+00**  
**Frequency: 3.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northeast (NEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - East (E) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeast (SEE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeast (SE) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeastsouth (SES) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.35e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - South (S) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.04e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**


**Initial Event 40 - Result - Night - Southwestsouth (SWS) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.96e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southwest (SW) - Outdoor**  
**Deaths: 0.00e+00**

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**Frequency: 3.04e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southwestwest (SWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.76e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - West (W) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwestwest (NWW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwest (NW) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.63e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwestnorth (NWN) - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.27e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.46e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.50e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.41e-08 /year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northeast (NEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.39e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - East (E) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 6.39e-11 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Southeast (SEE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 8.31e-10 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Southeast (SE) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.60e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Southeastsouth (SES) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 2.94e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - South (S) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 4.16e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Southwestsouth (SWS) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.98e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Southwest (SW) - Indoor**

**Deaths: 0.00e+00**

**Frequency: 1.21e-09 /year**

**Mean Social Risk: 0.00e+00 deaths/year**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Initial Event 40 - Result - Day - Southwestwest (SWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.03e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.79e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.45e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Day - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.71e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - North (N) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.37e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northeastnorth (NEN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.74e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northeast (NE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.52e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

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**Initial Event 40 - Result - Night - Northeast (NEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - East (E) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.60e-10 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeast (SEE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 2.08e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeast (SE) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.00e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southeastsouth (SES) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.35e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - South (S) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.04e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southwestsouth (SWS) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.96e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southwest (SW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 3.04e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Southwestwest (SWW) - Indoor**

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Deaths: 0.00e+00**  
**Frequency: 1.76e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - West (W) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 4.48e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwestwest (NWW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 7.51e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwest (NW) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 8.63e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 40 - Result - Night - Northwestnorth (NWN) - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 9.27e-09 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 41 - Result - Day - Outdoor**  
**Deaths: 8.50e+00**  
**Frequency: 6.80e-08 /year**  
**Mean Social Risk: 5.78e-07 deaths/year**

**Initial Event 41 - Result - Night - Outdoor**  
**Deaths: 0.00e+00**  
**Frequency: 1.70e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 41 - Result - Day - Indoor**  
**Deaths: 0.00e+00**  
**Frequency: 6.80e-08 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Initial Event 41 - Result - Night - Indoor**  
**Deaths: 0.00e+00**

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 IFC  
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**Frequency: 1.70e-07 /year**  
**Mean Social Risk: 0.00e+00 deaths/year**

**Mean Individual Risks**

==== =====

**Population            Mean Individual Risk**

Population 1	2.84e-07
Population 2	3.06e-06
Population 3	2.65e-06
Population 4	2.73e-09
Population 5	1.07e-08
Population 8	1.77e-07
Population 9	2.78e-08
Population 11	5.33e-07
Population 12	1.11e-08
Population 13	1.10e-08
Population 14	2.28e-09
Population 15	6.08e-09
Population 16	7.40e-09
Population 17	2.97e-09
Population 18	2.95e-09

**End of Results File**  
**Results for Site 'Site 2'**

====  
**Input Data**  
 =====

**Wind Directions**  
 =====

**Wind directions considered: 16**

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**Population Situations**

=====

Population situations considered: 2

Situation: Day

Fraction of time: 1.00e+00

Population Area	Area [m2]	Population	Indoor fraction	Pop. Density [ha/m2]
Population 20	2.46e+05	6.00e+01	0.00	2.44e-04
Population 22	3.46e+04	3.50e+01	0.00	1.01e-03
Population 23	1.59e+05	8.00e+01	0.00	5.04e-04
<b>TOTAL</b>	<b>4.40e+05</b>	<b>1.75e+02</b>		<b>3.98e-04</b>

Wind directions probability:

North (N) : 1.48e-01  
 Northeastnorth (NEN) : 2.34e-01  
 Northeast (NE) : 2.20e-01  
 Northeasteast (NEE) : 1.00e-03  
 East (E) : 1.00e-03  
 Southeasteast (SEE) : 1.30e-02  
 Southeast (SE) : 2.50e-02  
 Southeastsouth (SES) : 4.60e-02  
 South (S) : 6.50e-02  
 Southwestsouth (SWS) : 3.10e-02  
 Southwest (SW) : 1.90e-02  
 Southwestwest (SWW) : 1.10e-02  
 West (W) : 2.80e-02  
 Northwestwest (NWW) : 4.70e-02  
 Northwest (NW) : 5.40e-02  
 Northwestnorth (NWN) : 5.80e-02

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Situation: Night

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Fraction of time: 1.00e+00

Population Area	Area [m2]	Population	Indoor fraction	Pop. Density [ha/m2]
Population 20	2.46e+05	2.00e+01	0.00	8.12e-05
Population 22	3.46e+04	0.00e+00	0.00	0.00e+00
Population 23	1.59e+05	2.00e+01	0.00	1.26e-04
<b>TOTAL</b>	<b>4.40e+05</b>	<b>4.00e+01</b>		<b>9.10e-05</b>

Wind directions probability:

North (N) : 1.48e-01  
 Northeastnorth (NEN) : 2.34e-01  
 Northeast (NE) : 2.20e-01  
 Northeasteast (NEE) : 1.00e-03  
 East (E) : 1.00e-03  
 Southeasteast (SEE) : 1.30e-02  
 Southeast (SE) : 2.50e-02  
 Southeastsouth (SES) : 4.60e-02  
 South (S) : 6.50e-02  
 Southwestsouth (SWS) : 3.10e-02  
 Southwest (SW) : 1.90e-02  
 Southwestwest (SWW) : 1.10e-02  
 West (W) : 2.80e-02  
 Northwestwest (NWW) : 4.70e-02  
 Northwest (NW) : 5.40e-02  
 Northwestnorth (NWN) : 5.80e-02

Events

=====

Initial Event 42

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Description:

S6C.JF

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<b>ABS Group</b>	<b>REPORT</b>	<b>Nº</b>	<b>2016-6708-VP</b>
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**Simulation applicable to all situations**  
**Frequency: 1.80e-05 /year**

**Type: Jet Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00059**

**Exposure factor for Day situation: 0.0700**  
**Exposure factor for Night situation: 0.0100**

**Initial Event 43**  
-----

**Description:**  
**S10.FF**

**Simulation applicable to all situations**  
**Frequency: 2.50e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00010**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 44**  
-----

**Description:**  
**S7A**

**Simulation applicable to all situations**  
**Frequency: 1.10e-05 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00050**

**Exposure factor for Day situation: 0.9300**  
**Exposure factor for Night situation: 0.9900**

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**Initial Event 45**  
-----

**Description:**  
**S7B.FF**

**Simulation applicable to all situations**  
**Frequency: 2.80e-07 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00022**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 46**  
-----

**Description:**  
**S7B.JET.FIRE**

**Simulation applicable to all situations**  
**Frequency: 3.60e-07 /year**

**Type: Jet Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00060**

**Exposure factor for Day situation: 0.0700**  
**Exposure factor for Night situation: 0.0100**

**Initial Event 47**  
-----

**Description:**  
**S8B.VCE**

**Simulation applicable to all situations**

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IFC  
Mar 24, 2016 13:24

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**Frequency: 3.50e-07 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00049**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 48**

**Description:**  
**S8A.FF**

**Simulation applicable to all situations**  
**Frequency: 1.10e-05 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00011**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 49**

**Description:**  
**S8A.JF**

**Simulation applicable to all situations**  
**Frequency: 9.00e-06 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00049**

**Exposure factor for Day situation: 0.0700**  
**Exposure factor for Night situation: 0.0100**

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**Initial Event 50**

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-----  
**Description:**  
**S8A.VCE**

**Simulation applicable to all situations**  
**Frequency: 4.90e-06 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00050**

**Exposure factor for Day situation: 0.9300**  
**Exposure factor for Night situation: 0.9900**

**Initial Event 51**  
-----

**Description:**  
**S8B.FF**

**Simulation applicable to all situations**  
**Frequency: 1.40e-07 /year**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00023**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 52**  
-----

**Description:**  
**S8B.JET.FIRE**

**Simulation applicable to all situations**  
**Frequency: 1.80e-07 /year**

**Type: Jet Fire**

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TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00062

Exposure factor for Day situation: 0.0700  
Exposure factor for Night situation: 0.0100

**Initial Event 53**

-----

Description:  
S8B.VCE

Simulation applicable to all situations  
Frequency: 1.80e-07 /year

Type: Explosion (Multi-Energy)

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00052

Exposure factor for Day situation: 1.0000  
Exposure factor for Night situation: 1.0000

**Initial Event 54**

-----

Description:  
S9A.FF

Simulation applicable to all situations  
Frequency: 3.40e-06 /year

TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00012

Exposure factor for Day situation: 1.0000  
Exposure factor for Night situation: 1.0000

**Initial Event 55**

-----

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**Description:**  
**S9A**

**Simulation applicable to all situations**  
**Frequency: 2.43e-06 /year**

**Type: Jet Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00064**

**Exposure factor for Day situation: 0.0700**  
**Exposure factor for Night situation: 0.0100**

**Initial Event 56**  
-----

**Description:**  
**S9A.VCE**

**Simulation applicable to all situations**  
**Frequency: 1.40e-06 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00053**

**Exposure factor for Day situation: 0.9700**  
**Exposure factor for Night situation: 0.9900**

**Initial Event 57**  
-----

**Description:**  
**S9B.FF**

**Simulation applicable to all situations**  
**Frequency: 3.40e-08 /year**

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**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00024**

**Exposure factor for Day situation: 1.0000**  
**Exposure factor for Night situation: 1.0000**

**Initial Event 58**  
-----

**Description:**  
**S9B**

**Simulation applicable to all situations**  
**Frequency: 2.50e-08 /year**

**Type: Jet Fire**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00063**

**Exposure factor for Day situation: 0.0700**  
**Exposure factor for Night situation: 0.0100**

**Initial Event 59**  
-----

**Description:**  
**S9B.VCE**

**Simulation applicable to all situations**  
**Frequency: 1.40e-08 /year**

**Type: Explosion (Multi-Energy)**

**TRACE File: C:\SAFER Trace\Projects\Project11\CaseRuns\00054**

**Exposure factor for Day situation: 0.9300**  
**Exposure factor for Night situation: 0.9900**

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<b>REPORT</b>		<b>Nº</b>	<b>2016-6708-VP</b>
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=====  
**Output Data**  
=====

**Listing of accidents:**

**Mean Individual Risks**

==== =====

**End of Results File**

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