Annex 5F

Frequency Analysis

5F FREQUENCY ANALYSIS

This *Annex* summarises the frequency analysis as follows:

- ***Section 5F.1*** – Frequency Analysis for Marine Transit of the LNGC and FSRU Vessel to the LNG Terminal;
- ***Section 5F.2*** – Frequency Analysis for the LNG Terminal;
- ***Section 5F.3*** –Frequency Analysis for the Subsea Pipelines; and
- ***Section 5F.4*** –Frequency Analysis for the GRS at the BPPS and LPS.

5F.1 FREQUENCY ANALYSIS FOR MARINE TRANSIT OF THE LNGC AND FSRU VESSEL TO THE LNG TERMINAL

5F.1.1 Ship Collision Frequency

The ship collision frequency analysis was conducted following the approach adopted under the previous EIA study that was approved by the EPD [(1)]. DYMTRI (Dynamic Marine Traffic simulation) model [(2)] was adopted as the platform for the traffic simulation to predict the collision and grounding frequencies along the LNGC and FSRU Vessel transit route. The details of the ship collision frequency assessment are provided in the Marine Traffic Impact Assessment Report [(2)].

The key steps associated with the assessment, include:

- Identification of Modelled Traffic – All vessel activity associated with ships with Length (LOA) greater than 75 m and transits within 2.5 km of the LNGC route were included in the marine traffic model that contains database of radar and AIS records collected during 2016. Traffic data were organized into a series of representative routes with a variety of ship classes;
- Hazard Identification – The distribution of historical collision incidents was mapped for Hong Kong waters for a six (6) year period from 2008 to 2013;
- Model Validation – The model was run for the 2016 traffic activity and the linkage between model output of "encounters" and historic collisions along the proposed route waterspace confirmed.
- Traffic Forecasts – An extensive forecasting exercise was conducted based on various principal sources including Hong Kong, Mainland Port and ShenZhen West Port statistics data. The increase in traffic volume was

(1) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(2) BMT Asia Pacific Limited, Hong Kong Offshore LNG Terminal Marine Impact Assessment, R.9331.08, Issue 1.

derived by trend analysis for each vessel class so that a representative pattern could be developed for the 2020 and 2030 timeframes ;

- Scenario Development – A series of scenarios were developed to examine traffic activity at 2016 (baseline) and 2020 and 2030. The scenarios adopted for consequence examination were those that considered the initial operation of the terminal in 2020, and a span of traffic for 2030.

- Collision Frequency Assessment – The DYMITRI model was run for all scenarios with the LNGC/ FSRU Vessel introduced into the simulation in order to ensure that transits were conducted across the full spectrum of daylight arrivals, and providing the LNGC/ FSRU Vessel the opportunity to interact with all ships within the traffic "mix". The following data was output:

  - Anticipated collision location and timing; and

  - Vessel details, including route and vessel class identifier, vessel speed at point that avoidance maneuver is initiated, and vessel headings and encounter type (i.e. Overtaking, Crossing, or Headings).

- The collision data was then processed and the encounter data was rationalized and the total collision frequency identified on a per transit basis, for each individual route segments.

- Collision Energy Distribution – Having identified the collision frequency associated with the LNGC/ FSRU Vessel transit it was then necessary to characterize the collision energy associated with each encounter. The detailed data extracted for key scenarios took account of

  - The colliding vessel's displacement (assuming an upper-bound envelope of vessel size);

  - The potential for the vessels to collide at a series of angles deviated from the initial encounter angle;

  - Impact energy absorbed by the colliding vessel during collision with the double hulled LNGC/ FSRU Vessel;

  - Nominal reduction in speed by the colliding vessel prior to impact; and

  - Perpendicular penetration energy component into the LNGC/FSRU Vessel hull.

The total collision frequencies leading to breach of LNG containment [1] are provided in ***Table 5F.1***, ***Table 5F.2*** and ***Table 5F.3***.

(1) BMT Asia Pacific Limited, Hong Kong Offshore LNG Terminal Marine Impact Assessment, R.9331.08, Issue 1.

Table 5F.1 ***Total Ship Collision Frequency Leading to Loss of Containment of LNG (Year 2020)***

Type of Vessel	Total Release Frequency in Sub-Segment "a" (/year/m)	Total Release Frequency in Sub-Segment "b" (/year/m)
Small LNGC	1.6×10^{-8}	1.5×10^{-9}
Large LNGC	1.6×10^{-8}	1.5×10^{-9}

Table 5F.2 ***Total Ship Collision Frequency Leading to Loss of Containment of LNG (Year 2030)***

Type of Vessel	Total Release Frequency in Sub-Segment "a" (/year/m)	Total Release Frequency in Sub-Segment "b" (/year/m)
Small LNGC	1.7×10^{-8}	4.9×10^{-10}
Large LNGC	1.8×10^{-8}	5.2×10^{-10}

Table 5F.3 ***Ship Collision Frequency Leading to Breach of LNG Containment from the FSRU Vessel during the Initial Transit***

Type of Vessel	Total Release Frequency in Sub-Segment "a" (/year/m)	Total Release Frequency in Sub-Segment "b" (/year/m)
FSRU Vessel (Initial Transit in Year 2020)	2.2×10^{-10}	2.0×10^{-11}

5F.1.2 *Grounding Frequency*

Since no grounding incident was observed along the LNGC/ FSRU Vessel transit route in history, the grounding frequency in Ma Wan (1) (i.e. 0.556 per year) was conservatively used as a benchmark to represent the grounding frequency along the LNGC/ FSRU Vessel transit route. ***Table 5F.4** and **Table 5F.5*** below present the grounding frequency and grounding release frequency adopted in the QRA Study respectively.

Table 5F.4 ***Grounding Frequency (1)***

Node	Section Length (km)	Annual Transit (1)	Grounding Frequency (2) (/year)	Grounding Frequency (/km/year)	Grounding Frequency (/km/transit)
Urmston, Ma Wan to East Lamma area	70	12,800	0.556	7.9×10^{-3}	6.2×10^{-7}

Note:
(1): The annual transit number was calculated, considering that there are 70 daily transits related to Urmston, Ma Wan to East Lamma area; and the % of vessels with LOA greater than 200 m is 50%.
(2): 5 ocean-going vessel grounding incident happened over 9 years (2008-2016) in this node.

Table 5F.5 Grounding Release Frequency for LNGC and FSRU Vessel

Type of Vessel	Grounding Frequency (/km/transit)	LNG Transits (/year)	Grounding Frequency (/km/year)	Grounding Release Frequency (1) (/km/year)
Small/ Large LNGC	6.2×10^{-7}	75	4.7×10^{-5}	1.2×10^{-6}

Note:
(1): A conditional probability of 0.025 was applied to calculate the LNG release frequency upon grounding events, as per the approved EIA Report.

The initial transit of the FSRU vessel to the LNG Terminal was also considered in the QRA Study. The associated grounding frequency was adopted as 6.2×10^{-7} per km along the transit route.

5F.1.3 *Ignition Probability*

As per the previous EIA Report that was approved by the EPD (1), the immediate ignition probability for the collision scenarios was selected as 0.8; and the immediate ignition probability for the grounding scenarios was selected as 0.2 for the QRA Study.

5F.1.4 *Event Tree Analysis*

The LNG release frequencies upon ship collision and grounding events were calculated as illustrated in the above section. An event tree analysis, as shown in ***Figure 5F.1***, was then conducted to calculate the hazardous scenario frequency with consideration of the ignition probability, as shown in ***Table 5F.6*** to ***Table 5F.8***.

Table 5F.6 Hazardous Scenario Frequency due to Collision Events (Year 2020)

Type of Vessel	Hole Size	Hazardous Scenario Frequency in Sub-Segment "a" (/year/m)		Hazardous Scenario Frequency in Sub-Segment "b" (/year/m)	
		Pool Fire	Flash Fire	Pool Fire	Flash Fire
Small LNGC	Small	3.3×10^{-12}	4.1×10^{-13}	1.1×10^{-10}	1.4×10^{-11}
Small LNGC	Medium	3.3×10^{-9}	4.1×10^{-10}	2.2×10^{-10}	2.8×10^{-11}
Small LNGC	Large	5.2×10^{-9}	6.5×10^{-10}	4.6×10^{-10}	5.8×10^{-11}
Large LNGC	Small	1.6×10^{-12}	2.0×10^{-13}	5.4×10^{-13}	6.8×10^{-14}
Large LNGC	Medium	8.5×10^{-11}	1.1×10^{-11}	4.2×10^{-10}	4.2×10^{-11}
Large LNGC	Large	8.4×10^{-9}	1.0×10^{-9}	5.8×10^{-10}	5.8×10^{-11}
FSRU Vessel*	Small	2.2×10^{-14}	2.7×10^{-15}	7.2×10^{-15}	9.0×10^{-16}
FSRU Vessel*	Medium	1.1×10^{-12}	1.4×10^{-13}	4.4×10^{-12}	5.6×10^{-13}
FSRU Vessel*	Large	1.1×10^{-10}	1.4×10^{-11}	6.2×10^{-12}	7.7×10^{-13}

*Note: The initial transit of FSRU Vessel to the LNG Terminal was considered.

Table 5F.7 Hazardous Scenario Frequency due to Collision Events (Year 2030)

Type of Vessel	Hole Size	Hazardous Scenario Frequency in Sub-Segment "a" (/year/m)		Hazardous Scenario Frequency in Sub-Segment "b" (/year/m)	
		Pool Fire	**Flash Fire**	**Pool Fire**	**Flash Fire**
Small LNGC	Small	1.0×10^{-10}	2.5×10^{-11}	1.5×10^{-11}	3.7×10^{-12}
Small LNGC	Medium	5.2×10^{-10}	1.3×10^{-10}	1.2×10^{-10}	2.9×10^{-11}
Small LNGC	Large	8.4×10^{-9}	2.1×10^{-9}	1.3×10^{-10}	3.1×10^{-11}
Large LNGC	Small	1.4×10^{-10}	1.7×10^{-11}	1.5×10^{-11}	3.7×10^{-12}
Large LNGC	Medium	3.7×10^{-10}	4.6×10^{-11}	1.3×10^{-10}	3.3×10^{-11}
Large LNGC	Large	8.7×10^{-9}	1.1×10^{-9}	1.3×10^{-10}	3.2×10^{-11}

Table 5F.8 Hazardous Scenario Frequency due to Grounding Events

Type of Vessel	Hole Size	Hazardous Scenario Frequency (/year/m)	
		Pool Fire	**Flash Fire**
Small/ Large LNGC	Small	9.3×10^{-7}	1.2×10^{-7}

5F.2 FREQUENCY ANALYSIS FOR THE LNG TERMINAL

5F.2.1 *Release Frequency Database*

Historical database from the International Association of Oil and Gas Producers (OGP) (1) was adopted in the QRA Study for estimating the release frequency of hazardous scenarios in the LNG Terminal. The primary source of OGP data is the Hydrocarbon Release Database (HCRD) form UK HSE, which is based on approximately 4,000 recorded leaks recorded between October 1992 and March 2010 from UK section of the North Sea. Considering that the LNG Terminal is located in an offshore environment in Hong Kong, this database was considered adequate for the purpose of the QRA Study. The release frequencies of various equipment items are summarised in ***Table 5F.9***.

For the unloading arm sections, the associated failure frequency suggested by UK HSE (2) was adopted. The following causes of unloading arm failure have been taken into account in the failure frequency:

- Connection failures (arm and coupler);
- Operator error;
- Mooring fault; and
- Impact from passing ships.

(1) OGP, *Risk Assessment Data Directly, Report No. 434-.1*, March 2010.

(2) UK HSE, Failure Rate and Event Data for use within Risk Assessment, 28 June 2012.

Table 5F.9 Release Frequency

Equipment	Release Scenario	Release Phase	Release Frequency	Unit	Reference
Piping 2″ to 6″	10 mm hole	Liquid/ Gas	3.45E-05	per metre per year	OGP
	25 mm hole	Liquid/ Gas	2.70E-06	per metre per year	OGP
	50 mm hole	Liquid/ Gas	6.00E-07	per metre per year	OGP
Piping 8″ to 12″	10 mm hole	Liquid/ Gas	3.06E-05	per metre per year	OGP
	25 mm hole	Liquid/ Gas	2.40E-06	per metre per year	OGP
	50 mm hole	Liquid/ Gas	3.70E-07	per metre per year	OGP
	>150 mm hole	Liquid/ Gas	1.70E-07	per metre per year	OGP
Piping 14″ to 18″	10 mm hole	Liquid/ Gas	3.05E-05	per metre per year	OGP
	25 mm hole	Liquid/ Gas	2.40E-06	per metre per year	OGP
	50 mm hole	Liquid/ Gas	3.60E-07	per metre per year	OGP
	>150 mm hole	Liquid/ Gas	1.70E-07	per metre per year	OGP
Piping 20″ to 24″	10 mm hole	Liquid/ Gas	3.04E-05	per metre per year	OGP
	25 mm hole	Liquid/ Gas	2.40E-06	per metre per year	OGP
	50 mm hole	Liquid/ Gas	3.60E-07	per metre per year	OGP
	>150 mm hole	Liquid/ Gas	1.60E-07	per metre per year	OGP
Piping 26″ to 48″	10 mm hole	Liquid/ Gas	3.04E-05	per metre per year	OGP
	25 mm hole	Liquid/ Gas	2.30E-06	per metre per year	OGP
	50 mm hole	Liquid/ Gas	3.60E-07	per metre per year	OGP
	>150 mm hole	Liquid/ Gas	1.60E-07	per metre per year	OGP
Pressure Vessel - Large Connection (> 6″)	10 mm hole	Liquid/ Gas	5.90E-04	per year	OGP
	25 mm hole	Liquid/ Gas	1.00E-04	per year	OGP
	50 mm hole	Liquid/ Gas	2.70E-05	per year	OGP
	>150 mm hole	Liquid/ Gas	2.40E-05	per year	OGP
Pump Centrifugal - Small Connection (up to 6″)	10 mm hole	Liquid	4.40E-03	per year	OGP
	25 mm hole	Liquid	2.90E-04	per year	OGP
	50 mm hole	Liquid	5.40E-05	per year	OGP
Pump Centrifugal - Large Connection (> 6″)	10 mm hole	Liquid	4.40E-03	per year	OGP
	25 mm hole	Liquid	2.90E-04	per year	OGP
	50 mm hole	Liquid	3.90E-05	per year	OGP
	>150 mm hole	Liquid	1.50E-05	per year	OGP
Compressor Reciprocating -	10 mm hole	Gas	3.22E-02	per year	OGP
	25 mm hole	Gas	2.60E-03	per year	OGP

Equipment	Release Scenario	Release Phase	Release Frequency	Unit	Reference
Large Connection (> 6")	50 mm hole	Gas	4.00E-04	per year	OGP
	>150 mm hole	Gas	4.08E-04	per year	OGP
Shell and Tube Heat Exchanger - Large Connection (> 6")	10 mm hole	Liquid/Gas	1.20E-03	per year	OGP
	25 mm hole	Liquid/Gas	1.80E-04	per year	OGP
	50 mm hole	Liquid/Gas	4.30E-05	per year	OGP
	>150 mm hole	Liquid/Gas	3.30E-05	per year	OGP
Unloading Arm	10 mm hole	Liquefied Gas	4.00E-06*	per transfer operation	UK HSE (1)
	25 mm hole	Liquefied Gas	4.00E-06*	per transfer operation	UK HSE (1)
	>150 mm hole	Liquefied Gas	7.00E-06	per transfer operation	UK HSE (1)
Riser	10 mm hole	Gas	7.2E-05	per year	OGP
	25 mm hole	Gas	1.8E-05	per year	OGP
	>150 mm hole	Gas	3.0E-05	per year	OGP
Diesel Storage Tank	10 mm hole	Liquid	1.6E-03	per year	OGP
	25 mm hole	Liquid	4.6E-04	per year	OGP
	50 mm hole	Liquid	2.3E-04	per year	OGP
	Rupture	Liquid	3.0E-05	per year	OGP
Unloading Hose	10 mm hole	Liquid	1.3E-05#	per hour	Purple Book (2)
	25 mm hole	Liquid	1.3E-05	per hour	Purple Book
	50 mm hole	Liquid	1.3E-05	per hour	Purple Book
	Rupture	Liquid	4.0E-06	per hour	Purple Book
LNG Storage Tank	10 mm hole	Liquid	3.3E-06!	per year	OGP
	25 mm hole	Liquid	3.3E-06!	per year	OGP
	50 mm hole	Liquid	3.3E-06!	per year	OGP
	Rupture	Liquid	2.5E-08	per year	OGP

*Note: The leak frequency of unloading arm, presented in the UK HSE (1), has been evenly distributed into 10 mm and 25 mm hole sizes.
#Note: The leak frequency of unloading hose, presented in the Purple Book (2), has been evenly distributed into 10 mm, 25 mm and 50 mm hole sizes.
!Notes: The leak frequency of LNG storage tank, presented in OGP, has been evenly distributed into 10 mm, 25 mm and 50 mm hole sizes.

5F.2.2 *Release Hole Sizes*

The hole sizes presented in ***Table 5F.10***, which are consistent with OGP (3) database, were adopted in the QRA Study:

(1) UK HSE, Failure Rate and Event Data for use within Risk Assessment, 28 June 2012.

(2) *Guidelines for Quantitative Risk Assessment*, "Purple Book", 2005.

(3) OGP, *Risk Assessment Data Directly, Report No. 434-.1*, March 2010.

Table 5F.10 Hole Sizes Considered in the QRA Study for The LNG Terminal

Leak Description	Hole Size
Very Small Leak	10 mm
Small Leak	25 mm
Medium Leak	50 mm
Rupture	>150 mm

5F.2.3 *Flammable Gas Detection and Emergency Shutdown Probability*

With reference to Purple Book [1], the effect of blocking valve system is determined by various factors, such as the position of gas detection monitors and the distribution thereof over the various wind directions, the direction limit of the detection system, the system reaction time and the intervention time of an operator. The probability of failure on demand of the system as a whole is 0.01 per demand.

Considering that the FSRU vessel and the Jetty are provided with gas detection system and automatic emergency shutdown system, the probability of executing the isolation successfully when required was selected as 99% in the QRA Study.

5F.2.4 *Ignition Probability*

The immediate ignition was estimated based on offshore ignition scenarios No. 24 from OGP Ignition Probability Database [2].

For flammable liquids with flash point of 55 C or higher (e.g. diesel, fuel oil etc.), a modification factor of 0.1 was applied to reduce the ignition probability as suggested in OGP [2].

The delayed ignition for various ignition sources was referred from Appendix 4.A of the Purple Book [1].

5F.2.5 *Vapour Cloud Explosion (VCE) Probability*

The explosion probability given an ignition was taken from Cox, Lees and Ang model [3], as shown in ***Table 5F.11***. VCE occurs upon a delayed ignition from a flammable gas release at a congested area. Details of the identified congested area and congestion volume are provided in ***Annex 5G***.

Table 5F.11 Probability of Explosion

Leak Size (Release Rate)	Explosion Probability
Minor (< 1 kg s^{-1})	0.04
Major (1 – 50 kg s^{-1})	0.12
Massive (> 50 kg s^{-1})	0.30

(1) *Guidelines for Quantitative Risk Assessment*, "Purple Book", 2005.

(2) OGP, *Risk Assessment Data Directly, Report No. 434-6.1*, March 2010.

(3) Cox, Lees and Ang, *Classification of Hazardous Locations*, IChemE.

5F.2.6 Escalation

If neighbouring equipment and piping is within range of the flame zone of a fire event, an escalation probability of 1/6 [1] [2] has been taken to conservatively estimate the directional probability and chance of impingement if applicable. Escalation has been assumed to cause a full bore rupture of the affected equipment and piping only.

5F.2.7 Event Tree Analysis

An event tree analysis was performed to model the development of each hazardous scenario (jet fire, pool fire, flash fire, fireball and VCE) from an initial release scenario. The event tree analysis was considered whether there is immediate ignition, delayed ignition or no ignition, with consideration of the associated ignition probability as discussed above.

The generic event tree diagrams for the LNG release, natural gas and diesel release on the FSRU Vessel and the Jetty are illustrated from ***Figure 5F.2*** to ***Figure 5F.4*** respectively. The full list of event tree diagrams for identified hazardous sections of the LNG Terminal are summarised in ***Annex 5F-1***.

The hazardous event frequency is summarised in ***Table 5F.12*** and ***Table 5F.13***.

(1) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(2) ERM, EIA for *Black Point Gas Supply Project* (Register No.: AEIAR-150/2010), February 2010.

Table 5F.12 Hazardous Event Frequency: QRA Study for the LNG Terminal (Isolation Success Case)

Hazardous Section	Leak Size (mm)	Release Frequency * (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
HKOLNGT_01	10	2.98E-03	1.93E-06	-	1.85E-06	7.72E-08	-
	25	1.25E-03	7.14E-06	-	6.29E-06	8.57E-07	-
	50	2.22E-05	6.86E-07	-	6.04E-07	8.23E-08	-
	150	1.82E-03	-	1.37E-04	9.57E-05	4.10E-05	-
HKOLNGT_03	10	9.67E-03	7.36E-06	7.36E-06	6.47E-06	8.83E-07	-
	25	8.12E-04	5.71E-06	5.71E-06	5.02E-06	6.85E-07	-
	50	1.37E-04	5.17E-06	5.17E-06	4.55E-06	6.20E-07	-
	150	7.43E-05	-	5.57E-06	3.90E-06	1.67E-06	-
HKOLNGT_04	10	2.42E-02	8.41E-05	-	7.40E-05	1.01E-05	-
	25	1.63E-03	5.22E-05	-	4.60E-05	6.27E-06	-
	50	2.22E-04	1.67E-05	-	1.17E-05	5.00E-06	-
	150	8.77E-05	6.58E-06	-	4.60E-06	1.97E-06	-
HKOLNGT_05	10	1.69E-02	1.45E-05	-	1.28E-05	1.74E-06	-
	25	1.66E-03	1.32E-05	-	1.16E-05	1.59E-06	-
	50	3.17E-04	1.35E-05	-	1.19E-05	1.63E-06	-
	150	1.98E-04	-	-	1.04E-05	4.46E-06	1.49E-05
HKOLNGT_06	10	1.15E-02	6.48E-05	-	5.70E-05	7.78E-06	-
	25	5.96E-03	4.55E-05	-	4.01E-05	5.73E-06	-
	50	7.33E-05	3.01E-06	-	2.65E-06	3.61E-07	-
	150	9.10E-03	-	-	4.78E-04	2.05E-04	6.83E-04
HKOLNGT_07	10	8.11E-03	6.69E-06	-	5.89E-06	8.03E-07	-
	25	6.05E-04	4.62E-06	-	4.06E-06	5.54E-07	-
	50	9.33E-05	3.83E-06	-	3.37E-06	4.60E-07	-

Hazardous Section	Leak Size (mm)	Release Frequency * (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
	150	4.08E-05	-	-	2.14E-06	9.18E-07	3.06E-06
HKOLNGT_08	10	7.13E-05	5.88E-08	-	5.18E-08	7.06E-09	-
	25	1.78E-05	1.36E-07	-	1.20E-07	1.63E-08	-
	150	2.97E-05	-	-	1.56E-06	6.68E-07	2.23E-06
HKOLNGT_10	10	8.11E-03	6.69E-06	-	5.89E-06	8.03E-07	-
	25	6.22E-04	4.75E-06	-	4.18E-06	5.70E-07	-
	50	9.33E-05	3.83E-06	-	3.37E-06	4.60E-07	-
	150	4.08E-05	-	-	2.14E-06	9.18E-07	3.06E-06
HKOLNGT_11	10	7.13E-05	5.88E-08	-	5.18E-08	7.06E-09	-
	25	1.78E-05	1.36E-07	-	1.20E-07	1.63E-08	-
	150	2.97E-05	-	-	1.56E-06	6.68E-07	2.23E-06
HKOLNGT_13	10	8.13E-03	6.18E-06	6.18E-06	5.44E-06	7.42E-07	-
	25	6.42E-04	4.51E-06	4.51E-06	3.97E-06	5.41E-07	-
	50	9.62E-05	3.64E-06	3.64E-06	3.20E-06	4.37E-07	-
	150	4.28E-05	-	3.21E-06	2.25E-06	9.62E-07	-
HKOLNGT_14	10	3.92E-03	2.13E-06	-	2.04E-06	8.51E-08	-
	25	3.92E-04	2.43E-07	-	2.33E-07	9.73E-09	-
	50	9.01E-05	1.44E-07	-	1.26E-07	1.72E-08	-
	150	3.27E-05	7.49E-07	-	6.59E-07	8.99E-08	-
HKOLNGT_15	10	8.13E-03	4.06E-06	-	3.90E-06	1.63E-07	-
	25	6.42E-04	3.57E-07	-	3.43E-07	1.43E-08	-
	50	9.62E-05	5.92E-08	-	5.68E-08	2.37E-09	-
	150	4.28E-05	1.60E-07	-	1.41E-07	1.92E-08	-
HKOLNGT_16	10	6.46E-03	3.51E-06	-	3.37E-06	1.40E-07	-
	25	3.19E-04	1.98E-07	-	1.90E-07	7.90E-09	-

Hazardous Section	Leak Size (mm)	Release Frequency * (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
	50	3.92E-05	6.17E-08	-	5.43E-08	7.41E-09	-
	150	1.59E-05	3.61E-07	-	3.18E-07	4.34E-08	-
HKOLNGT_17	10	2.42E-03	1.33E-06	-	1.28E-06	5.32E-08	-
	25	1.90E-04	1.19E-07	-	1.14E-07	4.77E-09	-
	50	2.93E-05	5.57E-08	-	4.90E-08	6.69E-09	-
	150	1.35E-05	3.69E-07	-	3.24E-07	4.42E-08	-
HKOLNGT_18	10	8.76E-03	4.81E-06	4.81E-06	4.62E-06	1.92E-07	-
	25	7.41E-04	4.64E-07	4.64E-07	4.46E-07	1.86E-08	-
	50	1.26E-04	2.39E-07	2.39E-07	2.10E-07	2.87E-08	-
	150	6.92E-05	-	5.19E-06	3.63E-06	1.56E-06	-
HKOLNGT_19	10	2.41E-03	1.20E-06	-	1.16E-06	4.82E-08	-
	25	1.90E-04	1.06E-07	-	1.02E-07	4.23E-09	-
	50	2.85E-05	1.75E-08	-	1.68E-08	7.02E-10	-
	150	1.27E-05	4.75E-08	-	4.18E-08	5.70E-09	-
HKOLNGT_20	10	2.36E-03	1.21E-06	-	1.16E-06	4.83E-08	-
	25	6.92E-04	4.05E-07	-	3.89E-07	1.62E-08	-
	50	2.14E-05	1.38E-08	-	1.33E-08	5.54E-10	-
	150	9.16E-04	8.05E-06	-	7.08E-06	9.66E-07	-
HKOLNGT_21	10	2.36E-03	1.21E-06	-	1.16E-06	4.83E-08	-
	25	6.92E-04	4.05E-07	-	3.89E-07	1.62E-08	-
	50	2.14E-05	1.38E-08	-	1.33E-08	5.54E-10	-
	150	9.16E-04	8.05E-06	-	7.08E-06	9.66E-07	-
HKOLNGT_22	10	2.73E-03	1.48E-06	-	1.42E-06	5.93E-08	-
	25	2.14E-04	1.33E-07	-	1.27E-07	5.30E-09	-
	50	4.75E-05	7.57E-08	-	6.66E-08	9.09E-09	-

Hazardous Section	Leak Size (mm)	Release Frequency * (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
HKOLNGT_23	10	2.26E-02	-	1.13E-06	1.08E-06	-	-
	25	3.59E-03	-	1.27E-06	1.12E-06	-	-
	50	1.53E-03	-	2.90E-06	2.55E-06	-	-
	150	1.78E-04	-	1.34E-06	9.36E-07	-	-
HKOLNGT_24	10	1.50E-02	-	9.47E-07	9.10E-07	-	-
	25	2.40E-03	-	8.46E-07	7.44E-07	-	-
	50	1.02E-03	-	1.93E-06	1.70E-06	-	-
	150	1.19E-04	-	8.91E-07	6.24E-07	-	-
HKOLNGT_25	10	2.25E-02	-	1.42E-06	-	-	-
	25	2.34E-03	-	8.25E-07	-	-	-
	50	9.62E-04	-	1.83E-06	-	-	-
	150	1.19E-04	-	8.91E-07	-	-	-

Note *: The release frequency for each hazardous section has taken into account the number and type of equipment as well as the associated pipe connection.

Table 5F.13 Hazardous Event Frequency: QRA Study for the LNG Terminal (Isolation Failure Case)

Hazardous Section	Leak Size (mm)	Release Frequency* (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
HKOLNGT_01	10	3.01E-05	1.95E-08	-	1.87E-08	7.80E-10	-
	25	1.26E-05	7.22E-08	-	6.35E-08	8.66E-09	-
	50	2.25E-07	6.93E-09	-	6.10E-09	8.32E-10	-
	150	1.84E-05	-	1.38E-06	9.66E-07	4.14E-07	-
HKOLNGT_02	10	3.33E-06	-	2.01E-09	1.93E-09	8.05E-11	-
	25	3.33E-06	-	5.80E-09	5.10E-09	6.96E-10	-
	50	3.33E-06	-	3.11E-08	2.74E-08	3.74E-09	-
	Catastrophic Rupture	2.50E-08	-	-	1.31E-09	5.63E-10	-
HKOLNGT_03	10	9.77E-05	7.43E-08	7.43E-08	6.54E-08	8.92E-09	-
	25	8.20E-06	5.77E-08	5.77E-08	5.08E-08	6.92E-09	-
	50	1.38E-06	5.22E-08	5.22E-08	4.60E-08	6.27E-09	-
	150	7.50E-07	-	5.63E-08	3.94E-08	1.69E-08	-
HKOLNGT_04	10	2.44E-04	8.49E-07	8.49E-07	7.47E-07	1.02E-07	-
	25	1.64E-05	5.27E-07	5.27E-07	4.64E-07	6.33E-08	-
	50	2.25E-06	1.68E-07	1.68E-07	1.18E-07	5.05E-08	-
	150	8.86E-07	6.65E-08	6.65E-08	4.65E-08	1.99E-08	-
HKOLNGT_05	10	1.70E-04	1.46E-07	-	1.29E-07	1.76E-08	-
	25	1.68E-05	1.34E-07	-	1.17E-07	1.60E-08	-
	50	3.20E-06	1.37E-07	-	1.20E-07	1.64E-08	-
	150	2.00E-06	-	-	1.05E-07	4.50E-08	1.50E-07
HKOLNGT_06	10	1.17E-04	8.75E-06	-	6.12E-06	2.62E-06	-
	25	6.02E-05	4.60E-07	-	4.05E-07	5.52E-08	-
	50	7.40E-07	3.04E-08	-	2.67E-08	3.65E-09	-
	150	9.20E-05	-	-	4.83E-06	2.07E-06	6.90E-06
HKOLNGT_07	10	8.19E-05	6.76E-08	-	5.95E-08	8.11E-09	-
	25	6.11E-06	4.66E-08	-	4.10E-08	5.60E-09	-
	50	9.42E-07	3.87E-08	-	3.40E-08	4.64E-09	-
	150	4.12E-07	-	-	2.16E-08	9.27E-09	3.09E-08

Hazardous Section	Leak Size (mm)	Release Frequency* (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
HKOLNGT_08	10	7.20E-07	5.94E-10	-	5.23E-10	7.13E-11	-
	25	1.80E-07	1.37E-09	-	1.21E-09	1.65E-10	-
	150	3.00E-07	-	-	1.58E-08	6.75E-09	2.25E-08
HKOLNGT_10	10	8.19E-05	6.76E-08	-	5.95E-08	8.11E-09	-
	25	6.28E-06	4.79E-08	-	4.22E-08	5.75E-09	-
	50	9.42E-07	3.87E-08	-	3.40E-08	4.64E-09	-
	150	4.12E-07	-	-	2.16E-08	9.27E-09	3.09E-08
HKOLNGT_11	10	7.20E-07	5.94E-10	-	5.23E-10	7.13E-11	-
	25	1.80E-07	1.37E-09	-	1.21E-09	1.65E-10	-
	150	3.00E-07	-	-	1.58E-08	6.75E-09	2.25E-08
HKOLNGT_13	10	8.21E-05	6.24E-08	6.24E-08	5.49E-08	7.49E-09	-
	25	6.48E-06	4.56E-08	4.56E-08	4.01E-08	5.47E-09	-
	50	9.72E-07	3.68E-08	3.68E-08	3.24E-08	4.41E-09	-
	150	4.32E-07	-	3.24E-08	2.27E-08	9.72E-09	-
HKOLNGT_14	10	3.96E-05	2.15E-08	-	2.06E-08	8.60E-10	-
	25	3.96E-06	2.46E-09	-	2.36E-09	9.82E-11	-
	50	9.10E-07	1.45E-09	-	1.28E-09	1.74E-10	-
	150	3.30E-07	7.57E-09	-	6.66E-09	9.08E-10	-
HKOLNGT_15	10	8.21E-05	4.10E-08	-	3.94E-08	1.64E-09	-
	25	6.48E-06	3.61E-09	-	3.46E-09	1.44E-10	-
	50	9.72E-07	5.98E-10	-	5.74E-10	2.39E-11	-
	150	4.32E-07	1.62E-09	-	1.42E-09	1.94E-10	-
HKOLNGT_16	10	6.53E-05	3.54E-08	-	3.40E-08	1.42E-09	-
	25	3.22E-06	2.00E-09	-	1.92E-09	7.98E-11	-
	50	3.96E-07	6.24E-10	-	5.49E-10	7.48E-11	-
	150	1.61E-07	3.65E-09	-	3.21E-09	4.38E-10	-
HKOLNGT_17	10	2.45E-05	1.34E-08	-	1.29E-08	5.37E-10	-
	25	1.92E-06	1.20E-09	-	1.16E-09	4.81E-11	-
	50	2.96E-07	5.63E-10	-	4.95E-10	6.76E-11	-
	150	1.36E-07	3.72E-09	-	3.28E-09	4.47E-10	-

Hazardous Section	Leak Size (mm)	Release Frequency* (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
HKOLNGT_18	10	8.85E-05	4.86E-08	4.86E-08	4.66E-08	1.94E-09	-
	25	7.48E-06	4.69E-09	4.69E-09	4.50E-09	1.88E-10	-
	50	1.27E-06	2.41E-09	2.41E-09	2.12E-09	2.90E-10	-
	150	6.99E-07	-	5.24E-08	3.67E-08	1.57E-08	-
HKOLNGT_19	10	2.43E-05	1.22E-08	-	1.17E-08	4.86E-10	-
	25	1.92E-06	1.07E-09	-	1.03E-09	4.27E-11	-
	50	2.88E-07	1.77E-10	-	1.70E-10	7.09E-12	-
	150	1.28E-07	4.79E-10	-	4.22E-10	5.75E-11	-
HKOLNGT_20	10	2.38E-05	1.22E-08	-	1.17E-08	4.88E-10	-
	25	6.99E-06	4.09E-09	-	3.93E-09	1.64E-10	-
	50	2.16E-07	1.40E-10	-	1.34E-10	5.60E-12	-
	150	9.25E-06	8.13E-08		7.15E-08	9.76E-09	-
HKOLNGT_21	10	2.38E-05	1.22E-08	-	1.17E-08	4.88E-10	-
	25	6.99E-06	4.09E-09	-	3.93E-09	1.64E-10	-
	50	2.16E-07	1.40E-10	-	1.34E-10	5.60E-12	-
	150	9.25E-06	8.13E-08	-	7.15E-08	9.76E-09	-
HKOLNGT_22	10	2.76E-05	1.50E-08	-	1.44E-08	5.99E-10	-
	25	2.16E-06	1.34E-09	-	1.29E-09	5.36E-11	-
	50	4.80E-07	7.65E-10	-	6.73E-10	9.18E-11	-
HKOLNGT_23	10	2.28E-04	-	1.14E-07	1.09E-07	-	-
	25	3.63E-05	-	1.28E-07	1.13E-07	-	-
	50	1.54E-05	-	2.93E-07	2.58E-07	-	-
	150	1.80E-06	-	1.35E-07	9.45E-08	-	-
HKOLNGT_24	10	1.52E-04	-	9.57E-08	9.19E-08	-	-
	25	2.42E-05	-	8.54E-08	7.52E-08	-	-
	50	1.03E-05	-	1.95E-07	1.72E-07	-	-
	150	1.20E-06	-	9.00E-08	6.30E-08	-	-
HKOLNGT_25	10	2.27E-04	-	1.43E-07	-	-	-
	25	2.36E-05	-	8.33E-08	-	-	-
	50	9.72E-06	-	1.85E-07	-	-	-

Hazardous Section	Leak Size (mm)	Release Frequency* (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Pool Fire	Flash Fire	Vapour Cloud Explosion	Fireball
	150	1.20E-06	-	9.00E-08	-	-	-

Note *: The release frequency for each hazardous section has taken into account the number and type of equipment as well as the associated pipe connection.

5F.3 SUBSEA PIPELINES

5F.3.1 *Release Frequency Database*

The international databases considered in the QRA Study are *PARLOC 2012* [1] and *PARLOC 2001* [2]. The *PARLOC 2012* updates the loss of containment failure rate data for subsea pipelines and risers from 2001 through the end of 2012; however, it does not include any incident data covered by the *PARLOC 2001* study, which has coverage of incidents from 1960s until year 2000.

In the QRA Study, both *PARLOC 2001* and P*ARLOC 2012* database have been considered to cover the incidents from the 1960s until the end of 2012 for all offshore pipelines and risers operating in the UK North Sea, Eastern Irish Sea, West of Shetland, and Norwegian, Danish and Dutch sectors of the North Sea.

Incidents recorded in the database have been classified according to several categories, including:

- Failure location: The database includes risers, pipelines within 500 m of an offshore platform, pipelines within 500 m of a subsea well and mid-line (pipelines located more than 500 m from a platform or a subsea well). It is noted that the failure data pertaining to risers is not relevant to the QRA Study for subsea pipelines and therefore excluded;
- Pipeline contents: The database includes both oil and gas pipelines. Where the contents in the pipeline have an impact on failure rate, such as corrosion, only incidents pertaining to gas pipelines were considered; and
- Pipeline type: The database includes steel pipelines (both pipe body and fittings) and flexible lines. Only failures involving the pipe body of steel pipelines were considered.

A breakdown of the incidents by failure location is presented in ***Table 5F.14***.

Table 5F.14 Subsea Pipeline Failure Rate Based on PARLOC 2012 and PARLOC 2001

Region of Pipeline	**Operating Experience^**	**No. of Incidents^**	**Failure Rate^**
Mid-line	506,603 km-years	43	8.5×10^{-5} /km/year
Platform safety zone	28,774 years (14,387 km-years)*	26	9.0×10^{-4} /year (1.8×10^{-3} /km/year)
Subsea well safety zone	10,842 years# (5,421 km-years)*	8	7.4×10^{-4} /year (1.5×10^{-3} /km/year)

(1) Energy Institute, London and Oil & Gas UK, *Pipeline and Riser Loss of Containment 2010 – 2012 (PARLOC 2012), 6th Edition of PARLOC Report Series*, March 2015.

(2) Mott MacDonald Ltd., *The Update of Loss of Containment Data for Offshore Pipelines (PARLOC 2001), Revision F*, June 2003.

Region of Pipeline	Operating Experience^	No. of Incidents^	Failure Rate^
Total	526,411 km-years	77	1.5×10^{-4}/km/year

Note:
^: The database of *PARLOC 2012* has been added up to that of *PARLOC 2001* for the QRA Study.
*: The number of years in the case of platform and subsea well safety zone has been multiplied by 500 m of safety zone to obtain corresponding km-years.
#: The operating experience for steel pipelines within the subsea well safety zone is that associated with the less than 3-km pipeline length.

The main causes of pipeline failure are summarized in ***Table 5F.15*** and ***Table 5F.16***, based on the cause identified in *PARLOC 2012* and *PARLOC 2001*. It was observed that anchor impact and material defects (including corrosion) are the major contributors to the subsea pipeline incidents.

Table 5F.15 Main Contributors to Subsea Pipeline Incidents (PARLOC 2012)*

Cause	Platform Safety Zone	Subsea Well Safety Zone	Mid-line	Total
Impact	-	-	5 (19.2%)	5 (19.2%)
Material	5 (19.2%)	1 (3.8%)	9 (34.6%)	15 (57.7%)
Ops and Maintenance	-	-	1 (3.8%)	1 (3.8%)
Construction	2 (7.7%)	1 (3.8%)	1 (3.8%)	4 (15.4%)
Others	1 (3.8%)	-	-	1 (3.8%)
Total	8	2	16	26

*: With reference to the Table 15 "Steel pipelines – number of incidents (as reported) by location and cause of *PARLOC 2012*.

Table 5F.16 Main Contributors to Subsea Pipeline Failure (PARLOC 2001)

Cause	Platform Safety Zone	Subsea Well Safety Zone	Mid-line	Total
Anchor/Impact	7 (39%)	-	10 (37%)	17 (33%)
Internal corrosion	3 (17%)	4 (67%)	7 (26%)	14 (27%)
Corrosion -others	2 (11%)	-	4 (15%)	6 (12%)
Material defect	4 (22%)	1 (17%)	2 (7%)	7 (14%)
Others	2 (11%)	1 (17%)	4 (15%)	7 (14%)
Total	18	6	27	51

5F.3.2 *Analysis of Subsea Pipeline Failure Causes*

The failure frequency derived from *PARLOC 2012* and *PARLOC 2001* data was then further filtered to discount the factors that do not apply to the proposed subsea pipelines to the BPPS and LPS.

Corrosion and Material Defect

For the proposed subsea pipelines to the BPPS and LPS, failures due to internal corrosion are expected to be less likely as the regasified natural gas is clean, unlike the gas transported from wells/ platforms which may contain moisture and hydrogen sulphide. Also, the condition of the subsea pipeline is expected to be monitored periodically and maintenance work will be carried out when necessary.

The *PARLOC 1996* (1) provides a breakdown of loss of containment incidents due to corrosion and material defect for gas pipelines greater than 5 km in length. The failure rate for gas pipelines is 5.9×10^{-6} /km/year (based on 0.7 failures in 119,182 km-years). In *PARLOC 2012* and *PARLOC 2001*, the failure rate for gas pipelines due to corrosion and material defects cannot be directly extracted due to a difference in the presentation format of the data.

In addition, a downward trend in failure frequency is expected due to improvement in technology. There have been significant improvements in pipeline material and welding over the last 10 to 20 years. Hence, as per the previous EIA Report that was approved by the EPD (2), a 80% reduction factor has been applied for all forms of corrosion and material defects. As a result, the corrosion/material defect frequency for subsea gas pipelines adopted in the QRA Study is 1.18×10^{-6} /km/year.

Anchor Drop and Impact Incidents

According to *PARLOC 2012* and *PARLOC 2001*, the failure frequency for 20" and 30" subsea pipelines due to anchor/ impact are presented in ***Table 5F.17***.

Table 5F.17 Frequency of Loss of Containment Incidents due to Anchor/ Impact

Location	Failure Frequency (per km per year)* 20" diameter	30" diameter
Mid-line	1.32×10^{-5}	1.25×10^{-5}
Safety zone	1.06×10^{-4}	1.77×10^{-4}

*: The database of *PARLOC 2012* has been added up to that of *PARLOC 2001* for the QRA Study.

It is considered that the likelihood of subsea pipeline damage due to anchor/ impact incidents may be related to the level of marine activity (this is taken to be a combination of marine traffic and anchor drop). The frequency of subsea pipeline failure due to these causes has therefore been derived as a function of three levels of marine activity: high, medium and low. The associated failure frequencies for different levels of marine activities are presented in ***Table 5F.18***.

(1) Health and Safety Executive UK, PARLOC 96: The Update of Loss of Containment Data for Offshore Pipelines.

(2) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

Table 5F.18 Frequency of Loss of Containment Incidents due to Anchor/ Impact

Marine Activity	**Failure Frequency (per km per year)***	
	20″ Subsea Pipeline to the LPS	**30″ Subsea Pipeline to the BPPS**
Low	1.32×10^{-5}	1.25×10^{-5}
Medium*	5.96×10^{-5}	9.49×10^{-5}
High	1.06×10^{-4}	1.77×10^{-4}

*: The failure frequency for medium marine activity was calculated based on the intermediate value of low and high marine activity.

The above failure frequencies from *PARLOC* assume minimal protection for the pipeline. The proposed subsea pipelines to the BPPS and LPS are provided with rock armour protection, hence the failure frequency due to anchor/impact are reduced by appropriate factors as discussed in ***Section 5F.3.4***.

Other Causes

Other causes include blockages, procedural errors, pressure surges, etc. As with corrosion, improvements in technology and operating practices are expected to reduce this significantly. Therefore, as per the previous EIA study that has been approved by the EPD (1), a 90% reduction factor has been applied, which gives a failure frequency of 7.90×10^{-7} /km/year (4 incidents in 506,603 km-years (2) (3) with 90% reduction).

5F.3.3 Anchor Damage Frequency

As per the previous EIA Report that was approved by the EPD (4), the anchor damage frequency for the mid-line was applied for regions of low marine vessel volume and low anchor drop activity. The platform safety zone frequency was applied for regions of high marine traffic. Some sections have intermediate levels of marine activity and therefore an average value of anchor damage frequency in mid-line and platform safety zone (i.e. 1.77×10^{-4} per km-year) was adopted for these sections. Based on the above considerations, the failure frequencies due to anchor impact used in the QRA Study are summarized in ***Table 5F.19*** and ***Table 5F.20***.

It is noted that the anchor damage frequency estimated from *PALOC* database has been justified to be consistent with the local marine incidents due to anchor drop in the previous EIA Report that was approved by the EPD (5).

(1) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(2) Energy Institute, London and Oil & Gas UK, *Pipeline and Riser Loss of Containment 2010 – 2012 (PARLOC 2012), 6th Edition of PARLOC Report Series*, March 2015.

(3) Mott MacDonald Ltd., *The Update of Loss of Containment Data for Offshore Pipelines (PARLOC 2001), Revision F*, June 2003.

(4) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(5) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

Table 5F.19 Anchor Damage Frequencies for Subsea Pipelines to the BPPS

Section Number	Section Description	Anchor Damage Frequencies (/km-year)	Marine Traffic/ Comment
X	Jetty Approach to South of Soko Islands	1.25×10^{-5}	Low
A	Southwest of Soko Islands	1.25×10^{-5}	Low
B	Southwest of Fan Lau	1.77×10^{-4}	High (considering high marine Incident rate)
C	Southwest Lantau	9.48×10^{-5}	Medium
D	West of Tai O	9.48×10^{-5}	Medium
E	West of HKIA	9.48×10^{-5}	Medium
F	West of Sha Chau	9.48×10^{-5}	Medium
G	West of Lung Kwu Chau	1.77×10^{-4}	High
H	Lung Kwu Chau to Urmston Anchorage	1.77×10^{-4}	High (considering high marine Incident rate)
I	Urmston Road	1.77×10^{-4}	High (considering high traffic volume)
J	West of BPPS	9.48×10^{-5}	Medium

Table 5F.20 Anchor Damage Frequencies for Subsea Pipelines to the LPS

Section Number	Section Description	Anchor Damage Frequencies (/km-year)	Marine Traffic
A	Jetty Approach to South of Shek Kwu Chau	1.32×10^{-5}	Low
B	South of Cheung Chau	1.32×10^{-5}	Low
C	West Lamma Channel	1.32×10^{-5}	Low
D	Alternative Shore Approach	5.95×10^{-5}	Medium

5F.3.4 *Pipeline Protection Factors*

Different levels of armour rock protection have been proposed by the Pipeline Engineering Consultant for each segment of the proposed BPPS and LPS subsea pipelines based on the potential anchor drag and drop hazards. The cross sections of the trench designs and associated armour rock protection are illustrated in ***Section 3*** of the EIA Report.

With consideration of the armour rock protection for the subsea pipeline, the following pipeline protection factors [1][2] were adopted in the QRA Study:

- 99.99% is applied, if the vessel anchor size is smaller than the intended design capacity of the pipeline protection; and

(1) Worley Parsons, BPPS Pipeline Construction Method Report, 402012-00392-MX-REP-0005, 25 Jan 2017

(2) Worley Parsons, LPS Pipeline Construction Method Report, 402012-00392-MX-REP-0004, 25 Jan 2017

- 0% is applied, if the vessel anchor size is larger than the intended design capacity of the pipeline protection.

5F.3.5 *Summary of Failure Frequency for Proposed Subsea Pipelines*

Based on the above discussions, the failure frequencies proposed to be adopted in the QRA Study are summarised in ***Table 5F.21*** and ***Table 5F.22***.

Table 5F.21 *Summary of Release Frequency along Subsea BPPS Pipeline*

Pipeline Section	Trench Type	Anchor Impact (/km/yr)	Corrosion/ Defects (/km/yr)	Others (/km/yr)	Total (/km/yr)*
Jetty Approach to South of Soko Islands (X)	4	1.25E-05	1.18E-06	7.90E-07	2.30E-06
Southwest of Soko Islands (A)	5	1.25E-05	1.18E-06	7.90E-07	2.69E-06
Southwest of Fan Lau (B)	5	1.77E-04	1.18E-06	7.90E-07	1.99E-06
Southwest Lantau (C)	2	9.49E-05	1.18E-06	7.90E-07	5.85E-06
West of Tai O (D)	5	9.49E-05	1.18E-06	7.90E-07	1.98E-06
West of HKIA (E)	5	9.49E-05	1.18E-06	7.90E-07	1.98E-06
West of Sha Chau (F)	5	9.49E-05	1.18E-06	7.90E-07	1.98E-06
West of Lung Kwu Chau (G)	3	1.77E-04	1.18E-06	7.90E-07	1.99E-06
Lung Kwu Chau to Urmston Anchorage (H)	5	1.77E-04	1.18E-06	7.90E-07	1.99E-06
Urmston Road (I)	4	1.77E-04	1.18E-06	7.90E-07	1.99E-06
West of BPPS (J)	5/1	9.49E-05	1.18E-06	7.90E-07	1.98E-06

*The armour rock protection factor for the subsea pipeline has been taken into account in the total release frequency.

Table 5F.22 *Summary of Release Frequency along Subsea LPS Pipeline*

Pipeline Section	Trench Type	Anchor Impact (/km/yr)	Corrosion/ Defects (/km/yr)	Others (/km/yr)	Total (/km/yr) *
Jetty Approach to South of Shek Kwu Chau (A)	4	1.32E-05	1.18E-06	7.90E-07	1.97E-06
South of Cheung Chau (B)	5	1.32E-05	1.18E-06	7.90E-07	1.97E-06
West Lamma Channel (C)	5	1.32E-05	1.18E-06	7.90E-07	1.97E-06
Alternative Shore Approach (D)	1	5.95E-05	1.18E-06	7.90E-07	1.98E-06

*The armour rock protection factor for the subsea pipeline has been taken into account in the total release frequency.

5F.3.6 *Event Tree Analysis*

An event tree analysis was performed to model the development of each event from an initial release to final hazardous scenario. The key event trees for the external damage on subsea pipelines, and spontaneous failure of subsea pipeline, are depicted in ***Figure 5F.5*** and ***Figure 5F.6*** respectively.

The following factors were considered in the event tree development:

- Failure cause;
- Hole size;

- Vessel position and type; and
- Ignition probability.

The probabilities used in the event trees are discussed below.

Failure Cause

Failures due to corrosion and other events are considered separately from failures caused by anchor impact. This is because the hole size distribution is different in both cases, as described below. Also, in the event of failure due to anchor impact, the probability of vessel presence is assumed to be higher, as discussed below.

Hole Size Distribution

The data on hole size distribution from *PARLOC 2001* is summarised in ***Table 5F.23***.

Table 5F.23 Hole Size Distribution from PARLOC 2001

Pipeline size (")		**Hole size (mm)**		
	Location	**0 to 20**	**20 to 80**	**> 80**
2 to 9	Safety zone	6	3 (1 rupture)	2
	Mid line	14	4 (2 ruptures)	1 (1 rupture)
10 to 16	Safety zone	1	1	4 (3 rupture)
	Mid line	1	-	3
>16	Safety zone	1	-	-
	Mid line	2	-	2 (2 ruptures)
Total		25 (55.0%)	8 (18.0%)	12 (27.0%)

This data on hole size distribution is clearly limited, particularly for large diameter pipelines. One approach is to compare this hole size distribution with that for onshore pipelines, which include a much larger database of operating experience and failure data. For example, the US DOT database from 1984 to 2016 (1) is based on more than 9 million onshore transmission and gathering pipeline km years of operating data as compared to 526,411 km-years in the *PARLOC 2001* and *PARLOC 2012* study.

An analysis of hole size distribution for onshore pipelines as given in the US Gas database (1) and European Gas Pipelines database (2) provides a hole size distribution as given in ***Table 5F.24***.

(1) PRC International American Gas Association, Analysis of DOT Reportable Incidents for Gas Transmission and Gathering Pipelines –January 1, 1985 Through December 31, 1994 Keifner & Associate Inc., 1996.

(2) European Gas Pipeline Incident Data Group 3rd EGIG-Report 1970-1997.

Table 5F.24 Hole Size Distribution Adopted for Corrosion and Other Failures

Category	**Hole Size**		**Proportion**
	Subsea Pipeline to the BPPS	**Subsea Pipeline to the LPS**	
Rupture (Full Bore)	Full bore	Full bore	5%
Puncture	4" (100 mm)	4" (100 mm)	15%
Hole	2" (50 mm)	2" (50 mm)	30%
Leak	< 25 mm	< 25 mm	50%

The above distribution is largely similar to the distribution derived in *PARLOC 2001* and *PARLOC 2012* study. The only difference is the consideration of a small percentage of ruptures. It is a matter of debate whether ruptures could indeed occur although ruptures extending over several meters are reported in the various failure databases. Hence the hole size distribution summarised in ***Table 5F.24*** were adopted for failures caused by corrosion and other failures (including material/ weld defect).

In the case of failures caused by anchor damage, the hole sizes are expected to be larger and the distribution summarised in ***Table 5F.25*** was adopted.

Table 5F.25 Hole Size Distribution for Anchor Impact

Category	**Hole Size**		**Proportion**
	Subsea Pipeline to BPPS	**Subsea Pipeline to LPS**	
Rupture (Half Bore)	15" (381 mm)	12" (300 mm)	10%
Major	15" (381 mm) – half bore	10" (254 mm) – half bore	20%
Minor	4" (100 mm)	4" (100 mm)	70%

Vessel Position

In the case of failures due to corrosion/ other events, the probability of a vessel being affected by the leak is calculated based on the traffic volume and the size of the flammable cloud. Dispersion modelling using *PHAST* is used to obtain the size of the flammable cloud for each hole size scenario and four (4) weather scenarios covering atmosphere stability classes, B, D and F. Once the cloud size is known, the probability that a passing marine vessel will travel through this area within a given time can be calculated. A time period of thirty (30) minutes is used since it is assumed that if a leak occurs, warnings will be issued to all shipping within thirty (30) minutes. .

In the case of failures due to anchor impact, the following two (2) scenarios are considered:

- "Vessel in vicinity" – the vessel that caused damage to the proposed subsea pipelines (due to anchor drop) is still in the vicinity of the incident zone. The probability of this is assumed to be 0.3; and

- "Passing vessels" – ships approach or pass the scene of the incident following a failure. In this case, the probability of a vessel passing through the plume is calculated using the same method as for a corrosion failure, i.e. based on cloud size and traffic volume.

Ignition Probability for Subsea Pipelines

Ignition of the release is expected only from passing vessels or vessels in the vicinity. As per the previous EIA Report that was approved by the EPD [1], similar values were adopted in the QRA Study for the subsea pipelines to the BPPS and LPS, as given in ***Table 5F.26***.

Table 5F.26 Ignition Probability Assumed for Subsea Pipeline

Release Case	Ignition Probability	
	Passing Vessels (1)	Vessels in Vicinity (2)
<25 mm	0.01	n/a
50 mm	0.05	n/a
100 mm	0.10	0.15
Half bore	0.20	0.30
Full bore	0.30	0.40

Note:

1: Values applied to passing vessels for all types of incidents, i.e. corrosion, others and anchor impact.

2: Values applied only to scenarios where the vessel causing pipeline damage due to anchor impact is still in the vicinity.

5F.4 PROPOSED GRSS AT THE BPPS AND LPS

5F.4.1 *Release Frequency Database*

Failure frequencies for various hazard sources/ equipment were adopted from historical databases, as per the approved EIA Report [2], summarised in ***Table 5F.27***.

The failure frequencies for natural gas facilities were selected from Hawksley [3], who presents his own derived data for both above and below ground pipework in 1984. The failure rates from Hawksley was also compared with that suggested by UK HSE [4], which was established by the Hazardous Installations Directorate (HID) C15 of the UK HSE in 2012. The UK HSE failure rates are intended for use on Land Use Planning cases and have been in use for several years. After review, it was found that the failure rates for pipework from Hawksley and UK HSE are in the same order of magnitude.

(1) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(2) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(3) Hawksley, J.L., *Some Social, Technical and Economic Aspects of the Risks of Large Plants*, CHEMRAWN III, 1984.

(4) UK HSE, *Failure Rate and Event Data for use within Risk Assessments*, 28 July 2012.

Table 5F.27 Release Event Frequencies

Equipment	Release Scenario	Release Phase	Release Frequency	Unit	Reference
Pipe size 600 mm to 750 mm	i) 10 & 25 mm hole	Liquid/ Gas	1.00E-07	per meter-year	Hawksley
	ii) 50 & 100 mm hole	Liquid/ Gas	7.00E-08	per meter-year	Hawksley
	iii) Full bore rupture	Liquid/ Gas	3.00E-08	per meter-year	Hawksley
Pipe size 150 mm to 500 mm	i) 10 & 25 mm hole	Liquid/ Gas	3.00E-07	per meter-year	Hawksley
	ii) 50 & 100 mm hole	Liquid/ Gas	1.00E-07	per meter-year	Hawksley
	iii) Full bore rupture	Liquid/ Gas	5.00E-08	per meter-year	Hawksley

5F.4.2 *Fault Tree Analysis for Construction Vehicle Impact on the Existing GRS Facilities*

During the construction phase of the proposed GRSs at the BPPS and LPS, external construction vehicles will be present at the site for various kinds of construction activities. This introduces the risk of construction vehicle impact on the existing nearby GRS facilities, leading to potential loss of containment of natural gas

Fault tree analysis for the construction vehicle impact on the existing GRS facilities was conducted. The fault tree diagrams for the GRS at the BPPS and the LPS are presented in ***Figure 5F.7*** and ***Figure 5F.8*** respectively.

The frequency of construction vehicle impact on the existing GRS at the BPPS and the LPS was calculated as 2.01×10^{-6} per year and 1.21×10^{-6} per year respectively.

5F.4.3 *Flammable Gas Detection and Shutdown Probability*

With reference to the Purple Book (1), the effect of blocking valve system is determined by various factors, such as the position of gas detection monitors and the distribution thereof over the various wind directions, the direction limit of the detection system, the system reaction time and the intervention time of an operator. The probability of failure on demand for an automatic blocking system is 0.001 per demand while that for a hand-operated blocking system is 0.01 per demand. However, as a conservative approach, the probability of failure on demand for all detection and shutdown system was selected as 1 in the QRA Study.

5F.4.4 *Ignition Probability*

The ignition probability depends not only on the presence of ignition sources, but also the release rate and release duration. Larger releases are more likely

(1) *Guidelines for Quantitative Risk Assessment*, "Purple Book", 2005.

to be ignited than smaller releases. Similarly releases that continue for a longer duration have a higher probability of ignition than short duration releases.

Ignition Probability for Natural Gas

Table 5F.28 summarises the ignition probabilities adopted in the QRA Study as per the approved EIA Reports (1) (2). The total ignition probability is 0.32 for large leaks/ruptures, and 0.07 for other leaks. These ignition probabilities are consistent with the model of Cox, Lees and Ang (3).

The ignition probabilities are distributed between immediate ignition and delayed ignition. Delayed ignition is further divided between delayed ignition 1 and delayed ignition 2 to take into account that a dispersing gas cloud may be ignited at different points during its dispersion. Delayed ignition 1 results in a flash fire and takes into account the possibility that an ignition could occur within the plant area due to the presence of ignition sources on-site. Delayed ignition 2 gives a flash fire after the gas cloud has expanded to its maximum (steady state) extent.

If both delayed ignition 1 and 2 do not occur, the gas cloud disperses with no hazardous effect.

Table 5F.28 Ignition Probability for Natural Gas

	Immediate Ignition	Delayed Ignition 1	Delayed Ignition 2	Delayed Ignition Probability	Total Ignition Probability
Small leak	0.02	0.045	0.005	0.05	0.07
Large leak/ rupture	0.10	0.200	0.020	0.22	0.32

For isolation failure scenarios, the delayed ignition probabilities given in ***Table 5F.28*** are doubled. The longer duration and larger inventory release from a non-isolated release is assumed to make it more likely that an ignition takes place.

5F.4.5 VCE

The explosion probability given an ignition adopted in the QRA Study was taken from Cox, Lees and Ang model (4), as shown in ***Table 5F.29***. VCE occurs upon a delayed ignition from a gas release at a congested area. Since a liquid release is contained in a potential explosion site, it is conservative to assume an unignited liquid release vapourises to produce a flammable vapour cloud, subsequently ignited to produce an explosion.

(1) ERM, EIA for *Black Point Gas Supply Project* (Register No.: AEIAR-150/2010), February 2010.

(2) ERM, EIA for *Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities* (Register No.: AEIAR-106/2007), December 2006.

(3) Cox, Lees and Ang, *Classification of Hazardous Locations*, IChemE.

(4) Cox, Lees and Ang, *Classification of Hazardous Locations*, IChemE.

Table 5F.29 Probability of Explosion

Leak Size (Release Rate)	Explosion Probability
Minor (< 1 kg s^{-1})	0.04
Major (1 – 50 kg s^{-1})	0.12
Massive (> 50 kg s^{-1})	0.30

5F.4.6 Escalation

An initially small release may escalate into a larger, more serious event if a jet fire impinges on neighbouring equipment for an extended time (more than about ten (10) minutes). It is taken into account the modelling for the isolation fail branch of the event trees for natural gas facilities. If neighbouring piping is within range of the flame zone of a jet fire, an escalation probability of 1/6 is taken to conservatively estimate the directional probability and chance of impingement. Escalation is assumed to cause a full bore rupture of the affected pipeline/ piping only.

5F.4.7 Event Tree Analysis

An event tree analysis was performed to model the development of each event from an initial release to a final hazardous scenario. The event tree analysis was considered whether there is immediate ignition, delayed ignition or no ignition. The possible hazardous scenarios include jet fire, flash fire, pool fire, toxicity effect, fireball and VCE. The event tree diagram for GRS facilities is presented in ***Figure 5F.9***. The hazardous event frequency is summarized in ***Table 5F.30*** and ***Table 5F.31***. The full list of event tree diagrams for identified hazardous sections of the GRS facilities at the BPPS and LPS are summarised in ***Annex 5F-2*** and ***Annex 5F-3*** respectively.

Table 5F.30 Hazardous Event Frequency: QRA Study for GRS at the BPPS

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
NGRS_01	10	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	25	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	50	2.80E-06	5.60E-08	-	2.22E-07	2.80E-08	3.02E-08
	100	2.80E-06	2.80E-07	-	7.84E-07	1.12E-07	3.36E-07
	Line Rupture	1.20E-06	-	1.20E-07	3.36E-07	4.80E-08	1.44E-07
NGRS_02	10	2.00E-06	4.00E-08	-	1.58E-07	2.00E-08	2.16E-08
	25	2.00E-06	4.00E-08	-	1.58E-07	2.00E-08	2.16E-08
	50	1.40E-06	2.80E-08	-	1.11E-07	1.40E-08	1.51E-08
	100	1.40E-06	1.40E-07	-	3.92E-07	5.60E-08	1.68E-07
	Line Rupture	6.00E-07	-	6.00E-08	1.68E-07	2.40E-08	7.20E-08
NGRS_03	10	6.50E-06	1.30E-07	-	5.15E-07	6.50E-08	7.02E-08
	25	6.50E-06	1.30E-07	-	5.15E-07	6.50E-08	7.02E-08
	50	4.55E-06	9.10E-08	-	3.60E-07	4.55E-08	4.91E-08
	100	4.55E-06	4.55E-07	-	1.27E-06	1.82E-07	5.46E-07
	Line Rupture	1.95E-06	-	1.95E-07	5.46E-07	7.80E-08	2.34E-07
NGRS_04	10	1.04E-05	2.08E-07	-	8.24E-07	1.04E-07	1.12E-07
	25	1.04E-05	2.08E-07	-	8.24E-07	1.04E-07	1.12E-07
	50	7.28E-06	1.46E-07	-	5.77E-07	7.28E-08	7.86E-08
	100	7.28E-06	7.28E-07	-	2.04E-06	2.91E-07	8.74E-07
	Line Rupture	3.12E-06	-	3.12E-07	8.74E-07	1.25E-07	3.74E-07
NGRS_05	10	3.42E-05	6.84E-07	-	2.71E-06	3.42E-07	3.69E-07
	25	3.42E-05	6.84E-07	-	2.71E-06	3.42E-07	3.69E-07
	50	1.14E-05	2.28E-07	-	9.03E-07	1.14E-07	1.23E-07
	100	1.14E-05	1.14E-06	-	3.19E-06	4.56E-07	1.37E-06
	Line Rupture	5.70E-06	-	5.70E-07	1.60E-06	2.28E-07	6.84E-07
NGRS_06	10	1.56E-05	3.12E-07	-	1.24E-06	1.56E-07	1.68E-07
	25	1.56E-05	3.12E-07	-	1.24E-06	1.56E-07	1.68E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	50	5.20E-06	1.04E-07	-	4.12E-07	5.20E-08	5.62E-08
	100	5.20E-06	5.20E-07	-	1.46E-06	2.08E-07	6.24E-07
	Line Rupture	2.60E-06	-	2.60E-07	7.28E-07	1.04E-07	3.12E-07
NGRS_07	10	2.20E-05	4.40E-07	-	1.90E-06	2.20E-07	7.92E-08
	25	2.20E-05	4.40E-07	-	1.74E-06	2.20E-07	2.38E-07
	50	1.54E-05	3.08E-07	-	1.22E-06	1.54E-07	1.66E-07
	100	1.54E-05	3.08E-07	-	1.22E-06	1.54E-07	1.66E-07
	Line Rupture	6.60E-06	-	6.60E-07	1.85E-06	2.64E-07	7.92E-07
NGRS_08	10	8.71E-07	1.74E-08	-	6.90E-08	8.71E-09	9.41E-09
	25	8.71E-07	1.74E-08	-	6.90E-08	8.71E-09	9.41E-09
	50	6.10E-07	1.22E-08	-	4.83E-08	6.10E-09	6.58E-09
	100	6.10E-07	6.10E-08	-	1.71E-07	2.44E-08	7.32E-08
	Line Rupture	2.61E-07	-	2.61E-08	7.32E-08	1.05E-08	3.14E-08
GRS_01	10	1.60E-05	3.20E-07	-	1.27E-06	1.60E-07	1.73E-07
	25	1.60E-05	3.20E-07	-	1.27E-06	1.60E-07	1.73E-07
	50	1.12E-05	1.12E-06	-	3.14E-06	4.48E-07	1.34E-06
	100	1.12E-05	1.12E-06	-	3.14E-06	4.48E-07	1.34E-06
	Line Rupture	4.80E-06	-	4.80E-07	1.34E-06	1.92E-07	5.76E-07
GRS_02	10	3.50E-06	7.00E-08	-	2.77E-07	3.50E-08	3.78E-08
	25	3.50E-06	7.00E-08	-	2.77E-07	3.50E-08	3.78E-08
	50	2.45E-06	2.45E-07	-	6.86E-07	9.80E-08	2.94E-07
	100	2.45E-06	2.45E-07	-	6.86E-07	9.80E-08	2.94E-07
	Line Rupture	1.05E-06	-	1.05E-07	2.94E-07	4.20E-08	1.26E-07
GRS_03	10	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	25	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	50	2.80E-06	2.80E-07	-	7.84E-07	1.12E-07	3.36E-07
	100	2.80E-06	2.80E-07	-	7.84E-07	1.12E-07	3.36E-07
	Line Rupture	1.20E-06	-	1.20E-07	3.36E-07	4.80E-08	1.44E-07
GRS_04	10	1.05E-05	2.10E-07	-	8.32E-07	1.05E-07	1.13E-07
	25	1.05E-05	2.10E-07	-	8.32E-07	1.05E-07	1.13E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	50	7.35E-06	7.35E-07	-	2.06E-06	2.94E-07	8.82E-07
	100	7.35E-06	7.35E-07	-	2.06E-06	2.94E-07	8.82E-07
	Line Rupture	3.15E-06	-	3.15E-07	8.82E-07	1.26E-07	3.78E-07
GRS_05	10	9.50E-06	1.90E-07	-	7.52E-07	9.50E-08	1.03E-07
	25	9.50E-06	1.90E-07	-	7.52E-07	9.50E-08	1.03E-07
	50	6.65E-06	6.65E-07	-	1.86E-06	2.66E-07	7.98E-07
	100	6.65E-06	6.65E-07	-	1.86E-06	2.66E-07	7.98E-07
	Line Rupture	2.85E-06	-	2.85E-07	7.98E-07	1.14E-07	3.42E-07
GRS_06	10	2.00E-06	4.00E-08	-	1.58E-07	2.00E-08	2.16E-08
	25	2.00E-06	4.00E-08	-	1.58E-07	2.00E-08	2.16E-08
	50	1.40E-06	1.40E-07	-	3.92E-07	5.60E-08	1.68E-07
	100	1.40E-06	1.40E-07	-	3.92E-07	5.60E-08	1.68E-07
	Line Rupture	6.00E-07	-	6.00E-08	1.68E-07	2.40E-08	7.20E-08
GRS_07	10	4.50E-06	9.00E-08	-	3.89E-07	4.50E-08	1.62E-08
	25	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	50	3.15E-06	6.30E-08	-	2.49E-07	3.15E-08	3.40E-08
	100	3.15E-06	6.30E-08	-	2.49E-07	3.15E-08	3.40E-08
	Line Rupture	1.35E-06	-	1.35E-07	3.78E-07	5.40E-08	1.62E-07
GRS_08	10	8.71E-07	1.74E-08	-	6.90E-08	8.71E-09	9.41E-09
	25	8.71E-07	1.74E-08	-	6.90E-08	8.71E-09	9.41E-09
	50	6.10E-07	6.10E-08	-	1.71E-07	2.44E-08	7.32E-08
	100	6.10E-07	6.10E-08	-	1.71E-07	2.44E-08	7.32E-08
	Line Rupture	2.61E-07	-	2.61E-08	7.32E-08	1.05E-08	3.14E-08
GRS_11	10	7.00E-06	1.40E-07	-	6.05E-07	7.00E-08	2.52E-08
	25	7.00E-06	1.40E-07	-	5.54E-07	7.00E-08	7.56E-08
	50	4.90E-06	9.80E-08	-	3.88E-07	4.90E-08	5.29E-08
	100	4.90E-06	4.90E-07	-	1.37E-06	1.96E-07	5.88E-07
	Line Rupture	2.10E-06	-	2.10E-07	5.88E-07	8.40E-08	2.52E-07
GRS_12	10	9.50E-06	1.90E-07	-	8.21E-07	9.50E-08	3.42E-08
	25	9.50E-06	1.90E-07	-	7.52E-07	9.50E-08	1.03E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	50	6.65E-06	1.33E-07	-	5.27E-07	6.65E-08	7.18E-08
	100	6.65E-06	6.65E-07	-	1.86E-06	2.66E-07	7.98E-07
	Line Rupture	2.85E-06	-	2.85E-07	7.98E-07	1.14E-07	3.42E-07
GRS_13	10	4.50E-06	9.00E-08	-	3.89E-07	4.50E-08	1.62E-08
	25	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	50	1.50E-06	3.00E-08	-	1.19E-07	1.50E-08	1.62E-08
	100	1.50E-06	1.50E-07	-	4.20E-07	6.00E-08	1.80E-07
	Line Rupture	7.50E-07	-	7.50E-08	2.10E-07	3.00E-08	9.00E-08
GRS_14	10	4.50E-06	9.00E-08	-	3.89E-07	4.50E-08	1.62E-08
	25	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	50	3.15E-06	6.30E-08	-	2.49E-07	3.15E-08	3.40E-08
	100	3.15E-06	3.15E-07	-	8.82E-07	1.26E-07	3.78E-07
	Line Rupture	1.35E-06	-	1.35E-07	3.78E-07	5.40E-08	1.62E-07
GRS_15	10	8.00E-06	1.60E-07	-	6.91E-07	8.00E-08	2.88E-08
	25	8.00E-06	1.60E-07	-	6.34E-07	8.00E-08	8.64E-08
	50	5.60E-06	1.12E-07	-	4.44E-07	5.60E-08	6.05E-08
	100	5.60E-06	5.60E-07	-	1.57E-06	2.24E-07	6.72E-07
	Line Rupture	2.40E-06	-	2.40E-07	6.72E-07	9.60E-08	2.88E-07
GRS_16	10	1.20E-05	2.40E-07	-	1.04E-06	1.20E-07	4.32E-08
	25	1.20E-05	2.40E-07	-	9.50E-07	1.20E-07	1.30E-07
	50	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	100	4.00E-06	4.00E-07	-	1.12E-06	1.60E-07	4.80E-07
	Line Rupture	2.00E-06	-	2.00E-07	5.60E-07	8.00E-08	2.40E-07
GRS_17	10	3.50E-06	7.00E-08	-	3.02E-07	3.50E-08	1.26E-08
	25	3.50E-06	7.00E-08	-	2.77E-07	3.50E-08	3.78E-08
	50	2.45E-06	4.90E-08	-	1.94E-07	2.45E-08	2.65E-08
	100	2.45E-06	2.45E-07	-	6.86E-07	9.80E-08	2.94E-07
	Line Rupture	1.05E-06	-	1.05E-07	2.94E-07	4.20E-08	1.26E-07
GRS_18	10	2.65E-05	5.30E-07	-	2.29E-06	2.65E-07	9.54E-08
	25	2.65E-05	5.30E-07	-	2.10E-06	2.65E-07	2.86E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency (per year)				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	50	1.86E-05	3.71E-07	-	1.47E-06	1.86E-07	2.00E-07
	100	1.86E-05	3.71E-07	-	1.47E-06	1.86E-07	2.00E-07
	Line Rupture	7.95E-06	-	7.95E-07	2.23E-06	3.18E-07	9.54E-07
GRS_19	10	8.71E-07	1.74E-08	-	7.53E-08	8.71E-09	3.14E-09
	25	8.71E-07	1.74E-08	-	6.90E-08	8.71E-09	9.41E-09
	50	6.10E-07	1.22E-08	-	4.83E-08	6.10E-09	6.58E-09
	100	6.10E-07	6.10E-08	-	1.71E-07	2.44E-08	7.32E-08
	Line Rupture	2.61E-07	-	2.61E-08	7.32E-08	1.05E-08	3.14E-08

Table 5F.31 Hazardous Event Frequency: QRA Study for GRS at the LPS

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
NGRS_01	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_02	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_03	10	3.00E-07	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	3.00E-07	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	1.00E-07	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-07	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-07	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_04	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_05	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_06	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_07	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_08	10	1.50E-05	3.00E-07	-	1.30E-06	1.50E-07	5.40E-08
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_09	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06		2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_10	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_11	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
NGRS_12	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_13	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_14	10	1.50E-05	3.00E-07	-	1.30E-06	1.50E-07	5.40E-08
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_15	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_16	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_17	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_18	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_19	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_20	10	1.50E-05	3.00E-07	-	1.30E-06	1.50E-07	5.40E-08
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_21	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_22	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_23	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_24	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_25	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_26	10	1.50E-05	3.00E-07	-	1.30E-06	1.50E-07	5.40E-08
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_27	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_28	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_29	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_30	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_31	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_32	10	1.50E-05	3.00E-07	-	1.30E-06	1.50E-07	5.40E-08
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_33	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_34	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
NGRS_35	10	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
	25	1.50E-05	3.00E-07	-	1.19E-06	1.50E-07	1.62E-07
	50	5.00E-06	1.00E-07	-	3.96E-07	5.00E-08	5.40E-08
	100	5.00E-06	5.00E-07	-	1.40E-06	2.00E-07	6.00E-07
	Line Rupture	2.50E-06	-	2.50E-07	7.00E-07	1.00E-07	3.00E-07
GRS_01	10	2.40E-05	4.80E-07	-	1.90E-06	2.40E-07	2.59E-07
	25	2.40E-05	4.80E-07	-	1.90E-06	2.40E-07	2.59E-07
	50	8.00E-06	1.60E-07	-	6.34E-07	8.00E-08	8.64E-08
	100	8.00E-06	8.00E-07	-	2.24E-06	3.20E-07	9.60E-07
	Line Rupture	4.00E-06	-	4.80E-07	1.12E-06	1.60E-07	4.80E-07
GRS_02	10	1.20E-05	2.40E-07	-	9.50E-07	1.20E-07	1.30E-07
	25	1.20E-05	2.40E-07	-	9.50E-07	1.20E-07	1.30E-07
	50	4.00E-06	8.00E-08	-	3.17E-07	4.00E-08	4.32E-08
	100	4.00E-06	4.00E-07	-	1.12E-06	1.60E-07	4.80E-07
	Line Rupture	2.00E-06	-	2.00E-07	5.60E-07	8.00E-08	2.40E-07
GRS_03	10	9.00E-06	1.80E-07	-	7.13E-07	9.00E-08	9.72E-08
	25	9.00E-06	1.80E-07	-	7.13E-07	9.00E-08	9.72E-08
	50	3.00E-06	6.00E-08	-	2.38E-07	3.00E-08	3.24E-08
	100	3.00E-06	3.00E-07	-	8.40E-07	1.20E-07	3.60E-07
	Line Rupture	1.50E-06	-	1.50E-07	4.20E-07	6.00E-08	1.80E-07
GRS_04	10	1.80E-05	3.60E-07	-	1.43E-06	1.80E-07	1.94E-07
	25	1.80E-05	3.60E-07	-	1.43E-06	1.80E-07	1.94E-07
	50	6.00E-06	1.20E-07	-	4.75E-07	6.00E-08	6.48E-08
	100	6.00E-06	6.00E-07	-	1.68E-06	2.40E-07	7.20E-07
	Line Rupture	3.00E-06	-	3.00E-07	8.40E-07	1.20E-07	3.60E-07
GRS_05	10	1.35E-05	2.70E-07	-	1.17E-06	1.35E-07	4.86E-08
	25	1.35E-05	2.70E-07	-	1.07E-06	1.35E-07	1.46E-07
	50	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	100	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	Line Rupture	2.25E-06	-	2.25E-07	6.30E-07	9.00E-08	2.70E-07

Hazardous Section	Leak Size (mm)	Release Frequency (per year)	Hazardous Event Frequency				
			Jet Fire	Fireball	Flash Fire Over Plant Area	Flash Fire Full Extent	Vapour Cloud Explosion
GRS_06	10	1.80E-05	3.60E-07	-	1.43E-06	1.80E-07	1.94E-07
	25	1.80E-05	3.60E-07	-	1.43E-06	1.80E-07	1.94E-07
	50	6.00E-06	1.20E-07	-	4.75E-07	6.00E-08	6.48E-08
	100	6.00E-06	6.00E-07	-	1.68E-06	2.40E-07	7.20E-07
	Line Rupture	3.00E-06	-	3.00E-07	8.40E-07	1.20E-07	3.60E-07
GRS_07	10	1.35E-05	2.70E-07	-	1.07E-06	1.35E-07	1.46E-07
	25	1.35E-05	2.70E-07	-	1.07E-06	1.35E-07	1.46E-07
	50	4.50E-06	9.00E-08	-	3.56E-07	4.50E-08	4.86E-08
	100	4.50E-06	4.50E-07	-	1.26E-06	1.80E-07	5.40E-07
	Line Rupture	2.25E-06	-	2.25E-07	6.30E-07	9.00E-08	2.70E-07
GRS_08	10	1.95E-05	3.90E-07	-	1.54E-06	1.95E-07	2.11E-07
	25	1.95E-05	3.90E-07	-	1.54E-06	1.95E-07	2.11E-07
	50	6.50E-06	1.30E-07	-	5.15E-07	6.50E-08	7.02E-08
	100	6.50E-06	6.50E-07	-	1.82E-06	2.60E-07	7.80E-07
	Line Rupture	3.25E-06	-	3.25E-07	9.10E-07	1.30E-07	3.90E-07
GRS_09	10	3.60E-05	7.20E-07	-	3.11E-06	3.60E-07	1.30E-07
	25	3.60E-05	7.20E-07	-	2.85E-06	3.60E-07	3.89E-07
	50	1.20E-05	2.40E-07	-	9.50E-07	1.20E-07	1.30E-07
	100	1.20E-05	1.20E-06	-	3.36E-06	4.80E-07	1.44E-06
	Line Rupture	6.00E-06	-	6.00E-07	1.68E-06	2.40E-07	7.20E-07
GRS_10	10	1.05E-05	2.10E-07	-	8.32E-07	1.05E-07	1.13E-07
	25	1.05E-05	2.10E-07	-	8.32E-07	1.05E-07	1.13E-07
	50	3.50E-06	7.00E-08	-	2.77E-07	3.50E-08	3.78E-08
	100	3.50E-06	3.50E-07	-	9.80E-07	1.40E-07	4.20E-07
	Line Rupture	1.75E-06	-	1.75E-07	4.90E-07	7.00E-08	2.10E-07

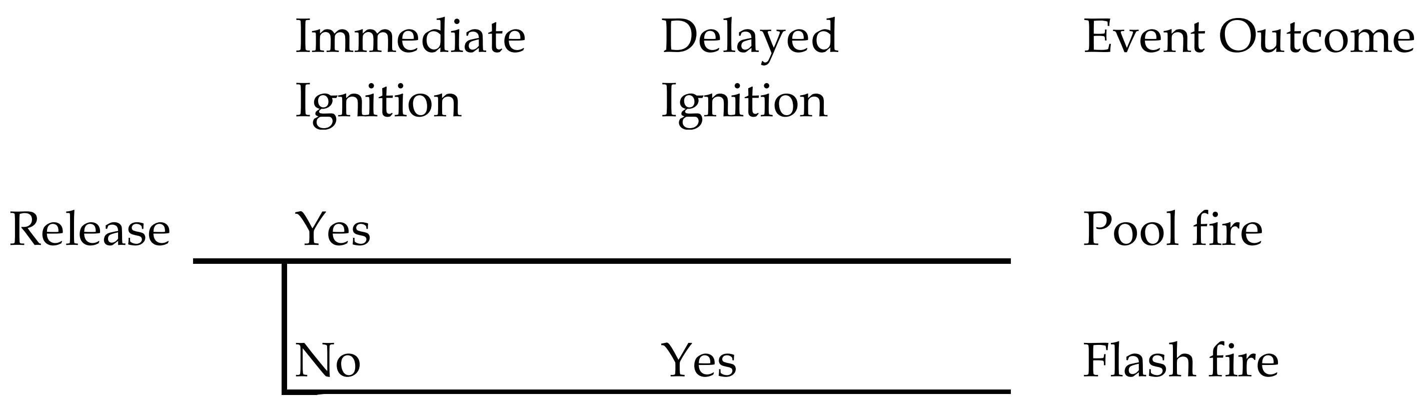


Figure 5F.1

Event Tree Analysis for LNG Release from LNGC

Environmental Resources Management

ERM

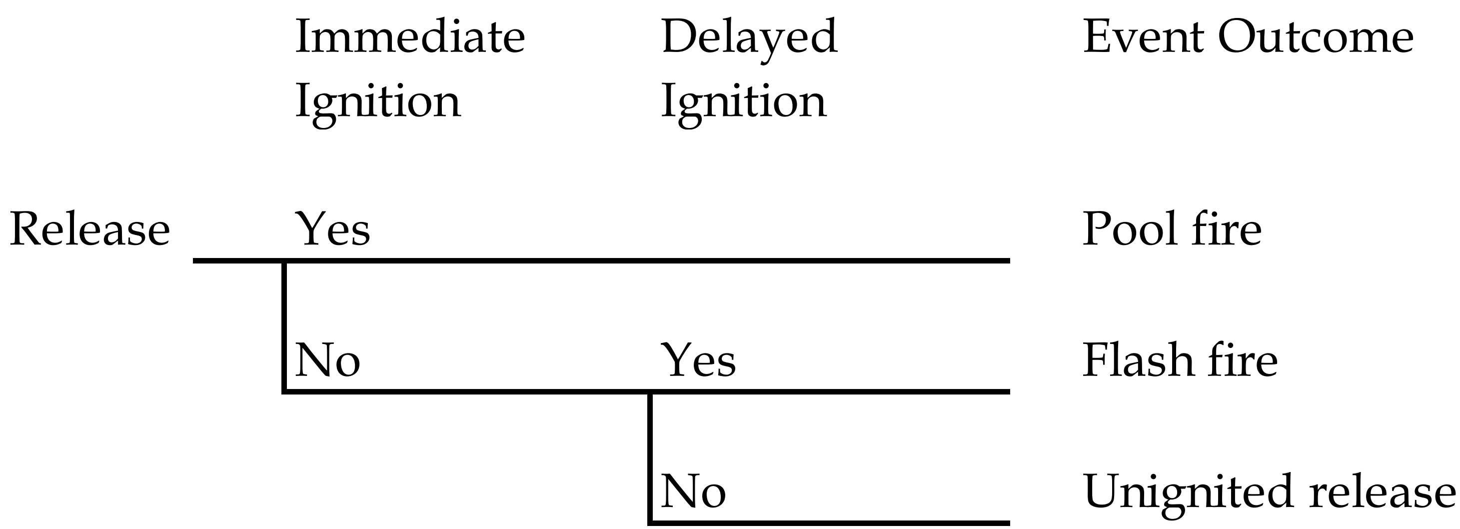


Figure 5F.2

Event Tree Analysis for LNG Release from the LNG Terminal

Environmental Resources Management

ERM

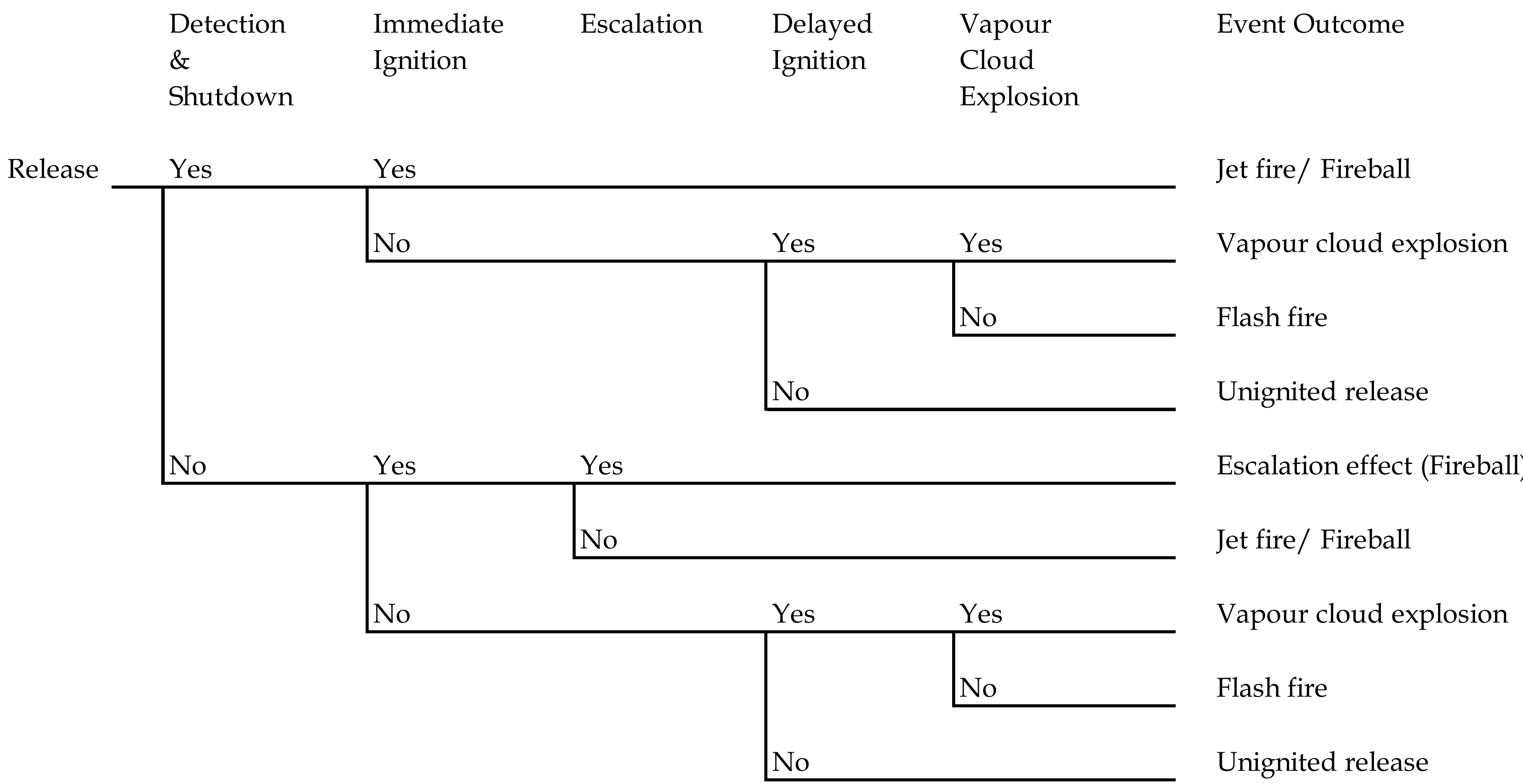


Figure 5F.3

Event Tree Analysis for Natural Gas Release from the LNG Terminal

Environmental Resources Management

ERM

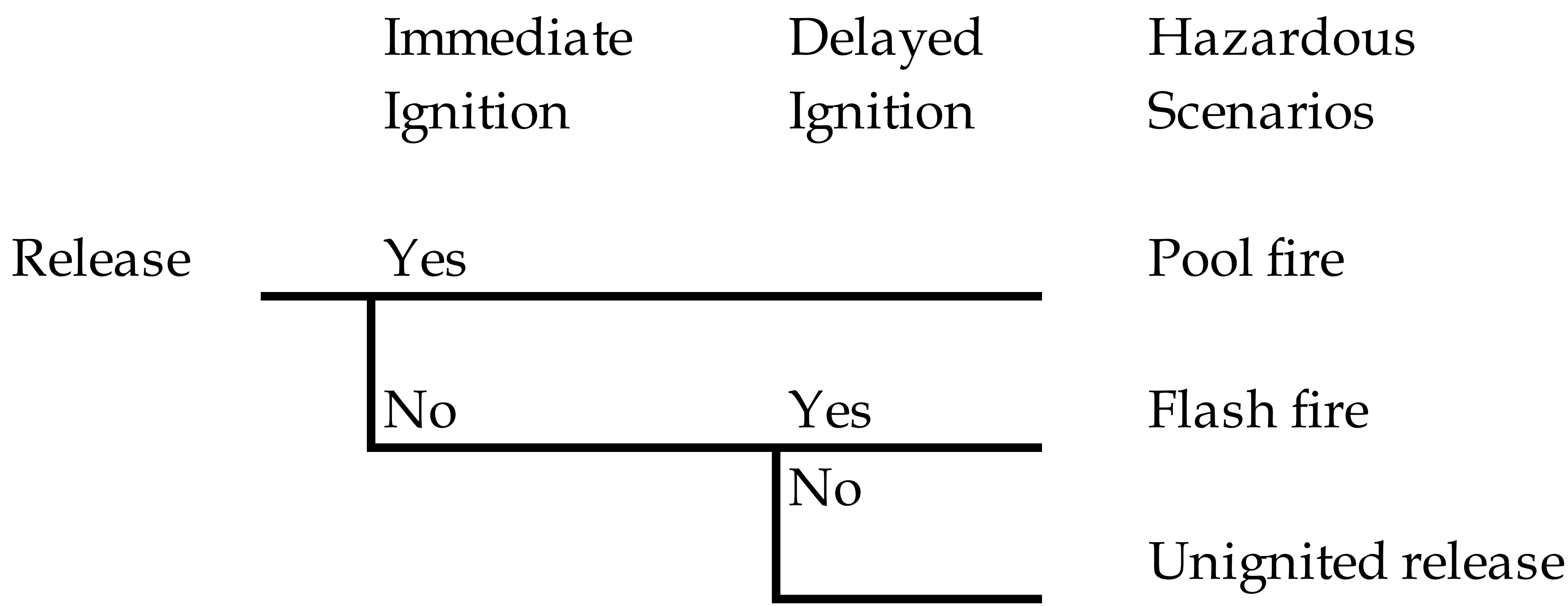


Figure 5F.4

Event Tree Analysis for Diesel Release from the LNG Terminal

Environmental Resources Management

ERM

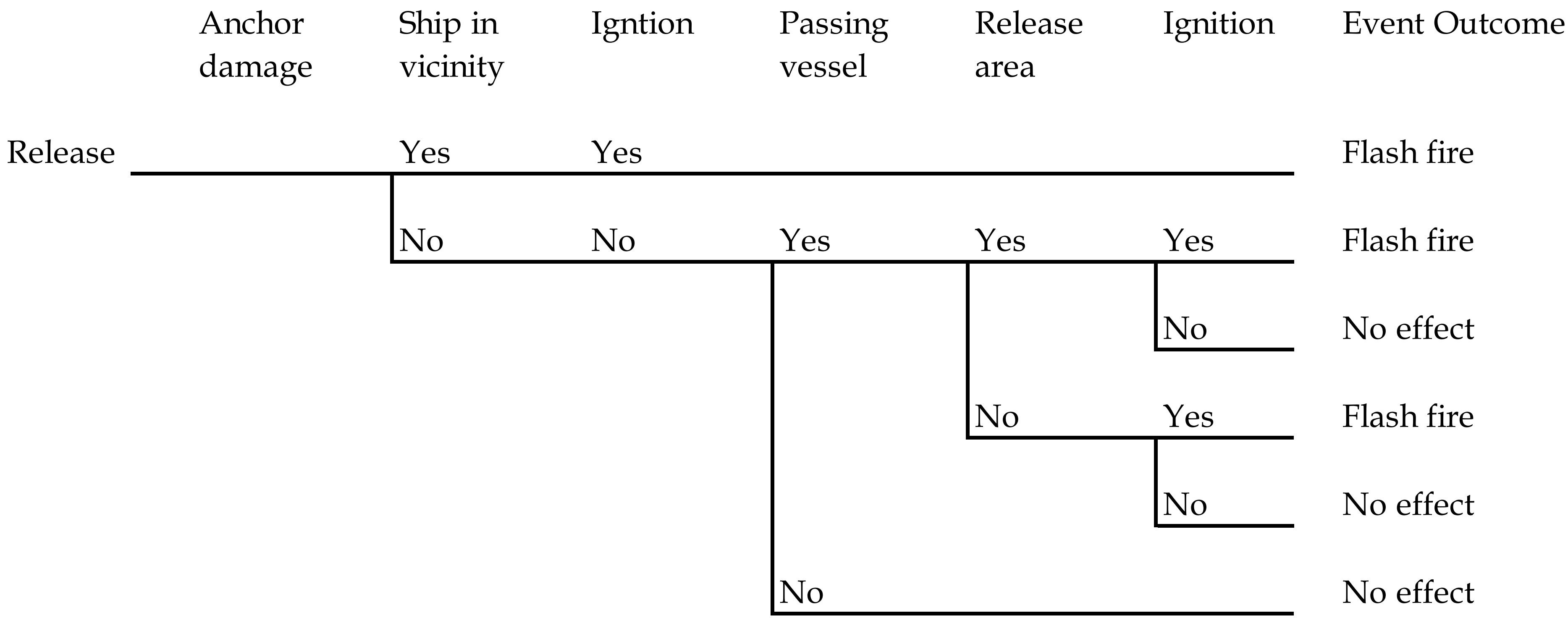


Figure 5F.5

Event Tree Analysis for Natural Gas Release from Subsea Pipeline (External Damage from Anchors)

Environmental Resources Management

ERM

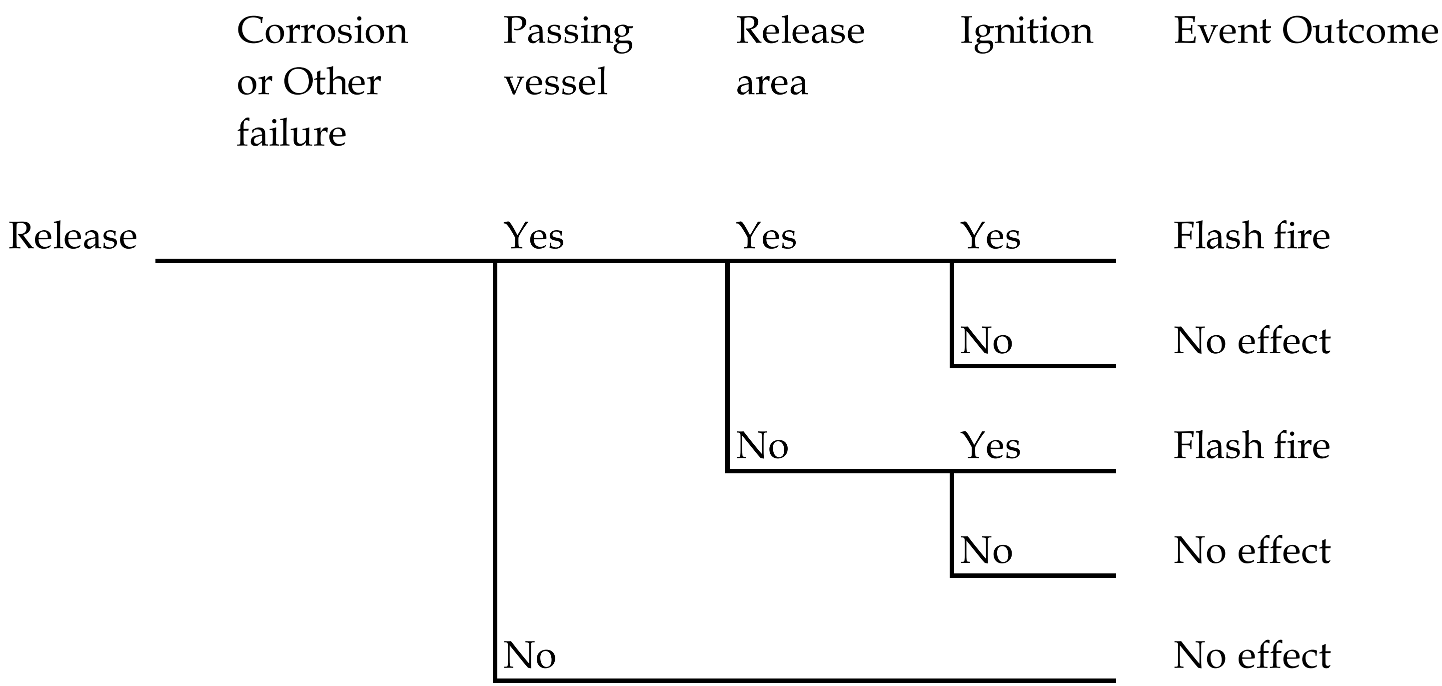


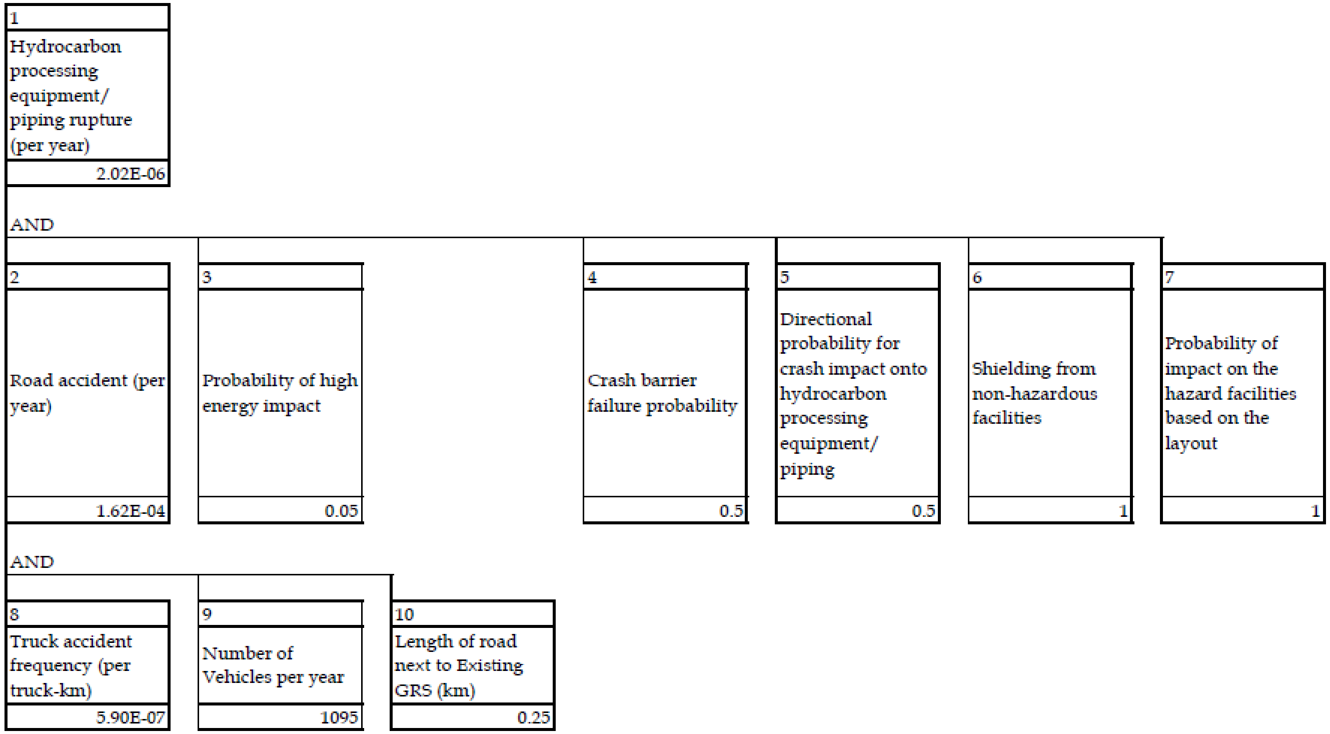
Figure 5F.6

Event Tree Analysis for Natural Gas Release from Subsea Pipeline (Spontaneous Failures)

Environmental Resources Management

ERM

Fault Tree for Construction Vehicles Impact on Existing BPPS GRS Facilities for Construction of the Proposed GRS at the BPPS



Note:

Item 3: Probability of high energy impact is 5% based on the UK (P A Davies & F P Lees, The assessment of major hazards: The road transport environment for conveyance of hazardous materials in Great Britain, Journal of Hazardous Materials, 32 (1992) 41-79) which assess the ratio of fatal incidents to non fatal accidents. The range was roughly estimated at 2%-5% for roads with speed limits lower than 40 mph.

Item 4: Crash barrier gives protection on the impact. 50% failure probability is conservatively taken to account for dependencies with Item 3.

Item 5: Directional probability for crash impact onto hydrocarbon processing equipment/ piping is taken at 0.5, as the the GRS facilities are located on one side only along the access road.

Item 6: Shielding from non-hazardous facilities factor is taken as 1, assuming no shielding protection.

Item 7: Probability of impact on the hazard facilities based on the layout is conservatively taken as 1, assuming the accident leading to loss of containment could occur along the whole access road.

Item 9: Three (3) construction trucks per day are assumed for 365 days a year.

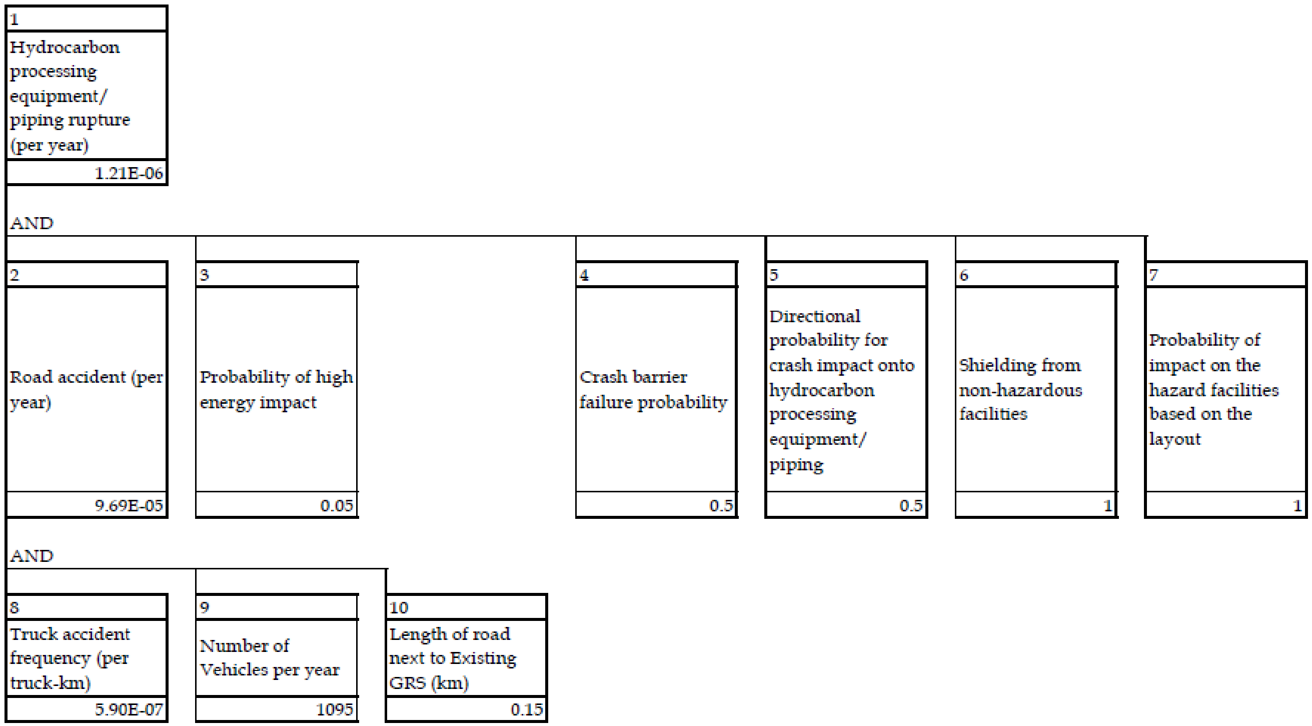
Figure 5F.7

Fault Tree Diagram for Construction Vehicle Impact on Existing BPPS GRS Facilities

Environmental Resources Management

ERM

Fault Tree for Construction Vehicles Impact on Existing BPPS GRS Facilities for Construction of the Proposed GRS at the LPS



Note:

Item 3: Probability of high energy impact is 5% based on the UK (P A Davies & F P Lees, The assessment of major hazards: The road transport environment for conveyance of hazardous materials in Great Britain, Journal of Hazardous Materials, 32 (1992) 41-79) which assess the ratio of fatal incidents to non fatal accidents. The range was roughly estimated at 2%-5% for roads with speed limits lower than 40 mph.

Item 4: Crash barrier gives protection on the impact. 50% failure probability is conservatively taken to account for dependencies with Item 3.

Item 5: Directional probability for crash impact onto hydrocarbon processing equipment/ piping is taken at 0.5, as the the GRS facilities are located on one side only along the access road.

Item 6: Shielding from non-hazardous facilities factor is taken as 1, assuming no shielding protection.

Item 7: Probability of impact on the hazard facilities based on the layout is conservatively taken as 1, assuming the accident leading to loss of containment could occur along the whole access road.

Item 9: Three (3) construction trucks per day are assumed for 365 days a year.

Figure 5F.8

Fault Tree Diagram for Construction Vehicle Impact on Existing LPS GRS Facilities

Environmental Resources Management

ERM

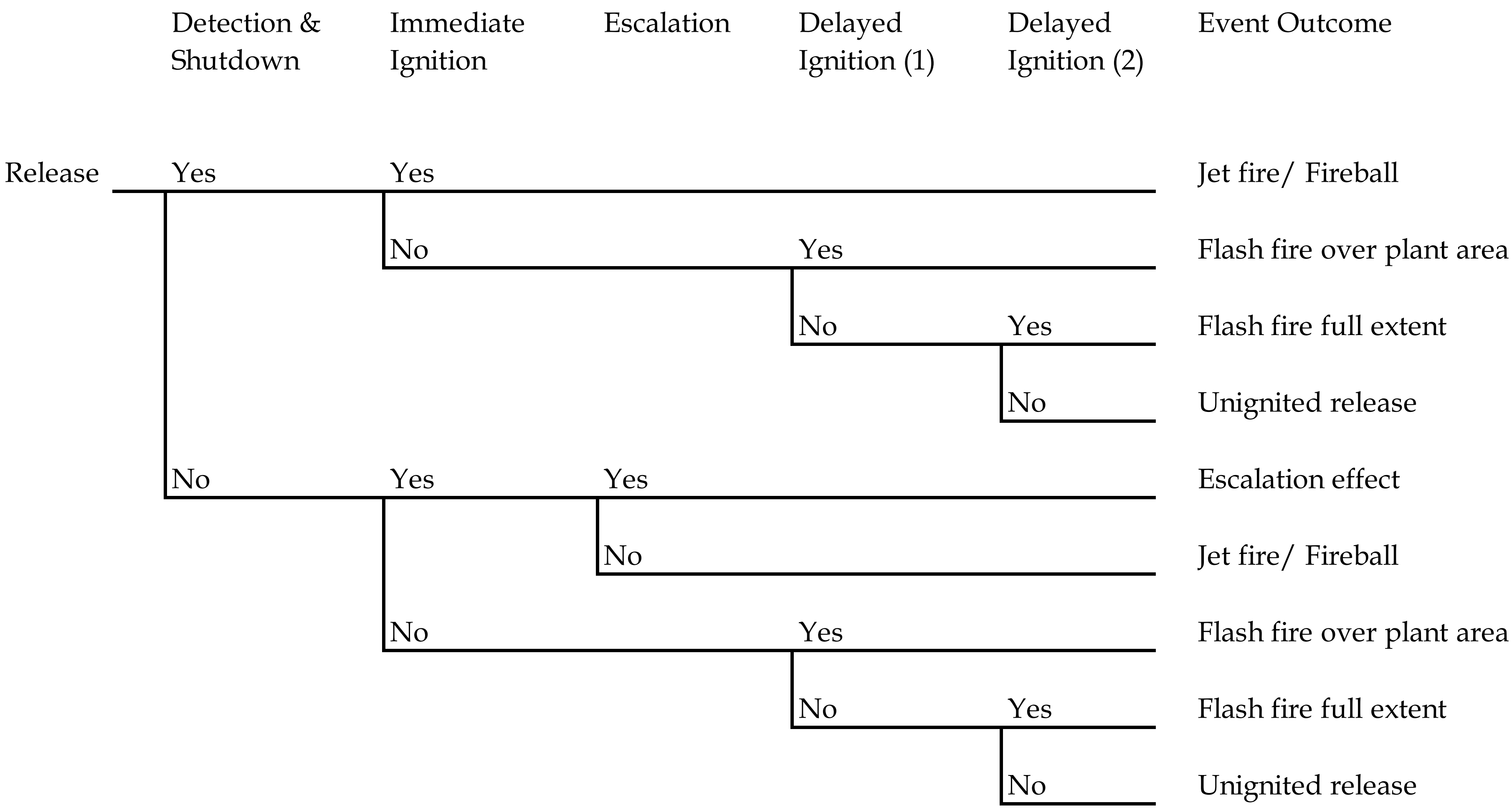


Figure 5F.9

Event Tree Analysis for Natural Gas Release from the Proposed GRSs at the BPPS and LPS

Environmental Resources Management
ERM

Annex 5F-1

Full List of Event Tree Analysis for the LNG Terminal

Hazardous Section HKOLNGT_01

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 10 mm hole size	3.01E-03	0.99	6.48E-04				1.93E-06	Jet Fire
					6.22E-04	2.59E-05	7.72E-08	Vapour Cloud Explosion
							1.85E-06	Flash Fire
							2.97E-03	Unignited release
		0.01	6.48E-04	*				Escalation effect (Fireball)
							1.95E-08	Jet Fire
					6.22E-04	2.59E-05	7.80E-10	Vapour Cloud Explosion
							1.87E-08	Flash Fire
							3.00E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 25 mm hole size	1.26E-03	0.99	5.73E-03				7.14E-06	Jet Fire
					5.05E-03	6.88E-04	8.57E-07	Vapour Cloud Explosion
							6.29E-06	Flash Fire
							1.23E-03	Unignited release
		0.01	5.73E-03	*				Escalation effect (Fireball)
							7.22E-08	Jet Fire
					5.05E-03	6.88E-04	8.66E-09	Vapour Cloud Explosion
							6.35E-08	Flash Fire
							1.24E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 50 mm hole size	2.25E-05	0.99	3.08E-02				6.86E-07	Jet Fire
					2.71E-02	3.70E-03	8.23E-08	Vapour Cloud Explosion
							6.04E-07	Flash Fire
							2.09E-05	Unignited release
		0.01	3.08E-02	*				Escalation effect (Fireball)
							6.93E-09	Jet Fire
					2.71E-02	3.70E-03	8.32E-10	Vapour Cloud Explosion
							6.10E-09	Flash Fire
							2.11E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 150 mm hole size	1.84E-03	0.99	7.50E-02				1.37E-04	Pool Fire
					5.25E-02	2.25E-02	4.10E-05	Vapour Cloud Explosion
							9.57E-05	Flash Fire
							1.55E-03	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							1.38E-06	Jet Fire
					5.25E-02	2.25E-02	4.14E-07	Vapour Cloud Explosion
							9.66E-07	Flash Fire
							1.56E-05	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_02

	Release Frequency (per year)	Detection & Shutdown Failure Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 10 mm hole size	3.33E-06	1	6.03E-04	*				Escalation effect (Fireball)
							2.01E-09	Pool Fire
					6.03E-04	2.41E-05	8.05E-11	Vapour Cloud Explosion
							1.93E-09	Flash Fire
							3.33E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 25 mm hole size	3.33E-06	1	1.74E-03	*				Escalation effect (Fireball)
							5.80E-09	Pool Fire
					1.53E-03	2.09E-04	6.96E-10	Vapour Cloud Explosion
							5.10E-09	Flash Fire
							3.32E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 50 mm hole size	3.33E-06	1	9.34E-03	*				Escalation effect (Fireball)
							3.11E-08	Pool Fire
					8.22E-03	1.12E-03	3.74E-09	Vapour Cloud Explosion
							2.74E-08	Flash Fire
							3.27E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as Catastrophic Rupture	2.50E-08	1	9.34E-03	*				Escalation effect (Fireball)
							1.88E-09	Pool Fire
					5.25E-02	2.25E-02	5.63E-10	Vapour Cloud Explosion
							1.31E-09	Flash Fire
							2.13E-08	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_03

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 10 mm hole size	9.77E-03	0.99	7.61E-04				7.36E-06	Jet Fire
					6.69E-04	9.13E-05	8.83E-07	Vapour Cloud Explosion
							6.47E-06	Flash Fire
							9.66E-03	Unignited release
		0.01	7.61E-04	*				Escalation effect (Fireball)
							7.43E-08	Jet Fire
					6.69E-04	9.13E-05	8.92E-09	Vapour Cloud Explosion
							6.54E-08	Flash Fire
							9.76E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 25 mm hole size	8.20E-04	0.99	7.03E-03				5.71E-06	Jet Fire
					6.19E-03	8.44E-04	8.83E-07	Vapour Cloud Explosion
							5.02E-06	Flash Fire
							8.00E-04	Unignited release
		0.01	7.03E-03	*				Escalation effect (Fireball)
							5.77E-08	Jet Fire
					6.19E-03	8.44E-04	6.92E-09	Vapour Cloud Explosion
							5.08E-08	Flash Fire
							8.08E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 50 mm hole size	1.38E-04	0.99	3.78E-02				5.17E-06	Jet Fire
					3.33E-02	4.54E-03	6.20E-07	Vapour Cloud Explosion
							4.55E-06	Flash Fire
							1.26E-04	Unignited release
		0.01	3.78E-02	*				Escalation effect (Fireball)
							5.22E-08	Jet Fire
					3.33E-02	4.54E-03	6.27E-09	Vapour Cloud Explosion
							4.60E-08	Flash Fire
							1.28E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 150 mm hole size	7.50E-05	0.99	7.50E-02				5.57E-06	Pool Fire
					5.25E-02	2.25E-02	1.67E-06	Vapour Cloud Explosion
							3.90E-06	Flash Fire
							6.31E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							5.63E-08	Pool Fire
					5.25E-02	2.25E-02	1.69E-08	Vapour Cloud Explosion
							3.94E-08	Flash Fire
							6.38E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration. As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_04

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.44E-02	0.99	3.47E-03				8.41E-05	Jet fire
					3.06E-03	4.17E-04	1.01E-05	Vapour cloud explosion
							7.40E-05	Flash fire
							2.40E-02	Unignited release
		0.01	3.47E-03	*				Escalation effect (Fireball)
							8.49E-07	Jet fire
					3.06E-03	4.17E-04	1.02E-07	Vapour cloud explosion
							7.47E-07	Flash fire
							2.43E-04	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.64E-03	0.99	3.21E-02				5.22E-05	Jet fire
					2.83E-02	3.85E-03	6.27E-06	Vapour cloud explosion
							4.60E-05	Flash fire
							1.52E-03	Unignited release
		0.01	3.21E-02	*				Escalation effect (Fireball)
							5.27E-07	Jet fire
					2.83E-02	3.85E-03	6.33E-08	Vapour cloud explosion
							4.64E-07	Flash fire
							1.54E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	2.25E-04	0.99	7.50E-02				1.67E-05	Jet fire
					5.25E-02	2.25E-02	5.00E-06	Vapour cloud explosion
							1.17E-05	Flash fire
							1.89E-04	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							1.68E-07	Jet fire
					5.25E-02	2.25E-02	5.05E-08	Vapour cloud explosion
							1.18E-07	Flash fire
							1.91E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	8.86E-05	0.99	7.50E-02				6.58E-06	Jet fire
					5.25E-02	2.25E-02	1.97E-06	Vapour cloud explosion
							4.60E-06	Flash fire
							7.46E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							6.65E-08	Jet fire
					5.25E-02	2.25E-02	1.99E-08	Vapour cloud explosion
							4.65E-08	Flash fire
							7.53E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_05

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	1.70E-02	0.99	8.59E-04				1.45E-05	Jet fire
					7.56E-04	1.03E-04	1.74E-06	Vapour cloud explosion
							1.28E-05	Flash fire
							1.68E-02	Unignited release
		0.01	8.59E-04	*				Escalation effect (Fireball)
							1.46E-07	Jet fire
					7.56E-04	1.03E-04	1.76E-08	Vapour cloud explosion
							1.29E-07	Flash fire
							1.70E-04	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.68E-03	0.99	7.95E-03				1.32E-05	Jet fire
					6.99E-03	9.54E-04	1.59E-06	Vapour cloud explosion
							1.16E-05	Flash fire
							1.64E-03	Unignited release
		0.01	7.95E-03	*				Escalation effect (Fireball)
							1.34E-07	Jet fire
					6.99E-03	9.54E-04	1.60E-08	Vapour cloud explosion
							1.17E-07	Flash fire
							1.65E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	3.20E-04	0.99	4.28E-02				1.35E-05	Jet fire
					3.76E-02	5.13E-03	1.63E-06	Vapour cloud explosion
							1.19E-05	Flash fire
							2.90E-04	Unignited release
		0.01	4.28E-02	*				Escalation effect (Fireball)
							1.37E-07	Jet fire
					3.76E-02	5.13E-03	1.64E-08	Vapour cloud explosion
							1.20E-07	Flash fire
							2.93E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	2.00E-04	0.99	7.50E-02				1.49E-05	Fireball
					5.25E-02	2.25E-02	4.46E-06	Vapour cloud explosion
							1.04E-05	Flash fire
							1.68E-04	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							1.50E-07	Fireball
					5.25E-02	2.25E-02	4.50E-08	Vapour cloud explosion
							1.05E-07	Flash fire
							1.70E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_06

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	1.17E-02	0.99	5.61E-03				6.48E-05	Jet fire
					4.94E-03	6.74E-04	7.78E-06	Vapour cloud explosion
							5.70E-05	Flash fire
							1.13E-02	Unignited release
		0.01	5.61E-03	*				Escalation effect (Fireball)
							8.75E-06	Jet fire
					4.94E-03	6.74E-04	2.62E-06	Vapour cloud explosion
							6.12E-06	Flash fire
							8.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.02E-03	0.99	7.63E-03				4.55E-05	Jet fire
					6.72E-03	9.16E-04	5.46E-06	Vapour cloud explosion
							4.01E-05	Flash fire
							5.78E-03	Unignited release
		0.01	7.63E-03	*				Escalation effect (Fireball)
							4.60E-07	Jet fire
					6.72E-03	9.16E-04	5.52E-08	Vapour cloud explosion
							4.05E-07	Flash fire
							5.84E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	7.40E-05	0.99	4.11E-02				3.01E-06	Jet fire
					3.61E-02	4.93E-03	3.61E-07	Vapour cloud explosion
							2.65E-06	Flash fire
							6.12E-05	Unignited release
		0.01	4.11E-02	*				Escalation effect (Fireball)
							3.04E-08	Jet fire
					3.61E-02	4.93E-03	3.65E-09	Vapour cloud explosion
							2.67E-08	Flash fire
							6.18E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	9.20E-03	0.99	7.50E-02				6.83E-04	Fireball
					5.25E-02	2.25E-02	2.05E-04	Vapour cloud explosion
							4.78E-04	Flash fire
							6.37E-03	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							6.90E-06	Fireball
					5.25E-02	2.25E-02	2.07E-06	Vapour cloud explosion
							4.83E-06	Flash fire
							6.44E-05	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_07

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	8.19E-03	0.99	8.26E-04				6.69E-06	Jet fire
					7.27E-04	9.91E-05	8.03E-07	Vapour cloud explosion
							5.89E-06	Flash fire
							8.08E-03	Unignited release
		0.01	8.26E-04	*				Escalation effect (Fireball)
							6.76E-08	Jet fire
					7.27E-04	9.91E-05	8.11E-09	Vapour cloud explosion
							5.95E-08	Flash fire
							8.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.11E-04	0.99	7.63E-03				4.62E-06	Jet fire
					6.72E-03	9.16E-04	5.54E-07	Vapour cloud explosion
							4.06E-06	Flash fire
							5.86E-04	Unignited release
		0.01	7.63E-03	*				Escalation effect (Fireball)
							4.66E-08	Jet fire
					6.72E-03	9.16E-04	5.60E-09	Vapour cloud explosion
							4.10E-08	Flash fire
							5.92E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	9.42E-05	0.99	4.11E-02				3.83E-06	Jet fire
					3.61E-02	4.93E-03	4.60E-07	Vapour cloud explosion
							3.37E-06	Flash fire
							7.79E-05	Unignited release
		0.01	4.11E-02	*				Escalation effect (Fireball)
							3.87E-08	Jet fire
					3.61E-02	4.93E-03	4.64E-09	Vapour cloud explosion
							3.40E-08	Flash fire
							7.87E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	4.12E-05	0.99	7.50E-02				3.06E-06	Fireball
					5.25E-02	2.25E-02	9.18E-07	Vapour cloud explosion
							2.14E-06	Flash fire
							2.86E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							3.09E-08	Fireball
					5.25E-02	2.25E-02	9.27E-09	Vapour cloud explosion
							2.16E-08	Flash fire
							2.88E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_08

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	7.20E-05	0.99	8.26E-04				5.88E-08	Jet fire
					7.27E-04	9.91E-05	7.06E-09	Vapour cloud explosion
							5.18E-08	Flash fire
							7.10E-05	Unignited release
		0.01	8.26E-04	*				Escalation effect (Fireball)
							5.94E-10	Jet fire
					7.27E-04	9.91E-05	7.13E-11	Vapour cloud explosion
							5.23E-10	Flash fire
							7.18E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.80E-05	0.99	7.63E-03				1.36E-07	Jet fire
					6.72E-03	9.16E-04	1.63E-08	Vapour cloud explosion
							1.20E-07	Flash fire
							1.73E-05	Unignited release
		0.01	7.63E-03	*				Escalation effect (Fireball)
							1.37E-09	Jet fire
					6.72E-03	9.16E-04	1.65E-10	Vapour cloud explosion
							1.21E-09	Flash fire
							1.75E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	3.00E-05	0.99	7.50E-02				2.23E-06	Fireball
					5.25E-02	2.25E-02	6.68E-07	Vapour cloud explosion
							1.56E-06	Flash fire
							2.08E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							2.25E-08	Fireball
					5.25E-02	2.25E-02	6.75E-09	Vapour cloud explosion
							1.58E-08	Flash fire
							2.10E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_10

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	8.19E-03	0.99	8.26E-04				6.69E-06	Jet fire
					7.27E-04	9.91E-05	8.03E-07	Vapour cloud explosion
							5.89E-06	Flash fire
							8.08E-03	Unignited release
		0.01	8.26E-04	*				Escalation effect (Fireball)
							6.76E-08	Jet fire
					7.27E-04	9.91E-05	8.11E-09	Vapour cloud explosion
							5.95E-08	Flash fire
							8.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.28E-04	0.99	7.63E-03				4.75E-06	Jet fire
					6.72E-03	9.16E-04	5.70E-07	Vapour cloud explosion
							4.18E-06	Flash fire
							6.03E-04	Unignited release
		0.01	7.63E-03	*				Escalation effect (Fireball)
							4.79E-08	Jet fire
					6.72E-03	9.16E-04	5.75E-09	Vapour cloud explosion
							4.22E-08	Flash fire
							6.09E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	9.42E-05	0.99	4.11E-02				3.83E-06	Jet fire
					3.61E-02	4.93E-03	4.60E-07	Vapour cloud explosion
							3.37E-06	Flash fire
							7.79E-05	Unignited release
		0.01	4.11E-02	*				Escalation effect (Fireball)
							3.87E-08	Jet fire
					3.61E-02	4.93E-03	4.64E-09	Vapour cloud explosion
							3.40E-08	Flash fire
							7.87E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	4.12E-05	0.99	7.50E-02				3.06E-06	Fireball
					5.25E-02	2.25E-02	9.18E-07	Vapour cloud explosion
							2.14E-06	Flash fire
							2.86E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							3.09E-08	Fireball
					5.25E-02	2.25E-02	9.27E-09	Vapour cloud explosion
							2.16E-08	Flash fire
							2.88E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_11

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	7.20E-05	0.99	8.26E-04				5.88E-08	Jet fire
					7.27E-04	9.91E-05	7.06E-09	Vapour cloud explosion
							5.18E-08	Flash fire
							7.10E-05	Unignited release
		0.01	8.26E-04	*				Escalation effect (Fireball)
							5.94E-10	Jet fire
					7.27E-04	9.91E-05	7.13E-11	Vapour cloud explosion
							5.23E-10	Flash fire
							7.18E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.80E-05	0.99	7.63E-03				1.36E-07	Jet fire
					6.72E-03	9.16E-04	1.63E-08	Vapour cloud explosion
							1.20E-07	Flash fire
							1.73E-05	Unignited release
		0.01	7.63E-03	*				Escalation effect (Fireball)
							1.37E-09	Jet fire
					6.72E-03	9.16E-04	1.65E-10	Vapour cloud explosion
							1.21E-09	Flash fire
							1.75E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	3.00E-05	0.99	7.50E-02				2.23E-06	Fireball
					5.25E-02	2.25E-02	6.68E-07	Vapour cloud explosion
							1.56E-06	Flash fire
							2.08E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							2.25E-08	Fireball
					5.25E-02	2.25E-02	6.75E-09	Vapour cloud explosion
							1.58E-08	Flash fire
							2.10E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_13

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 10 mm hole size	8.21E-03	0.99	7.61E-04				6.18E-06	Jet Fire
					6.69E-04	9.13E-05	7.42E-07	Vapour Cloud Explosion
							5.44E-06	Flash Fire
							8.11E-03	Unignited release
		0.01	7.61E-04	*				Escalation effect (Fireball)
							6.24E-08	Jet Fire
					6.69E-04	9.13E-05	7.49E-09	Vapour Cloud Explosion
							5.49E-08	Flash Fire
							8.19E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 25 mm hole size	6.48E-04	0.99	7.03E-03				4.51E-06	Jet Fire
					6.19E-03	8.44E-04	5.41E-07	Vapour Cloud Explosion
							3.97E-06	Flash Fire
							6.28E-04	Unignited release
		0.01	7.03E-03	*				Escalation effect (Fireball)
							4.56E-08	Jet Fire
					6.19E-03	8.44E-04	5.47E-09	Vapour Cloud Explosion
							4.01E-08	Flash Fire
							6.34E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 50 mm hole size	9.72E-05	0.99	3.78E-02				3.64E-06	Jet Fire
					3.33E-02	4.54E-03	4.37E-07	Vapour Cloud Explosion
							3.20E-06	Flash Fire
							8.53E-05	Unignited release
		0.01	3.78E-02	*				Escalation effect (Fireball)
							3.68E-08	Jet Fire
					3.33E-02	4.54E-03	4.41E-09	Vapour Cloud Explosion
							3.24E-08	Flash Fire
							8.62E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 150 mm hole size	4.32E-05	0.99	7.50E-02				3.21E-06	Pool Fire
					5.25E-02	2.25E-02	9.62E-07	Vapour Cloud Explosion
							2.25E-06	Flash Fire
							2.99E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							3.24E-08	Pool Fire
					5.25E-02	2.25E-02	9.72E-09	Vapour Cloud Explosion
							2.27E-08	Flash Fire
							3.02E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_14

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	3.96E-03	0.99	5.43E-04				2.13E-06	Jet fire
					5.21E-04	2.17E-05	8.51E-08	Vapour cloud explosion
							2.04E-06	Flash fire
							3.91E-03	Unignited release
		0.01	5.43E-04	*				Escalation effect (Fireball)
							2.15E-08	Jet fire
					5.21E-04	2.17E-05	8.60E-10	Vapour cloud explosion
							2.06E-08	Flash fire
							3.95E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	3.96E-04	0.99	6.20E-04				2.43E-07	Jet fire
					5.95E-04	2.48E-05	9.73E-09	Vapour cloud explosion
							2.33E-07	Flash fire
							3.91E-04	Unignited release
		0.01	6.20E-04	*				Escalation effect (Fireball)
							2.46E-09	Jet fire
					5.95E-04	2.48E-05	9.82E-11	Vapour cloud explosion
							2.36E-09	Flash fire
							3.95E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	9.10E-05	0.99	1.59E-03				1.44E-07	Jet fire
					1.40E-03	1.91E-04	1.72E-08	Vapour cloud explosion
							1.26E-07	Flash fire
							8.95E-05	Unignited release
		0.01	1.59E-03	*				Escalation effect (Fireball)
							1.45E-09	Jet fire
					1.40E-03	1.91E-04	1.74E-10	Vapour cloud explosion
							1.28E-09	Flash fire
							9.04E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	3.30E-05	0.99	2.29E-02				7.49E-07	Jet fire
					2.02E-02	2.75E-03	8.99E-08	Vapour cloud explosion
							6.59E-07	Flash fire
							2.97E-05	Unignited release
		0.01	2.29E-02	*				Escalation effect (Fireball)
							7.57E-09	Jet fire
					2.02E-02	2.75E-03	9.08E-10	Vapour cloud explosion
							6.66E-09	Flash fire
							3.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_15

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	8.21E-03	0.99	5.00E-04				4.06E-06	Jet fire
					4.80E-04	2.00E-05	1.63E-07	Vapour cloud explosion
							3.90E-06	Flash fire
							8.11E-03	Unignited release
		0.01	5.00E-04	*				Escalation effect (Fireball)
							4.10E-08	Jet fire
					4.80E-04	2.00E-05	1.64E-09	Vapour cloud explosion
							3.94E-08	Flash fire
							8.19E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.48E-04	0.99	5.57E-04				3.57E-07	Jet fire
					5.34E-04	2.23E-05	1.43E-08	Vapour cloud explosion
							3.43E-07	Flash fire
							6.40E-04	Unignited release
		0.01	5.57E-04	*				Escalation effect (Fireball)
							3.61E-09	Jet fire
					5.34E-04	2.23E-05	1.44E-10	Vapour cloud explosion
							3.46E-09	Flash fire
							6.47E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	9.72E-05	0.99	6.15E-04				5.92E-08	Jet fire
					5.91E-04	2.46E-05	2.37E-09	Vapour cloud explosion
							5.68E-08	Flash fire
							9.60E-05	Unignited release
		0.01	6.15E-04	*				Escalation effect (Fireball)
							5.98E-10	Jet fire
					5.91E-04	2.46E-05	2.39E-11	Vapour cloud explosion
							5.74E-10	Flash fire
							9.70E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	4.32E-05	0.99	3.75E-03				1.60E-07	Jet fire
					3.30E-03	4.50E-04	1.92E-08	Vapour cloud explosion
							1.41E-07	Flash fire
							4.21E-05	Unignited release
		0.01	3.75E-03	*				Escalation effect (Fireball)
							1.62E-09	Jet fire
					3.30E-03	4.50E-04	1.94E-10	Vapour cloud explosion
							1.42E-09	Flash fire
							4.26E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_16

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	6.53E-03	0.99	5.43E-04				3.51E-06	Jet fire
					5.21E-04	2.17E-05	1.40E-07	Vapour cloud explosion
							3.37E-06	Flash fire
							6.45E-03	Unignited release
		0.01	5.43E-04	*				Escalation effect (Fireball)
							3.54E-08	Jet fire
					5.21E-04	2.17E-05	1.42E-09	Vapour cloud explosion
							3.40E-08	Flash fire
							6.51E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	3.22E-04	0.99	6.20E-04				1.98E-07	Jet fire
					5.95E-04	2.48E-05	7.90E-09	Vapour cloud explosion
							1.90E-07	Flash fire
							3.18E-04	Unignited release
		0.01	6.20E-04	*				Escalation effect (Fireball)
							2.00E-09	Jet fire
					5.95E-04	2.48E-05	7.98E-11	Vapour cloud explosion
							1.92E-09	Flash fire
							3.21E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	3.96E-05	0.99	1.57E-03				6.17E-08	Jet fire
					1.39E-03	1.89E-04	7.41E-09	Vapour cloud explosion
							5.43E-08	Flash fire
							3.90E-05	Unignited release
		0.01	1.57E-03	*				Escalation effect (Fireball)
							6.24E-10	Jet fire
					1.39E-03	1.89E-04	7.48E-11	Vapour cloud explosion
							5.49E-10	Flash fire
							3.94E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	1.61E-05	0.99	2.27E-02				3.61E-07	Jet fire
					1.99E-02	2.72E-03	4.34E-08	Vapour cloud explosion
							3.18E-07	Flash fire
							1.45E-05	Unignited release
		0.01	2.27E-02	*				Escalation effect (Fireball)
							3.65E-09	Jet fire
					1.99E-02	2.72E-03	4.38E-10	Vapour cloud explosion
							3.21E-09	Flash fire
							1.46E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_17

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.45E-03	0.99	5.49E-04				1.33E-06	Jet fire
					5.27E-04	2.19E-05	5.32E-08	Vapour cloud explosion
							1.28E-06	Flash fire
							2.42E-03	Unignited release
		0.01	5.49E-04	*				Escalation effect (Fireball)
							1.34E-08	Jet fire
					5.27E-04	2.19E-05	5.37E-10	Vapour cloud explosion
							1.29E-08	Flash fire
							2.44E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.92E-04	0.99	6.27E-04				1.19E-07	Jet fire
					6.02E-04	2.51E-05	4.77E-09	Vapour cloud explosion
							1.14E-07	Flash fire
							1.90E-04	Unignited release
		0.01	6.27E-04	*				Escalation effect (Fireball)
							1.20E-09	Jet fire
					6.02E-04	2.51E-05	4.81E-11	Vapour cloud explosion
							1.16E-09	Flash fire
							1.92E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	2.96E-05	0.99	1.90E-03				5.57E-08	Jet fire
					1.67E-03	2.28E-04	6.69E-09	Vapour cloud explosion
							4.90E-08	Flash fire
							2.91E-05	Unignited release
		0.01	1.90E-03	*				Escalation effect (Fireball)
							5.63E-10	Jet fire
					1.67E-03	2.28E-04	6.76E-11	Vapour cloud explosion
							4.95E-10	Flash fire
							2.94E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	1.36E-05	0.99	2.74E-02				3.69E-07	Jet fire
					2.41E-02	3.29E-03	4.42E-08	Vapour cloud explosion
							3.24E-07	Flash fire
							1.20E-05	Unignited release
		0.01	2.74E-02	*				Escalation effect (Fireball)
							3.72E-09	Jet fire
					2.41E-02	3.29E-03	4.47E-10	Vapour cloud explosion
							3.28E-09	Flash fire
							1.21E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_18

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 10 mm hole size	8.85E-03	0.99	5.49E-04				4.81E-06	Jet Fire
					5.27E-04	2.19E-05	1.92E-07	Vapour Cloud Explosion
							4.62E-06	Flash Fire
							8.75E-03	Unignited release
		0.01	5.49E-04	*				Escalation effect (Fireball)
							4.86E-08	Jet Fire
					5.27E-04	2.19E-05	1.94E-09	Vapour Cloud Explosion
							4.66E-08	Flash Fire
							8.84E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 25 mm hole size	7.48E-04	0.99	6.27E-04				4.64E-07	Jet Fire
					6.02E-04	2.51E-05	1.86E-08	Vapour Cloud Explosion
							4.46E-07	Flash Fire
							7.39E-04	Unignited release
		0.01	6.27E-04	*				Escalation effect (Fireball)
							4.69E-09	Jet Fire
					6.02E-04	2.51E-05	1.88E-10	Vapour Cloud Explosion
							4.50E-09	Flash Fire
							7.47E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 50 mm hole size	1.27E-04	0.99	1.90E-03				2.39E-07	Jet Fire
					1.67E-03	2.28E-04	2.87E-08	Vapour Cloud Explosion
							2.10E-07	Flash Fire
							1.25E-04	Unignited release
		0.01	1.90E-03	*				Escalation effect (Fireball)
							2.41E-09	Jet Fire
					1.67E-03	2.28E-04	2.90E-10	Vapour Cloud Explosion
							2.12E-09	Flash Fire
							1.26E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Probability	Immediate Ignition Probability	Escalation	Delayed Ignition	Explosion Probability	Event Frequency	Event Outcome
Release as 150 mm hole size	6.99E-05	0.99	7.50E-02				5.19E-06	Pool Fire
					5.25E-02	2.25E-02	1.56E-06	Vapour Cloud Explosion
							3.63E-06	Flash Fire
							4.84E-05	Unignited release
		0.01	7.50E-02	*				Escalation effect (Fireball)
							5.24E-08	Pool Fire
					5.25E-02	2.25E-02	1.57E-08	Vapour Cloud Explosion
							3.67E-08	Flash Fire
							4.89E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_19

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.43E-03	0.99	5.00E-04				1.20E-06	Jet fire
					4.80E-04	2.00E-05	4.82E-08	Vapour cloud explosion
							1.16E-06	Flash fire
							2.40E-03	Unignited release
		0.01	5.00E-04	*				Escalation effect (Fireball)
							1.22E-08	Jet fire
					4.80E-04	2.00E-05	4.86E-10	Vapour cloud explosion
							1.17E-08	Flash fire
							2.43E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	1.92E-04	0.99	5.57E-04				1.06E-07	Jet fire
					5.34E-04	2.23E-05	4.23E-09	Vapour cloud explosion
							1.02E-07	Flash fire
							1.90E-04	Unignited release
		0.01	5.57E-04	*				Escalation effect (Fireball)
							1.07E-09	Jet fire
					5.34E-04	2.23E-05	4.27E-11	Vapour cloud explosion
							1.03E-09	Flash fire
							1.92E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	2.88E-05	0.99	6.15E-04				1.75E-08	Jet fire
					5.91E-04	2.46E-05	7.02E-10	Vapour cloud explosion
							1.68E-08	Flash fire
							2.84E-05	Unignited release
		0.01	6.15E-04	*				Escalation effect (Fireball)
							1.77E-10	Jet fire
					5.91E-04	2.46E-05	7.09E-12	Vapour cloud explosion
							1.70E-10	Flash fire
							2.87E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	1.28E-05	0.99	3.75E-03				4.75E-08	Jet fire
					3.30E-03	4.50E-04	5.70E-09	Vapour cloud explosion
							4.18E-08	Flash fire
							1.25E-05	Unignited release
		0.01	3.75E-03	*				Escalation effect (Fireball)
							4.79E-10	Jet fire
					3.30E-03	4.50E-04	5.75E-11	Vapour cloud explosion
							4.22E-10	Flash fire
							1.26E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_20

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.38E-03	0.99	5.13E-04				1.21E-06	Jet fire
					4.92E-04	2.05E-05	4.83E-08	Vapour cloud explosion
							1.16E-06	Flash fire
							2.35E-03	Unignited release
		0.01	5.13E-04	*				Escalation effect (Fireball)
							1.22E-08	Jet fire
					4.92E-04	2.05E-05	4.88E-10	Vapour cloud explosion
							1.17E-08	Flash fire
							2.37E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.99E-04	0.99	5.86E-04				4.05E-07	Jet fire
					5.62E-04	2.34E-05	1.62E-08	Vapour cloud explosion
							3.89E-07	Flash fire
							6.90E-04	Unignited release
		0.01	5.86E-04	*				Escalation effect (Fireball)
							4.09E-09	Jet fire
					5.62E-04	2.34E-05	1.64E-10	Vapour cloud explosion
							3.93E-09	Flash fire
							6.97E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	2.16E-05	0.99	6.48E-04				1.38E-08	Jet fire
					6.22E-04	2.59E-05	5.54E-10	Vapour cloud explosion
							1.33E-08	Flash fire
							2.13E-05	Unignited release
		0.01	6.48E-04	*				Escalation effect (Fireball)
							1.40E-10	Jet fire
					6.22E-04	2.59E-05	5.60E-12	Vapour cloud explosion
							1.34E-10	Flash fire
							2.15E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	9.25E-04	0.99	8.79E-03				8.05E-06	Jet fire
					7.73E-03	1.05E-03	9.66E-07	Vapour cloud explosion
							7.08E-06	Flash fire
							8.84E-04	Unignited release
		0.01	8.79E-03	*				Escalation effect (Fireball)
							8.13E-08	Jet fire
					7.73E-03	1.05E-03	9.76E-09	Vapour cloud explosion
							7.15E-08	Flash fire
							8.92E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_21

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.38E-03	0.99	5.13E-04				1.21E-06	Jet fire
					4.92E-04	2.05E-05	4.83E-08	Vapour cloud explosion
							1.16E-06	Flash fire
							2.35E-03	Unignited release
		0.01	5.13E-04	*				Escalation effect (Fireball)
							1.22E-08	Jet fire
					4.92E-04	2.05E-05	4.88E-10	Vapour cloud explosion
							1.17E-08	Flash fire
							2.37E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	6.99E-04	0.99	5.86E-04				4.05E-07	Jet fire
					5.86E-04	2.34E-05	1.62E-08	Vapour cloud explosion
							3.89E-07	Flash fire
							6.90E-04	Unignited release
		0.01	5.86E-04	*				Escalation effect (Fireball)
							4.09E-09	Jet fire
					5.86E-04	2.34E-05	1.64E-10	Vapour cloud explosion
							3.93E-09	Flash fire
							6.97E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	2.16E-05	0.99	6.48E-04				1.38E-08	Jet fire
					6.22E-04	2.59E-05	5.54E-10	Vapour cloud explosion
							1.33E-08	Flash fire
							2.13E-05	Unignited release
		0.01	6.48E-04	*				Escalation effect (Fireball)
							1.40E-10	Jet fire
					6.22E-04	2.59E-05	5.60E-12	Vapour cloud explosion
							1.34E-10	Flash fire
							2.15E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 150 mm hole size	9.25E-04	0.99	8.79E-03				8.05E-06	Jet fire
					7.73E-03	1.05E-03	9.66E-07	Vapour cloud explosion
							7.08E-06	Flash fire
							8.84E-04	Unignited release
		0.01	8.79E-03	*				Escalation effect (Fireball)
							8.13E-08	Jet fire
					7.73E-03	1.05E-03	9.76E-09	Vapour cloud explosion
							7.15E-08	Flash fire
							8.92E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_22

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 10 mm hole size	2.76E-03	0.99	5.43E-04				1.48E-06	Jet fire
					5.21E-04	2.17E-05	5.93E-08	Vapour cloud explosion
							1.42E-06	Flash fire
							2.73E-03	Unignited release
		0.01	5.43E-04	*				Escalation effect (Fireball)
							1.50E-08	Jet fire
					5.21E-04	2.17E-05	5.99E-10	Vapour cloud explosion
							1.44E-08	Flash fire
							2.75E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 25 mm hole size	2.16E-04	0.99	6.20E-04				1.33E-07	Jet fire
					5.95E-04	2.48E-05	5.30E-09	Vapour cloud explosion
							1.27E-07	Flash fire
							2.13E-04	Unignited release
		0.01	6.20E-04	*				Escalation effect (Fireball)
							1.34E-09	Jet fire
					5.95E-04	2.48E-05	5.36E-11	Vapour cloud explosion
							1.29E-09	Flash fire
							2.15E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Vapour Cloud Explosion	Event Frequency	Event Outcome
Release as 50 mm hole size	4.80E-05	0.99	1.59E-03				7.57E-08	Jet fire
					1.40E-03	1.91E-04	9.09E-09	Vapour cloud explosion
							6.66E-08	Flash fire
							4.72E-05	Unignited release
		0.01	1.59E-03	*				Escalation effect (Fireball)
							7.65E-10	Jet fire
					1.40E-03	1.91E-04	9.18E-11	Vapour cloud explosion
							6.73E-10	Flash fire
							4.77E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_23

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 10 mm hole size	2.28E-02	0.99	5.00E-04			1.13E-05	Pool fore
					4.80E-04	1.08E-05	Flash fire
						2.25E-02	Unignited release
		0.01	5.00E-04	*			Escalation effect (Fireball)
						1.14E-07	Pool fore
					4.80E-04	1.09E-07	Flash fire
						2.28E-04	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 25 mm hole size	3.63E-03	0.99	3.53E-03			1.27E-05	Pool fore
					3.11E-03	1.12E-05	Flash fire
						3.56E-03	Unignited release
		0.01	3.53E-03	*			Escalation effect (Fireball)
						1.28E-07	Pool fore
					3.11E-03	1.13E-07	Flash fire
						3.59E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 50 mm hole size	1.54E-03	0.99	1.90E-02			2.90E-05	Pool fore
					1.67E-02	2.55E-05	Flash fire
						1.44E-03	Unignited release
		0.01	1.90E-02	*			Escalation effect (Fireball)
					1.67E-02	2.93E-07	Pool fore
						2.58E-07	Flash fire
						1.46E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 150 mm hole size	1.80E-04	0.99	7.50E-02			1.34E-05	Pool fore
					5.25E-02	9.36E-06	Flash fire
						1.42E-04	Unignited release
		0.01	7.50E-02	*			Escalation effect (Fireball)
						1.35E-07	Pool fore
					5.25E-02	9.45E-08	Flash fire
						1.44E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_24

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 10 mm hole size	1.52E-02	0.99	6.30E-04			9.47E-06	Pool fore
					6.04E-04	9.10E-06	Flash fire
						1.50E-02	Unignited release
		0.01	6.30E-04	*			Escalation effect (Fireball)
						9.57E-08	Pool fore
					6.04E-04	9.19E-08	Flash fire
						1.52E-04	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 25 mm hole size	2.42E-03	0.99	3.53E-03			8.46E-06	Pool fore
					3.11E-03	7.44E-06	Flash fire
						2.37E-03	Unignited release
		0.01	3.53E-03	*			Escalation effect (Fireball)
						8.54E-08	Pool fore
					3.11E-03	7.52E-08	Flash fire
						2.40E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 50 mm hole size	1.03E-03	0.99	1.90E-02			1.93E-06	Pool fore
					1.67E-02	1.70E-06	Flash fire
						1.01E-03	Unignited release
		0.01	1.90E-02	*			Escalation effect (Fireball)
						1.95E-07	Pool fore
					1.67E-02	1.72E-07	Flash fire
						9.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 150 mm hole size	1.20E-04	0.99	7.50E-02			8.91E-07	Pool fore
					5.25E-02	6.24E-07	Flash fire
						1.16E-04	Unignited release
		0.01	7.50E-02	*			Escalation effect (Fireball)
						9.00E-08	Pool fore
					5.25E-02	6.30E-08	Flash fire
						9.57E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section HKOLNGT_25

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 10 mm hole size	2.27E-02	0.99	6.30E-04			1.42E-06	Pool fore
					6.04E-04	-	Flash fire
						2.25E-02	Unignited release
		0.01	6.30E-04	*			Escalation effect (Fireball)
						1.43E-07	Pool fore
					6.04E-04	-	Flash fire
						2.27E-04	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 25 mm hole size	2.36E-03	0.99	3.53E-04			8.25E-07	Pool fore
					3.11E-04	-	Flash fire
						2.33E-03	Unignited release
		0.01	3.53E-04	*			Escalation effect (Fireball)
						8.33E-08	Pool fore
					3.11E-04	-	Flash fire
						2.34E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 50 mm hole size	9.72E-04	0.99	1.90E-03			1.83E-06	Pool fore
					1.67E-03	-	Flash fire
						9.59E-04	Unignited release
		0.01	1.90E-03	*			Escalation effect (Fireball)
						1.85E-07	Pool fore
					1.67E-03	-	Flash fire
						9.35E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown	Immediate Ignition	Escalation	Delayed Ignition	Event Frequency	Event Outcome
Release as 150 mm hole size	1.20E-04	0.99	7.50E-03			8.91E-07	Pool fore
					5.25E-03	-	Flash fire
						1.17E-04	Unignited release
		0.01	7.50E-03	*			Escalation effect (Fireball)
						9.00E-08	Pool fore
					5.25E-03	-	Flash fire
						1.02E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Annex 5F-2

Full List of Event Tree Analysis for GRS facilities at the BPPS

Hazardous Section NGRS_01

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	4.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								8.00E-08	Jet fire
					0.09			3.17E-07	Flash fire over plant area
						0.12		4.32E-08	Vapour Cloud Explosion
							0.01	4.00E-08	Flash fire full extent
								3.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	4.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								8.00E-08	Jet fire
					0.09			3.17E-07	Flash fire over plant area
						0.12		4.32E-08	Vapour Cloud Explosion
							0.01	4.00E-08	Flash fire full extent
								3.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	2.80E-06	1.00	0.02	*					Escalation effect (Fireball)
								5.60E-08	Jet fire
					0.09			2.22E-07	Flash fire over plant area
						0.12		3.02E-08	Vapour Cloud Explosion
							0.01	2.80E-08	Flash fire full extent
								2.41E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	2.80E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.80E-07	Jet fire
					0.4			7.84E-07	Flash fire over plant area
						0.04		3.36E-07	Vapour Cloud Explosion
							0.3	1.12E-07	Flash fire full extent
								1.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.20E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.20E-07	Fireball
					0.4			3.36E-07	Flash fire over plant area
						0.3		1.44E-07	Vapour Cloud Explosion
							0.04	4.80E-08	Flash fire full extent
								4.32E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_02

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	2.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								4.00E-08	Jet fire
					0.09			1.58E-07	Flash fire over plant area
						0.01		2.16E-08	Vapour Cloud Explosion
							0.12	2.00E-08	Flash fire full extent
								1.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	2.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								4.00E-08	Jet fire
					0.09			1.58E-07	Flash fire over plant area
						0.01		2.16E-08	Vapour Cloud Explosion
							0.12	2.00E-08	Flash fire full extent
								1.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.40E-06	1.00	0.02	*					Escalation effect (Fireball)
								2.80E-08	Jet fire
					0.09			1.11E-07	Flash fire over plant area
						0.01		1.51E-08	Vapour Cloud Explosion
							0.12	1.40E-08	Flash fire full extent
								1.20E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.40E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.40E-07	Jet fire
					0.4			3.92E-07	Flash fire over plant area
						0.04		1.68E-07	Vapour Cloud Explosion
							0.3	5.60E-08	Flash fire full extent
								5.04E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	6.00E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.00E-08	Fireball
					0.4			1.68E-07	Flash fire over plant area
						0.04		7.20E-08	Vapour Cloud Explosion
							0.3	2.40E-08	Flash fire full extent
								2.16E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_03

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	6.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.30E-07	Jet fire
					0.09			5.15E-07	Flash fire over plant area
						0.12		7.02E-08	Vapour Cloud Explosion
							0.01	6.50E-08	Flash fire full extent
								5.59E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	6.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.30E-07	Jet fire
					0.09			5.15E-07	Flash fire over plant area
						0.12		7.02E-08	Vapour Cloud Explosion
							0.01	6.50E-08	Flash fire full extent
								5.59E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	4.55E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.10E-08	Jet fire
					0.09			3.60E-07	Flash fire over plant area
						0.12		4.91E-08	Vapour Cloud Explosion
							0.01	4.55E-08	Flash fire full extent
								3.91E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	4.55E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.55E-07	Jet fire
					0.4			1.27E-06	Flash fire over plant area
						0.12		5.46E-07	Vapour Cloud Explosion
							0.04	1.82E-07	Flash fire full extent
								1.64E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.95E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.95E-07	Fireball
					0.4			5.46E-07	Flash fire over plant area
						0.12		2.34E-07	Vapour Cloud Explosion
							0.04	7.80E-08	Flash fire full extent
								7.02E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_04

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.04E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.08E-07	Jet fire
					0.09			8.24E-07	Flash fire over plant area
						0.12		1.12E-07	Vapour Cloud Explosion
							0.01	1.04E-07	Flash fire full extent
								8.94E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.04E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.08E-07	Jet fire
					0.09			8.24E-07	Flash fire over plant area
						0.12		1.12E-07	Vapour Cloud Explosion
							0.01	1.04E-07	Flash fire full extent
								8.94E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	7.28E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.46E-07	Jet fire
					0.09			5.77E-07	Flash fire over plant area
						0.12		7.86E-08	Vapour Cloud Explosion
							0.01	7.28E-08	Flash fire full extent
								6.26E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	7.28E-06	1.00	0.10	*					Escalation effect (Fireball)
								7.28E-07	Jet fire
					0.4			2.04E-06	Flash fire over plant area
						0.3		8.74E-07	Vapour Cloud Explosion
							0.01	2.91E-07	Flash fire full extent
								2.62E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	3.12E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.12E-07	Fireball
					0.4			8.74E-07	Flash fire over plant area
						0.3		3.74E-07	Vapour Cloud Explosion
							0.01	1.25E-07	Flash fire full extent
								1.12E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_05

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	3.42E-05	1.00	0.02	*					Escalation effect (Fireball)
								6.84E-07	Jet fire
					0.09			2.71E-06	Flash fire over plant area
						0.12		3.69E-07	Vapour Cloud Explosion
							0.01	3.42E-07	Flash fire full extent
								2.94E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	3.42E-05	1.00	0.02	*					Escalation effect (Fireball)
								6.84E-07	Jet fire
					0.09			2.71E-06	Flash fire over plant area
						0.12		3.69E-07	Vapour Cloud Explosion
							0.01	3.42E-07	Flash fire full extent
								2.94E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.14E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.28E-07	Jet fire
					0.09			9.03E-07	Flash fire over plant area
						0.12		1.23E-07	Vapour Cloud Explosion
							0.01	1.14E-07	Flash fire full extent
								9.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.14E-05	1.00	0.10	*					Escalation effect (Fireball)
								1.14E-06	Jet fire
					0.4			3.19E-06	Flash fire over plant area
						0.12		1.37E-06	Vapour Cloud Explosion
							0.04	4.56E-07	Flash fire full extent
								4.10E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	5.70E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.70E-07	Fireball
					0.4			1.60E-06	Flash fire over plant area
						0.12		6.84E-07	Vapour Cloud Explosion
							0.04	2.28E-07	Flash fire full extent
								2.05E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_06

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.56E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.12E-07	Jet fire
					0.09			1.24E-06	Flash fire over plant area
						0.12		1.68E-07	Vapour Cloud Explosion
							0.01	1.56E-07	Flash fire full extent
								1.34E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.56E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.12E-07	Jet fire
					0.09			1.24E-06	Flash fire over plant area
						0.12		1.68E-07	Vapour Cloud Explosion
							0.01	1.56E-07	Flash fire full extent
								1.34E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.20E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.04E-07	Jet fire
					0.09			4.12E-07	Flash fire over plant area
						0.12		5.62E-08	Vapour Cloud Explosion
							0.01	5.20E-08	Flash fire full extent
								4.47E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.20E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.20E-07	Jet fire
					0.4			1.46E-06	Flash fire over plant area
						0.3		6.24E-07	Vapour Cloud Explosion
							0.04	2.08E-07	Flash fire full extent
								1.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.60E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.60E-07	Fireball
					0.4			7.28E-07	Flash fire over plant area
						0.3		3.12E-07	Vapour Cloud Explosion
							0.04	1.04E-07	Flash fire full extent
								9.36E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_07

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	2.20E-05	1.00	0.02	*					Escalation effect (Fireball)
								4.40E-07	Jet fire
					0.09			1.90E-06	Flash fire over plant area
						0.04		7.92E-08	Vapour Cloud Explosion
							0.01	2.20E-07	Flash fire full extent
								1.89E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	2.20E-05	1.00	0.02	*					Escalation effect (Fireball)
								4.40E-07	Jet fire
					0.09			1.74E-06	Flash fire over plant area
						0.12		2.38E-07	Vapour Cloud Explosion
							0.01	2.20E-07	Flash fire full extent
								1.89E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.54E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.08E-07	Jet fire
					0.09			1.22E-06	Flash fire over plant area
						0.12		1.66E-07	Vapour Cloud Explosion
							0.01	1.54E-07	Flash fire full extent
								1.32E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.54E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.08E-07	Jet fire
					0.09			1.22E-06	Flash fire over plant area
						0.12		1.66E-07	Vapour Cloud Explosion
							0.01	1.54E-07	Flash fire full extent
								1.32E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	6.60E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.60E-07	Fireball
					0.4			1.85E-06	Flash fire over plant area
						0.3		7.92E-07	Vapour Cloud Explosion
							0.04	2.64E-07	Flash fire full extent
								2.38E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_08

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			6.90E-08	Flash fire over plant area
						0.12		9.41E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			6.90E-08	Flash fire over plant area
						0.12		9.41E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.10E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.22E-08	Jet fire
					0.09			4.83E-08	Flash fire over plant area
						0.12		6.58E-09	Vapour Cloud Explosion
							0.01	6.10E-09	Flash fire full extent
								5.24E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.10E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.10E-08	Jet fire
					0.4			1.71E-07	Flash fire over plant area
						0.3		7.32E-08	Vapour Cloud Explosion
							0.04	2.44E-08	Flash fire full extent
								2.19E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.61E-07	1.00	0.10	*					Escalation effect (Fireball)
								2.61E-08	Fireball
					0.4			7.32E-08	Flash fire over plant area
						0.3		3.14E-08	Vapour Cloud Explosion
							0.04	1.05E-08	Flash fire full extent
								9.41E-08	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_01

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.60E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.20E-07	Jet fire
					0.09			1.27E-06	Flash fire over plant area
						0.12		1.73E-07	Vapour Cloud Explosion
							0.01	1.60E-07	Flash fire full extent
								1.38E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.60E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.20E-07	Jet fire
					0.09			1.27E-06	Flash fire over plant area
						0.12		1.73E-07	Vapour Cloud Explosion
							0.01	1.60E-07	Flash fire full extent
								1.38E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.12E-05	1.00	0.10	*					Escalation effect (Fireball)
								1.12E-06	Jet fire
					0.4			3.14E-06	Flash fire over plant area
						0.3		1.34E-06	Vapour Cloud Explosion
							0.04	4.48E-07	Flash fire full extent
								4.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.12E-05	1.00	0.10	*					Escalation effect (Fireball)
								1.12E-06	Jet fire
					0.4			3.14E-06	Flash fire over plant area
						0.3		1.34E-06	Vapour Cloud Explosion
							0.04	4.48E-07	Flash fire full extent
								4.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	4.80E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.80E-07	Fireball
					0.4			1.34E-06	Flash fire over plant area
						0.3		5.76E-07	Vapour Cloud Explosion
							0.04	1.92E-07	Flash fire full extent
								1.73E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_02

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	3.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								7.00E-08	Jet fire
					0.09			2.77E-07	Flash fire over plant area
						0.12		3.78E-08	Vapour Cloud Explosion
							0.01	3.50E-08	Flash fire full extent
								3.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	3.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								7.00E-08	Jet fire
					0.09			2.77E-07	Flash fire over plant area
						0.12		3.78E-08	Vapour Cloud Explosion
							0.01	3.50E-08	Flash fire full extent
								3.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	2.45E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.45E-07	Jet fire
					0.4			6.86E-07	Flash fire over plant area
						0.3		2.94E-07	Vapour Cloud Explosion
							0.04	9.80E-08	Flash fire full extent
								8.82E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	2.45E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.45E-07	Jet fire
					0.4			6.86E-07	Flash fire over plant area
						0.3		2.94E-07	Vapour Cloud Explosion
							0.04	9.80E-08	Flash fire full extent
								8.82E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.05E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.05E-07	Fireball
					0.4			2.94E-07	Flash fire over plant area
						0.3		1.26E-07	Vapour Cloud Explosion
							0.04	4.20E-08	Flash fire full extent
								3.78E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_03

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	4.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								8.00E-08	Jet fire
					0.09			3.17E-07	Flash fire over plant area
						0.12		4.32E-08	Vapour Cloud Explosion
							0.01	4.00E-08	Flash fire full extent
								3.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	4.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								8.00E-08	Jet fire
					0.09			3.17E-07	Flash fire over plant area
						0.12		4.32E-08	Vapour Cloud Explosion
							0.01	4.00E-08	Flash fire full extent
								3.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	2.80E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.80E-07	Jet fire
					0.4			7.84E-07	Flash fire over plant area
						0.3		3.36E-07	Vapour Cloud Explosion
							0.04	1.12E-07	Flash fire full extent
								1.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	2.80E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.80E-07	Jet fire
					0.4			7.84E-07	Flash fire over plant area
						0.3		3.36E-07	Vapour Cloud Explosion
							0.04	1.12E-07	Flash fire full extent
								1.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.20E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.20E-07	Fireball
					0.4			3.36E-07	Flash fire over plant area
						0.3		1.44E-07	Vapour Cloud Explosion
							0.04	4.80E-08	Flash fire full extent
								4.32E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_04

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.05E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.10E-07	Jet fire
					0.09			8.32E-07	Flash fire over plant area
						0.12		1.13E-07	Vapour Cloud Explosion
							0.01	1.05E-07	Flash fire full extent
								9.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.05E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.10E-07	Jet fire
					0.09			8.32E-07	Flash fire over plant area
						0.12		1.13E-07	Vapour Cloud Explosion
							0.01	1.05E-07	Flash fire full extent
								9.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	7.35E-06	1.00	0.10	*					Escalation effect (Fireball)
								7.35E-07	Jet fire
					0.4			2.06E-06	Flash fire over plant area
						0.3		8.82E-07	Vapour Cloud Explosion
							0.04	2.94E-07	Flash fire full extent
								2.65E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	7.35E-06	1.00	0.10	*					Escalation effect (Fireball)
								7.35E-07	Jet fire
					0.4			2.06E-06	Flash fire over plant area
						0.3		8.82E-07	Vapour Cloud Explosion
							0.04	2.94E-07	Flash fire full extent
								2.65E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	3.15E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.15E-07	Fireball
					0.4			8.82E-07	Flash fire over plant area
						0.3		3.78E-07	Vapour Cloud Explosion
							0.04	1.26E-07	Flash fire full extent
								1.13E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_05

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	9.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.90E-07	Jet fire
					0.09			7.52E-07	Flash fire over plant area
						0.12		1.03E-07	Vapour Cloud Explosion
							0.01	9.50E-08	Flash fire full extent
								8.17E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	9.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.90E-07	Jet fire
					0.09			7.52E-07	Flash fire over plant area
						0.12		1.03E-07	Vapour Cloud Explosion
							0.01	9.50E-08	Flash fire full extent
								8.17E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.65E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.65E-07	Jet fire
					0.4			1.86E-06	Flash fire over plant area
						0.3		7.98E-07	Vapour Cloud Explosion
							0.04	2.66E-07	Flash fire full extent
								2.39E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.65E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.65E-07	Jet fire
					0.4			1.86E-06	Flash fire over plant area
						0.3		7.98E-07	Vapour Cloud Explosion
							0.04	2.66E-07	Flash fire full extent
								2.39E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.85E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.85E-07	Fireball
					0.4			7.98E-07	Flash fire over plant area
						0.3		3.42E-07	Vapour Cloud Explosion
							0.04	1.14E-07	Flash fire full extent
								1.03E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_06

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	2.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								4.00E-08	Jet fire
					0.09			1.58E-07	Flash fire over plant area
						0.12		2.16E-08	Vapour Cloud Explosion
							0.01	2.00E-08	Flash fire full extent
								1.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	2.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								4.00E-08	Jet fire
					0.09			1.58E-07	Flash fire over plant area
						0.12		2.16E-08	Vapour Cloud Explosion
							0.01	2.00E-08	Flash fire full extent
								1.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.40E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.40E-07	Jet fire
					0.4			3.92E-07	Flash fire over plant area
						0.3		1.68E-07	Vapour Cloud Explosion
							0.04	5.60E-08	Flash fire full extent
								5.04E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.40E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.40E-07	Jet fire
					0.4			3.92E-07	Flash fire over plant area
						0.3		1.68E-07	Vapour Cloud Explosion
							0.04	5.60E-08	Flash fire full extent
								5.04E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	6.00E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.00E-08	Fireball
					0.4			1.68E-07	Flash fire over plant area
						0.3		7.20E-08	Vapour Cloud Explosion
							0.04	2.40E-08	Flash fire full extent
								2.16E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_07

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.89E-07	Flash fire over plant area
						0.04		1.62E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	3.15E-06	1.00	0.02	*					Escalation effect (Fireball)
								6.30E-08	Jet fire
					0.09			2.49E-07	Flash fire over plant area
						0.12		3.40E-08	Vapour Cloud Explosion
							0.01	3.15E-08	Flash fire full extent
								2.71E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	3.15E-06	1.00	0.02	*					Escalation effect (Fireball)
								6.30E-08	Jet fire
					0.09			2.49E-07	Flash fire over plant area
						0.12		3.40E-08	Vapour Cloud Explosion
							0.01	3.15E-08	Flash fire full extent
								2.71E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.35E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.35E-07	Fireball
					0.4			3.78E-07	Flash fire over plant area
						0.3		1.62E-07	Vapour Cloud Explosion
							0.04	5.40E-08	Flash fire full extent
								4.86E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_08

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			6.90E-08	Flash fire over plant area
						0.12		9.41E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			6.90E-08	Flash fire over plant area
						0.12		9.41E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.10E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.10E-08	Jet fire
					0.4			1.71E-07	Flash fire over plant area
						0.3		7.32E-08	Vapour Cloud Explosion
							0.04	2.44E-08	Flash fire full extent
								2.19E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.10E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.10E-08	Jet fire
					0.4			1.71E-07	Flash fire over plant area
						0.3		7.32E-08	Vapour Cloud Explosion
							0.04	2.44E-08	Flash fire full extent
								2.19E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.61E-07	1.00	0.10	*					Escalation effect (Fireball)
								2.61E-08	Fireball
					0.4			7.32E-08	Flash fire over plant area
						0.3		3.14E-08	Vapour Cloud Explosion
							0.04	1.05E-08	Flash fire full extent
								9.41E-08	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_11

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	7.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.40E-07	Jet fire
					0.09			6.05E-07	Flash fire over plant area
						0.01		2.52E-08	Vapour Cloud Explosion
							0.04	7.00E-08	Flash fire full extent
								6.02E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	7.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.40E-07	Jet fire
					0.09			5.54E-07	Flash fire over plant area
						0.01		7.56E-08	Vapour Cloud Explosion
							0.12	7.00E-08	Flash fire full extent
								6.02E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	4.90E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.80E-08	Jet fire
					0.09			3.88E-07	Flash fire over plant area
						0.01		5.29E-08	Vapour Cloud Explosion
							0.12	4.90E-08	Flash fire full extent
								4.21E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	4.90E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.90E-07	Jet fire
					0.4			1.37E-06	Flash fire over plant area
						0.04		5.88E-07	Vapour Cloud Explosion
							0.3	1.96E-07	Flash fire full extent
								1.76E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.10E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.10E-07	Fireball
					0.4			5.88E-07	Flash fire over plant area
						0.04		2.52E-07	Vapour Cloud Explosion
							0.3	8.40E-08	Flash fire full extent
								7.56E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_12

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	9.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.90E-07	Jet fire
					0.09			8.21E-07	Flash fire over plant area
						0.04		3.42E-08	Vapour Cloud Explosion
							0.01	9.50E-08	Flash fire full extent
								8.17E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	9.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.90E-07	Jet fire
					0.09			7.52E-07	Flash fire over plant area
						0.12		1.03E-07	Vapour Cloud Explosion
							0.01	9.50E-08	Flash fire full extent
								8.17E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.65E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.33E-07	Jet fire
					0.09			5.27E-07	Flash fire over plant area
						0.12		7.18E-08	Vapour Cloud Explosion
							0.01	6.65E-08	Flash fire full extent
								5.72E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.65E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.65E-07	Jet fire
					0.4			1.86E-06	Flash fire over plant area
						0.3		7.98E-07	Vapour Cloud Explosion
							0.04	2.66E-07	Flash fire full extent
								2.39E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.85E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.85E-07	Fireball
					0.4			7.98E-07	Flash fire over plant area
						0.3		3.42E-07	Vapour Cloud Explosion
							0.04	1.14E-07	Flash fire full extent
								1.03E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_13

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.89E-07	Flash fire over plant area
						0.04		1.62E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-08	Jet fire
					0.09			1.19E-07	Flash fire over plant area
						0.12		1.62E-08	Vapour Cloud Explosion
							0.01	1.50E-08	Flash fire full extent
								1.29E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.50E-07	Jet fire
					0.4			4.20E-07	Flash fire over plant area
						0.3		1.80E-07	Vapour Cloud Explosion
							0.04	6.00E-08	Flash fire full extent
								5.40E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	7.50E-07	1.00	0.10	*					Escalation effect (Fireball)
								7.50E-08	Fireball
					0.4			2.10E-07	Flash fire over plant area
						0.3		9.00E-08	Vapour Cloud Explosion
							0.04	3.00E-08	Flash fire full extent
								2.70E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_14

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.89E-07	Flash fire over plant area
						0.04		1.62E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	3.15E-06	1.00	0.02	*					Escalation effect (Fireball)
								6.30E-08	Jet fire
					0.09			2.49E-07	Flash fire over plant area
						0.12		3.40E-08	Vapour Cloud Explosion
							0.01	3.15E-08	Flash fire full extent
								2.71E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	3.15E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.15E-07	Jet fire
					0.4			8.82E-07	Flash fire over plant area
						0.3		3.78E-07	Vapour Cloud Explosion
							0.04	1.26E-07	Flash fire full extent
								1.13E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.35E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.35E-07	Fireball
					0.4			3.78E-07	Flash fire over plant area
						0.3		1.62E-07	Vapour Cloud Explosion
							0.04	5.40E-08	Flash fire full extent
								4.86E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_15

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	8.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.60E-07	Jet fire
					0.09			6.91E-07	Flash fire over plant area
						0.04		2.88E-08	Vapour Cloud Explosion
							0.01	8.00E-08	Flash fire full extent
								6.88E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	8.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.60E-07	Jet fire
					0.09			6.34E-07	Flash fire over plant area
						0.12		8.64E-08	Vapour Cloud Explosion
							0.01	8.00E-08	Flash fire full extent
								6.88E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.60E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.12E-07	Jet fire
					0.09			4.44E-07	Flash fire over plant area
						0.12		6.05E-08	Vapour Cloud Explosion
							0.01	5.60E-08	Flash fire full extent
								4.82E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.60E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.60E-07	Jet fire
					0.4			1.57E-06	Flash fire over plant area
						0.3		6.72E-07	Vapour Cloud Explosion
							0.04	2.24E-07	Flash fire full extent
								2.02E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.40E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.40E-07	Fireball
					0.4			6.72E-07	Flash fire over plant area
						0.3		2.88E-07	Vapour Cloud Explosion
							0.04	9.60E-08	Flash fire full extent
								8.64E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_16

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	8.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.60E-07	Jet fire
					0.09			6.91E-07	Flash fire over plant area
						0.04		2.88E-08	Vapour Cloud Explosion
							0.01	8.00E-08	Flash fire full extent
								6.88E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	8.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.60E-07	Jet fire
					0.09			6.34E-07	Flash fire over plant area
						0.12		8.64E-08	Vapour Cloud Explosion
							0.01	8.00E-08	Flash fire full extent
								6.88E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.60E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.12E-07	Jet fire
					0.09			4.44E-07	Flash fire over plant area
						0.12		6.05E-08	Vapour Cloud Explosion
							0.01	5.60E-08	Flash fire full extent
								4.82E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.60E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.60E-07	Jet fire
					0.4			1.57E-06	Flash fire over plant area
						0.3		6.72E-07	Vapour Cloud Explosion
							0.04	2.24E-07	Flash fire full extent
								2.02E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.40E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.40E-07	Fireball
					0.4			6.72E-07	Flash fire over plant area
						0.3		2.88E-07	Vapour Cloud Explosion
							0.04	9.60E-08	Flash fire full extent
								8.64E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_17

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	3.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								7.00E-08	Jet fire
					0.09			3.02E-07	Flash fire over plant area
						0.04		1.26E-08	Vapour Cloud Explosion
							0.01	3.50E-08	Flash fire full extent
								3.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	3.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								7.00E-08	Jet fire
					0.09			2.77E-07	Flash fire over plant area
						0.12		3.78E-08	Vapour Cloud Explosion
							0.01	3.50E-08	Flash fire full extent
								3.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	2.45E-06	1.00	0.02	*					Escalation effect (Fireball)
								4.90E-08	Jet fire
					0.09			1.94E-07	Flash fire over plant area
						0.12		2.65E-08	Vapour Cloud Explosion
							0.01	2.45E-08	Flash fire full extent
								2.11E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	2.45E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.45E-07	Jet fire
					0.4			6.86E-07	Flash fire over plant area
						0.3		2.94E-07	Vapour Cloud Explosion
							0.04	9.80E-08	Flash fire full extent
								8.82E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.05E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.05E-07	Fireball
					0.4			2.94E-07	Flash fire over plant area
						0.3		1.26E-07	Vapour Cloud Explosion
							0.04	4.20E-08	Flash fire full extent
								3.78E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_18

Scenario	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	2.65E-05	1.00	0.02	*					Escalation effect (Fireball)
								5.30E-07	Jet fire
					0.09			2.29E-06	Flash fire over plant area
						0.01		9.54E-08	Vapour Cloud Explosion
							0.04	2.65E-07	Flash fire full extent
								2.28E-05	Unignited release

Scenario	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	2.65E-05	1.00	0.02	*					Escalation effect (Fireball)
								5.30E-07	Jet fire
					0.09			2.10E-06	Flash fire over plant area
						0.01		2.86E-07	Vapour Cloud Explosion
							0.12	2.65E-07	Flash fire full extent
								2.28E-05	Unignited release

Scenario	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.86E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.71E-07	Jet fire
					0.09			1.47E-06	Flash fire over plant area
						0.01		2.00E-07	Vapour Cloud Explosion
							0.12	1.86E-07	Flash fire full extent
								1.60E-05	Unignited release

Scenario	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.86E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.71E-07	Jet fire
					0.09			1.47E-06	Flash fire over plant area
						0.01		2.00E-07	Vapour Cloud Explosion
							0.12	1.86E-07	Flash fire full extent
								1.60E-05	Unignited release

Scenario	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	7.95E-06	1.00	0.10	*					Escalation effect (Fireball)
								7.95E-07	Fireball
					0.4			2.23E-06	Flash fire over plant area
						0.04		9.54E-07	Vapour Cloud Explosion
							0.3	3.18E-07	Flash fire full extent
								2.86E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_19

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			7.53E-08	Flash fire over plant area
						0.04		3.14E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	8.71E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.74E-08	Jet fire
					0.09			6.90E-08	Flash fire over plant area
						0.12		9.41E-09	Vapour Cloud Explosion
							0.01	8.71E-09	Flash fire full extent
								7.49E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.10E-07	1.00	0.02	*					Escalation effect (Fireball)
								1.22E-08	Jet fire
					0.09			4.83E-08	Flash fire over plant area
						0.12		6.58E-09	Vapour Cloud Explosion
							0.01	6.10E-09	Flash fire full extent
								5.24E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.10E-07	1.00	0.10	*					Escalation effect (Fireball)
								6.10E-08	Jet fire
					0.4			1.71E-07	Flash fire over plant area
						0.3		7.32E-08	Vapour Cloud Explosion
							0.04	2.44E-08	Flash fire full extent
								2.19E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.61E-07	1.00	0.10	*					Escalation effect (Fireball)
								2.61E-08	Fireball
					0.4			7.32E-08	Flash fire over plant area
						0.3		3.14E-08	Vapour Cloud Explosion
							0.04	1.05E-08	Flash fire full extent
								9.41E-08	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Annex 5F-3

Full List of Event Tree Analysis for GRS facilities at the LPS

Hazardous Section NGRS_01

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_02

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.01		1.62E-07	Vapour Cloud Explosion
							0.12	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.01		1.62E-07	Vapour Cloud Explosion
							0.12	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.01		5.40E-08	Vapour Cloud Explosion
							0.12	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.04		6.00E-07	Vapour Cloud Explosion
							0.3	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.04		3.00E-07	Vapour Cloud Explosion
							0.3	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_03

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_04

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_05

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_06

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_07

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_08

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.30E-06	Flash fire over plant area
						0.04		5.40E-08	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_09

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_10

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_11

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_12

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_13

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_14

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.30E-06	Flash fire over plant area
						0.04		5.40E-08	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_15

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_16

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_17

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_18

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_19

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_20

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.30E-06	Flash fire over plant area
						0.04		5.40E-08	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_21

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_22

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_23

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_24

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_25

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_26

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.30E-06	Flash fire over plant area
						0.04		5.40E-08	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_27

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_28

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_29

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_30

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_31

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_32

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.30E-06	Flash fire over plant area
						0.04		5.40E-08	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_33

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_34

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section NGRS_35

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.50E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.09			1.19E-06	Flash fire over plant area
						0.12		1.62E-07	Vapour Cloud Explosion
							0.01	1.50E-07	Flash fire full extent
								1.29E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	5.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.00E-07	Jet fire
					0.09			3.96E-07	Flash fire over plant area
						0.12		5.40E-08	Vapour Cloud Explosion
							0.01	5.00E-08	Flash fire full extent
								4.30E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	5.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								5.00E-07	Jet fire
					0.4			1.40E-06	Flash fire over plant area
						0.3		6.00E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								1.80E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.50E-07	Fireball
					0.4			7.00E-07	Flash fire over plant area
						0.3		3.00E-07	Vapour Cloud Explosion
							0.04	1.00E-07	Flash fire full extent
								9.00E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_01

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	2.40E-05	1.00	0.02	*					Escalation effect (Fireball)
								4.80E-07	Jet fire
					0.09			1.90E-06	Flash fire over plant area
						0.12		2.59E-07	Vapour Cloud Explosion
							0.01	2.40E-07	Flash fire full extent
								2.06E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	2.40E-05	1.00	0.02	*					Escalation effect (Fireball)
								4.80E-07	Jet fire
					0.09			1.90E-06	Flash fire over plant area
						0.12		2.59E-07	Vapour Cloud Explosion
							0.01	2.40E-07	Flash fire full extent
								2.06E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	8.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.60E-07	Jet fire
					0.09			6.34E-07	Flash fire over plant area
						0.12		8.64E-08	Vapour Cloud Explosion
							0.01	8.00E-08	Flash fire full extent
								6.88E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	8.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								8.00E-07	Jet fire
					0.4			2.24E-06	Flash fire over plant area
						0.3		9.60E-07	Vapour Cloud Explosion
							0.04	2.00E-07	Flash fire full extent
								3.20E-07	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	4.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.00E-07	Fireball
					0.4			1.12E-06	Flash fire over plant area
						0.3		4.80E-07	Vapour Cloud Explosion
							0.04	1.60E-07	Flash fire full extent
								1.44E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_02

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.20E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.40E-07	Jet fire
					0.09			9.50E-07	Flash fire over plant area
						0.12		1.30E-07	Vapour Cloud Explosion
							0.01	1.20E-07	Flash fire full extent
								1.03E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.20E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.40E-07	Jet fire
					0.09			9.50E-07	Flash fire over plant area
						0.12		1.30E-07	Vapour Cloud Explosion
							0.01	1.20E-07	Flash fire full extent
								1.03E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	4.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								8.00E-08	Jet fire
					0.09			3.17E-07	Flash fire over plant area
						0.12		4.32E-08	Vapour Cloud Explosion
							0.01	4.00E-08	Flash fire full extent
								3.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	4.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.00E-07	Jet fire
					0.4			1.12E-06	Flash fire over plant area
						0.3		4.80E-07	Vapour Cloud Explosion
							0.04	1.60E-07	Flash fire full extent
								1.44E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.00E-07	Fireball
					0.4			5.60E-07	Flash fire over plant area
						0.3		2.40E-07	Vapour Cloud Explosion
							0.04	8.00E-08	Flash fire full extent
								7.20E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_03

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	9.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.80E-07	Jet fire
					0.09			7.13E-07	Flash fire over plant area
						0.12		9.72E-08	Vapour Cloud Explosion
							0.01	9.00E-08	Flash fire full extent
								7.74E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	9.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.80E-07	Jet fire
					0.09			7.13E-07	Flash fire over plant area
						0.12		9.72E-08	Vapour Cloud Explosion
							0.01	9.00E-08	Flash fire full extent
								7.74E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	3.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								6.00E-08	Jet fire
					0.09			2.38E-07	Flash fire over plant area
						0.12		3.24E-08	Vapour Cloud Explosion
							0.01	3.00E-08	Flash fire full extent
								2.58E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	3.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.00E-07	Jet fire
					0.4			8.40E-07	Flash fire over plant area
						0.3		3.60E-07	Vapour Cloud Explosion
							0.04	1.20E-07	Flash fire full extent
								1.08E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.50E-07	Fireball
					0.4			4.20E-07	Flash fire over plant area
						0.3		1.80E-07	Vapour Cloud Explosion
							0.04	6.00E-08	Flash fire full extent
								5.40E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_04

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.80E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.60E-07	Jet fire
					0.09			1.43E-06	Flash fire over plant area
						0.12		1.94E-07	Vapour Cloud Explosion
							0.01	1.80E-07	Flash fire full extent
								1.55E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.80E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.60E-07	Jet fire
					0.09			1.43E-06	Flash fire over plant area
						0.12		1.94E-07	Vapour Cloud Explosion
							0.01	1.80E-07	Flash fire full extent
								1.55E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.20E-07	Jet fire
					0.09			4.75E-07	Flash fire over plant area
						0.12		6.48E-08	Vapour Cloud Explosion
							0.01	6.00E-08	Flash fire full extent
								5.16E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.00E-07	Jet fire
					0.4			1.68E-06	Flash fire over plant area
						0.3		7.20E-07	Vapour Cloud Explosion
							0.04	2.40E-07	Flash fire full extent
								2.16E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	3.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.00E-07	Fireball
					0.4			8.40E-07	Flash fire over plant area
						0.3		3.60E-07	Vapour Cloud Explosion
							0.04	1.20E-07	Flash fire full extent
								1.08E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_05

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.35E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.70E-07	Jet fire
					0.09			1.17E-06	Flash fire over plant area
						0.04		4.86E-08	Vapour Cloud Explosion
							0.01	1.35E-07	Flash fire full extent
								1.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.35E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.70E-07	Jet fire
					0.09			1.07E-06	Flash fire over plant area
						0.12		1.46E-07	Vapour Cloud Explosion
							0.01	1.35E-07	Flash fire full extent
								1.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.25E-06	1.00	0.10	*					Escalation effect (Fireball)
								2.25E-07	Fireball
					0.4			6.30E-07	Flash fire over plant area
						0.3		2.70E-07	Vapour Cloud Explosion
							0.04	9.00E-08	Flash fire full extent
								8.10E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_06

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.80E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.60E-07	Jet fire
					0.09			1.43E-06	Flash fire over plant area
						0.12		1.94E-07	Vapour Cloud Explosion
							0.01	1.80E-07	Flash fire full extent
								1.55E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.80E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.60E-07	Jet fire
					0.09			1.43E-06	Flash fire over plant area
						0.12		1.94E-07	Vapour Cloud Explosion
							0.01	1.80E-07	Flash fire full extent
								1.55E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.00E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.20E-07	Jet fire
					0.09			4.75E-07	Flash fire over plant area
						0.12		6.48E-08	Vapour Cloud Explosion
							0.01	6.00E-08	Flash fire full extent
								5.16E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.00E-07	Jet fire
					0.4			1.68E-06	Flash fire over plant area
						0.3		7.20E-07	Vapour Cloud Explosion
							0.04	2.40E-07	Flash fire full extent
								2.16E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.80E-05	1.00	0.10	*					Escalation effect (Fireball)
								3.00E-07	Fireball
					0.4			8.40E-07	Flash fire over plant area
						0.3		3.60E-07	Vapour Cloud Explosion
							0.04	1.20E-07	Flash fire full extent
								1.08E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_07

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.35E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.70E-07	Jet fire
					0.09			1.07E-06	Flash fire over plant area
						0.12		1.46E-07	Vapour Cloud Explosion
							0.01	1.35E-07	Flash fire full extent
								1.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.35E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.70E-07	Jet fire
					0.09			1.07E-06	Flash fire over plant area
						0.12		1.46E-07	Vapour Cloud Explosion
							0.01	1.35E-07	Flash fire full extent
								1.16E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	4.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								9.00E-08	Jet fire
					0.09			3.56E-07	Flash fire over plant area
						0.12		4.86E-08	Vapour Cloud Explosion
							0.01	4.50E-08	Flash fire full extent
								3.87E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	4.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.50E-07	Jet fire
					0.4			1.26E-06	Flash fire over plant area
						0.3		5.40E-07	Vapour Cloud Explosion
							0.04	1.80E-07	Flash fire full extent
								1.62E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	2.25E-06	1.00	0.10	*					Escalation effect (Fireball)
								4.50E-07	Fireball
					0.4			1.26E-06	Flash fire over plant area
						0.3		5.40E-07	Vapour Cloud Explosion
							0.04	1.80E-07	Flash fire full extent
								1.62E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_08

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.95E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.90E-07	Jet fire
					0.09			1.54E-06	Flash fire over plant area
						0.12		2.11E-07	Vapour Cloud Explosion
							0.01	1.95E-07	Flash fire full extent
								1.68E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.95E-05	1.00	0.02	*					Escalation effect (Fireball)
								3.90E-07	Jet fire
					0.09			1.54E-06	Flash fire over plant area
						0.12		2.11E-07	Vapour Cloud Explosion
							0.01	1.95E-07	Flash fire full extent
								1.68E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	6.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								1.30E-07	Jet fire
					0.09			5.15E-07	Flash fire over plant area
						0.12		7.02E-08	Vapour Cloud Explosion
							0.01	6.50E-08	Flash fire full extent
								5.59E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	6.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.50E-07	Jet fire
					0.4			1.82E-06	Flash fire over plant area
						0.3		7.80E-07	Vapour Cloud Explosion
							0.04	2.60E-07	Flash fire full extent
								2.34E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	3.25E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.25E-07	Fireball
					0.4			9.10E-07	Flash fire over plant area
						0.3		3.90E-07	Vapour Cloud Explosion
							0.04	1.30E-07	Flash fire full extent
								1.17E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_09

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	3.60E-05	1.00	0.02	*					Escalation effect (Fireball)
								7.20E-07	Jet fire
					0.09			3.11E-06	Flash fire over plant area
						0.04		1.30E-07	Vapour Cloud Explosion
							0.01	3.60E-07	Flash fire full extent
								3.10E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	3.60E-05	1.00	0.02	*					Escalation effect (Fireball)
								7.20E-07	Jet fire
					0.09			2.85E-06	Flash fire over plant area
						0.12		3.89E-07	Vapour Cloud Explosion
							0.01	3.60E-07	Flash fire full extent
								3.10E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	1.20E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.40E-07	Jet fire
					0.09			9.50E-07	Flash fire over plant area
						0.12		1.30E-07	Vapour Cloud Explosion
							0.01	1.20E-07	Flash fire full extent
								1.03E-05	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	1.20E-05	1.00	0.10	*					Escalation effect (Fireball)
								1.20E-06	Jet fire
					0.4			3.36E-06	Flash fire over plant area
						0.3		1.44E-06	Vapour Cloud Explosion
							0.04	4.80E-07	Flash fire full extent
								4.32E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	6.00E-06	1.00	0.10	*					Escalation effect (Fireball)
								6.00E-07	Fireball
					0.4			1.68E-06	Flash fire over plant area
						0.3		7.20E-07	Vapour Cloud Explosion
							0.04	2.40E-07	Flash fire full extent
								2.16E-06	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.

Hazardous Section GRS_10

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 10 mm hole size	1.05E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.10E-07	Jet fire
					0.09			8.32E-07	Flash fire over plant area
						0.12		1.13E-07	Vapour Cloud Explosion
							0.01	1.05E-07	Flash fire full extent
								9.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 25 mm hole size	1.05E-05	1.00	0.02	*					Escalation effect (Fireball)
								2.10E-07	Jet fire
					0.09			8.32E-07	Flash fire over plant area
						0.12		1.13E-07	Vapour Cloud Explosion
							0.01	1.05E-07	Flash fire full extent
								9.03E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 50 mm hole size	3.50E-06	1.00	0.02	*					Escalation effect (Fireball)
								7.00E-08	Jet fire
					0.09			2.77E-07	Flash fire over plant area
						0.12		3.78E-08	Vapour Cloud Explosion
							0.01	3.50E-08	Flash fire full extent
								3.01E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as 100 mm hole size	3.50E-06	1.00	0.10	*					Escalation effect (Fireball)
								3.50E-07	Jet fire
					0.4			9.80E-07	Flash fire over plant area
						0.3		4.20E-07	Vapour Cloud Explosion
							0.04	1.40E-07	Flash fire full extent
								1.26E-06	Unignited release

	Release Frequency (per year)	Detection & Shutdown Failure	Immediate Ignition	Escalation	Delayed Ignition (1)	Explosion Probability	Delayed Ignition (2)	Event Outcome Frequency	Event Outcome
Release as Line Rupture	1.75E-06	1.00	0.10	*					Escalation effect (Fireball)
								1.75E-07	Fireball
					0.4			4.90E-07	Flash fire over plant area
						0.3		2.10E-07	Vapour Cloud Explosion
							0.04	7.00E-08	Flash fire full extent
								6.30E-07	Unignited release

Note *: The escalation effect probability is estimated based on the location of release scenario and target equipment, as well as the associated consequence impact distance and duration.
As such, the escalation probability for each hazardous scenario regardless different hole size and location are assumed as 1/6, and it is only applied if separation distance between release scenario and target equipment is within the associated consequence impact distance.