

**DERRYGREENAGH POWER  
PLANT**

**RESPONSE TO HSA  
REQUEST FOR FURTHER  
INFORMATION REFERENCE  
PAR 4351**

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Technical Report Prepared For

**AECOM**

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Technical Report Prepared By

**Matthew Michie**, Senior Risk Consultant

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Our Reference

237501.0530RR03

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4<sup>th</sup> November 2024

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## INTRODUCTION

This document summarises the Applicant's response to the Health and Safety Authority's (HSA) submission dated 12<sup>th</sup> September 2024, reference: PAR 4351. Please refer to the updated Land Use Planning (LUP) report, included with this response, for full detail (reference 237501.0530RR01c).

The previously submitted Land Use Planning (LUP) report has been updated in-line with the comments raised by the HSA.

This document refers to the Guidance on Technical Land Use Planning advice. This is the guidance document on completing Land Use Planning reports, issued by the HSA in 2023. Herein, this guidance will be referred to as the TLUP.

The updated Land Use Planning report, included with this response, will be referred to as the LUP report.

## ITEM 1

*Confirm the correct document has been submitted as the original date of issue is different to that on the revised document submitted in response to the Authority's request for further information.*

## ITEM 1 RESPONSE

The correct document was submitted.

## ITEM 2

*Note any change to the design/layout/operation as set out in this planning application, including the use of hydrogen or a hydrogen blend, will need assessment in advance of the change, in compliance with the requirements of Regulation 12 of the COMAH Regulations.*

## ITEM 2 RESPONSE

Any change to the design/layout/operation will be evaluated under the Guidance on Significant Modifications (HSA, 2023).

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**ITEM 3**

*Fig 1 site boundary [red line indicating proposed planning application site boundary] is different to fig. 2 COMAH boundary. Also, the site boundary indicated in Appendix 16.3 of EIA is different to that on the proposed development site location map sheet 1 of 8. Ref. S7060-8050-0040-1Rev 1.0. All operations and activities associated with the COMAH site must be incorporated within the COMAH site boundary. Further clarification on this boundary is required.*

**ITEM 3 RESPONSE**

As stated in ITEM Response 2 of the previous response letter (ref: 237501.0530RR02):

*'The site boundary shown on 'Figure 1', of the LUP report shows the planning application boundary. 'Figure 2' of the LUP report shows the COMAH boundary. The planning application boundary does not have to be the same as the proposed COMAH boundary. The COMAH boundary is the boundary of the proposed power plant area that will be the 'Establishment' under which the COMAH regulations apply. The blue line around the layout shows the proposed COMAH boundary and it encloses the power plant area.'*

Figure 1 of the LUP report shows the proposed planning application boundary which includes:

- CCGT Unit, including CCGT Turbine Hall and buildings, Heat Recovery Steam Generator (HRSG);
- OCGT Unit and emissions stack;
- Secondary Fuel Storage and Unloading Facility;
- Gas Connection Corridor AGI Compound;
- Associated buildings and infrastructure and subsidiary items of plant/ equipment;
- Electricity Grid Connection, including 220kV Substation, 220kV Overhead Line, 220kV Line-Cable Interface Compound, 220kV Underground Connection and 400kV 'Loop-in' Substation at entry point to the 400kV transmission network.

The high voltage Electricity Grid Connection and infrastructure will be operated by EirGrid the transmission system operator following installation and owned by the asset owner ESB. The Electricity Grid Connection and infrastructure does not fall under the COMAH regulations and will not form part of the COMAH boundary.

The proposed COMAH boundary relates to the main thermal power plant area east of the R400 road, which includes Combined Cycle Gas Turbine (CCGT) and Open Cycle Gas Turbine (OCGT) plant, a gas Above Ground Installation (AGI), water abstraction and water treatment infrastructure, respective surface and process water discharge connection routes.

The proposed COMAH boundary includes all activities associated with COMAH activities.

**ITEM 4**

*Following on from the point above, Fig. 2 site layout does not provide sufficient detail. No site entrance or exit locations are marked, all buildings are to be identified, two tanks beside the raw water tank are not identified, no legend is included for the red & blues lines - revise report to include all items listed.*

**ITEM 4 RESPONSE**

Figure 2 has been updated to show all buildings on-site, the 2 No. tanks next to the raw water tank and entrance / exit locations. Figure 2 has been reproduced in Appendix A, of the LUP, to provide a more detailed site layout.

**ITEM 5**

*Confirmation that all existing buildings at the location will either be demolished or repurposed within the COMAH establishment, is required. Further, any existing buildings that may remain should be identified on the site map and use and occupancy provided.*

**ITEM 5 RESPONSE**

All existing buildings within the COMAH establishment will be demolished as part of the proposed development to facilitate construction of the power plant area. For further detail on the demolition works please see section 5.4.91 of chapter 5 of the EIAR.

**ITEM 6**

Section 5.1 of Appendix 16.3 EIAR table 13 lists a number of major accident scenarios, there is no discussion or reference to elsewhere in the document how this sub-set of scenarios has been determined. Provide a detailed description and include HAZID tables or similar, to demonstrate that a systematic method of hazard identification has been applied. It should also set out what criteria has been used to determine the final sub-set of major hazard accident scenarios that could occur at the site – revise report to demonstrate that the subset of major accident events considered in the report are correct.

**ITEM 6 RESPONSE**

The *Guidance on Technical Land Use Planning Advice (HSA, 2023)* provides the Major Accident Scenarios for each hazardous installation at the proposed development.

The Table below details the major accident hazard installations at the proposed development and the corresponding section of the TLUP Guidance where the major accidents have been identified. There were no other criteria to determine the final sub-set of major accident hazard scenarios as all scenarios stated in the TLUP were included in the risk model.

Installation	TLUP Guidance Section Reference	LOC scenario	Consequence/Event
Indoor equipment (release in Turbine enclosure)	3.9.1.2	Instantaneous failure	VCE
		Continuous leak over 10 minutes	VCE
		10 mm pipe leak over 10 minutes	VCE
Natural Gas Pipeline	3.5.1	Rupture of Pipeline	Fireball/Jet fire
			VCE
			Flash fire
		Pipeline Leak of 0.1D	Fireball/Jet fire
			VCE
			Flash fire
LPG Tank	3.1.1	Instantaneous Failure	Fireball
			VCE
			Flash fire
		Continuous Leak over 10 minutes	Jet fire
			VCE
			Flash fire
		10mm pipe leak over 30 minutes	Jet fire
			VCE
			Flash fire
LPG Pipeline	3.1.1 and 3.5.1	Rupture of Pipeline	Fireball/Jet fire
			VCE
			Flash fire
		Pipeline Leak of 0.1D	Fireball/Jet fire
			VCE

Installation	TLUP Guidance Section Reference	LOC scenario	Consequence/Event
			Flash fire
LPG Tanker	3.1.2	Instantaneous Failure	Fireball
			VCE
			Flash fire
		Loss of entire Contents through Largest Connection	Jet fire
			VCE
			Flash fire
		Rupture of unloading arm	Jet fire
			VCE
			Flash fire
		Leak of unloading arm of 10% of diameter	Jet fire
VCE			
Flash fire			
BLEVE (hot)	BLEVE		
Hydrogen Storage	3.4.1	Instantaneous failure	VCE/Fireball
		Continuous leak over 10 minutes (total inventory of 1 skid)	VCE, jet fire or flash fire
		10 mm pipe leak over 10 minutes	VCE, jet fire or flash fire
Hydrogen Pipeline	3.4.3 and 3.5.1	Pipeline rupture	Jet fire/Fireball
			VCE
			Flash fire
		Pipeline leak (10% of diameter)	Jet fire
			VCE
	Flash fire		
Distillate Tank	3.6.7	Loss of Containment	MATTE
Aqueous Ammonia Tank		Loss of Containment	MATTE
Sodium Hypochlorite Tank		Loss of Containment	MATTE

A full HAZID study will be completed, and submitted to the HSA, as part of the requirements for Lower Tier Operators prior to the plant being operational.

#### ITEM 7

*Section 6.7.6 of Appendix 16.3 EIAR hydrogen pipeline release event frequencies states it follows the TLUP guidance, however in table 62 the calculated event frequencies do not follow TLUP sc. 3.4.3 w.r.t. 100% ignition, 30 % prob of delayed / 40 % prob of VCE instead of flash fire - revise report with correct immediate / delayed jet/VCE/Flash fire probabilities. Further,*

immediate ignition results for hydrogen events also need to be set out in this section of the report and included in the risk calculation in accordance with TLUP sc. 3.4.3.

**ITEM 7 RESPONSE**

Section 6.7.6 has been updated to follow Section 3.4.3 of the TLUP and this is reflected in the Risk Model, as follows:

*‘Table 40 of the HSA’s TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for overground pipelines within an establishment of diameter <75 mm:*

- Pipeline rupture frequency: 1E-06 per m per year

*The Table below, corresponding to Table 62 of the updated LUP report, details the event frequencies for the hydrogen pipeline at the proposed development.*

Installation	LOC scenario	LOC frequency		Modifier	LOC frequency /year	Consequence	Conditional probability	Event frequency (per year)
Hydrogen Pipeline	Pipeline rupture	1.00E-06	/m/yr	100	1.00E-04	Jet fire	0.7	7.00E-05
						VCE	0.12	1.20E-05
						Flash fire	0.18	1.80E-05

Event Frequencies for Hydrogen Pipeline Rupture’

The immediate ignition scenario (jet fire) for a hydrogen release from a pipeline is included in Section 6.7.3 of the land use planning assessment and is included in the risk calculation for the proposed development.

**ITEM 8**

*Regarding the LPG scenarios in sections 6.5.14 and 6.5.15. The hot BLEVE scenario should also consider thermal radiation risks from the fireball, which are generally more significant than the overpressure risks this has not been considered and refer to TLUP table 18 [pool fires] surface emissive power (SEP) for LPG is set at 250, note max SEP to be used for jet fires. TLUP sets a specific SEP [sc. 2.11] of 275 kW/m2 for BLEVES – revise report.*

**ITEM 8 RESPONSE**

Section 6.5.14 and 6.5.15 have been updated to consider the thermal radiation risks from the fireball, as follows:

“LPG Tanker BLEVE (hot) Model Inputs

A BLEVE is an explosion which occurs when a storage vessel containing a liquid at a temperature significantly above its boiling point at normal atmospheric pressure, experiences a catastrophic failure. The TLUP states that a fireball will be used exclusively when determining the BLEVE effects.

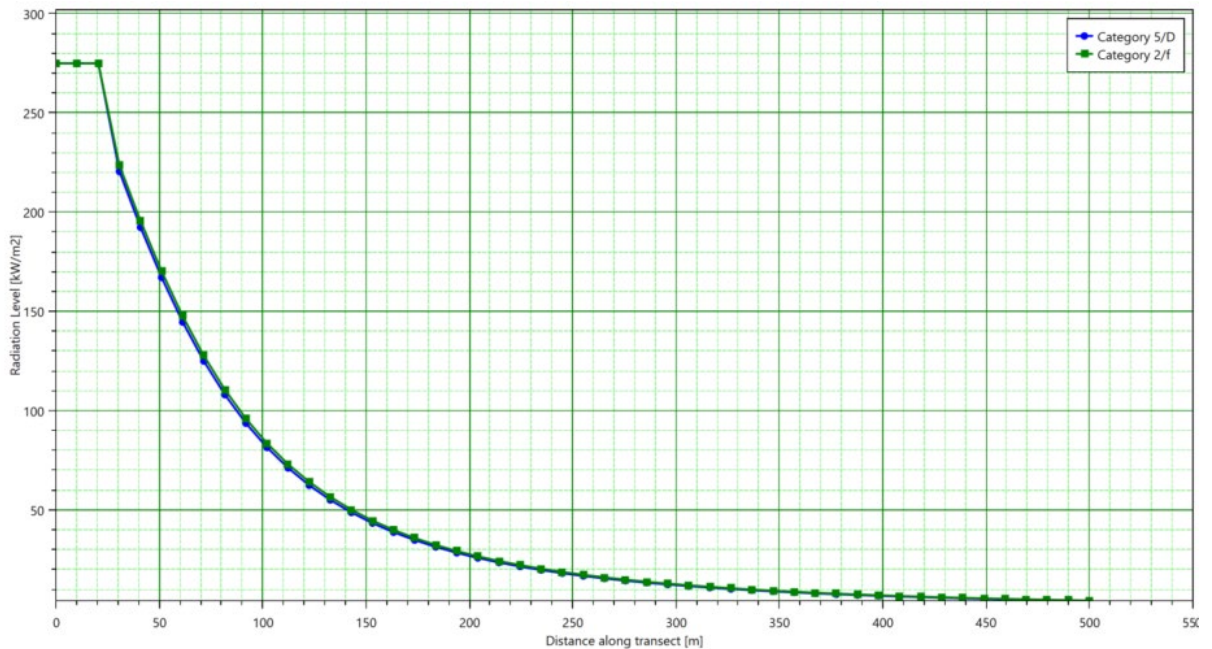
Parameter	Units	Value
Contents	kg	28,000
Substance	-	Propane
Surface Emissive Power	kW/m <sup>2</sup>	275
Burst Pressure (design pressure + 10%)	barg	33

LPG Tanker BLEVE: Model Inputs

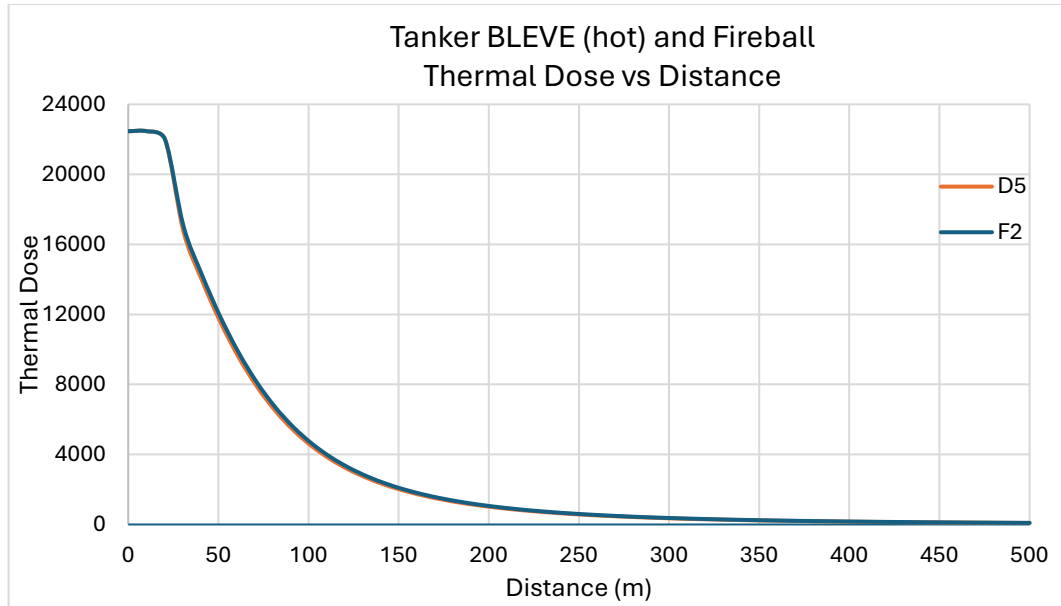
**LPG Tanker BLEVE (hot) Model Outputs**

In the event of LPG Tanker BLEVE (Hot), the fireball model calculates a fireball radius of 83 m, and the fireball duration is 12.8 s.

The Figures below, corresponding to Figures 86 and 87 of the updated LUP report, illustrate the thermal radiation vs distance profile for a BLEVE and fireball at the LPG tanker and the thermal dose vs distance profile for a BLEVE and fireball at the LPG tanker.



LPG Tanker BLEVE: Thermal Radiation vs Distance



LPG Tanker BLEVE: Thermal Dose vs Distance

The Table below, corresponding to Table 48 of the updated LUP report, details the distances to specified overpressure endpoints.

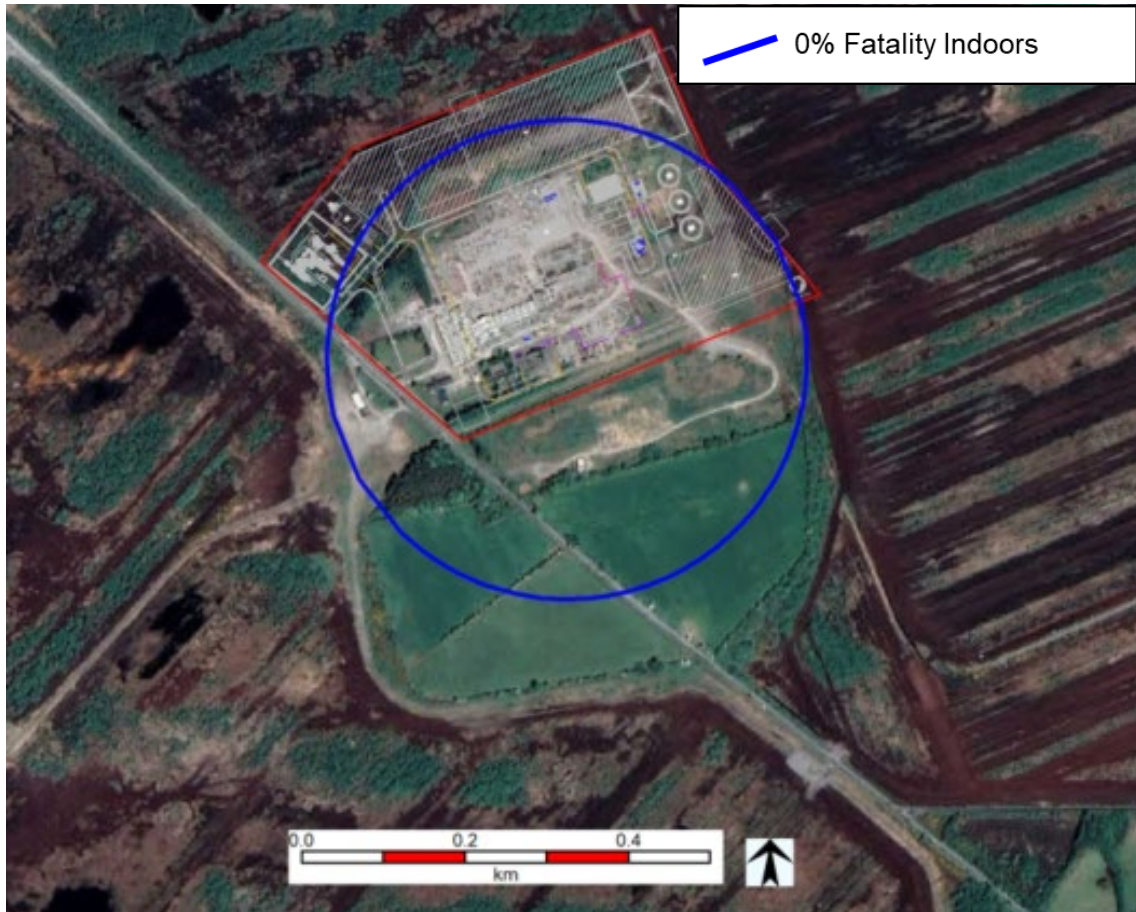
Criterion	Thermal Dose Level	Thermal Radiation	D5	F2
	TDUs	kW/m <sup>2</sup>	Distance (m)	Distance (m)
1% fatality (based on a 12.8s fireball duration)	963	-	204	204
100% fatality	Fireball radius	-	83	83
Building protected below this level, 0% fatality probability	-	12.7	295	295
Building will catch fire quickly, 100% fatality probability	-	25.6	201	201

LPG Tanker BLEVE: Distances to Specified Thermal Radiation Endpoints

The Figures below, corresponding to Figures 88 and Figure 89 of the updated LUP, illustrate the overpressure contours corresponding to 1% fatality outdoors and 0% fatality indoors.



LPG Tanker BLEVE and Fireball: 1% Fatality Outdoors Contour



LPG Tanker BLEVE and Fireball: 0% Fatality Indoors Contour

It is concluded for a Road Tanker BLEVE (hot) and Fireball:

- The thermal radiation level corresponding to 1% mortality outdoors could extend over the power plant area boundary. This area is not occupied and persons are not typically present. This contour also could extend to the R400 road to the south and west. There is potential for fatality of road users passing the site in the event of a Fireball.
- The 0% fatality indoors contour, extends over the site boundary, but does not extend to any off-site occupied building.”

## ITEM 9

*In section 6.5.16 table 49 RT event frequency all the hose frequencies are incorrect. The failure rates given in section 3.1.2 TLUP are per hour, not per year – revise report.*

## ITEM 9 RESPONSE

Table 49 of the LUP has been updated to include the correct frequency values as follows:

‘It is estimated that there will be 2 deliveries per year for the OCGTs and 12 deliveries per year for the CCGT. The delivery vehicle will be on site for 1.5 hours. Therefore, the fraction that the road tanker is on-site for per year is 0.0024 (21 / 8760).

Table 24 of the TLUP states an instantaneous failure frequency and loss of entire contents through largest connection of 5E-07 per year, this is adjusted to account for the time the tanker is on site per year.

Table 25 of the TLUP states a frequency of 4.0E-06 per hour for a rupture of a loading hose and a frequency of 4E-05 per hour for a leak of a loading hose. The delivery vehicle will be on-site for 21 hours per year.

Table 26 of the TLUP states a frequency of a BLEVE (hot) for tanker loading operations as 5.8E-10 per hour. The delivery vehicle will be on-site for 21 hours per year.

The event frequencies for the proposed development are detailed in the Table below, corresponding to Table 49 of the LUP.

Installation	LOC scenario	Consequence	Frequency (per year)
LPG Road Tanker	Instantaneous failure	Fireball	4.79E-10
		VCE	2.88E-10
		Flash fire	4.32E-10
	Loss of contents through largest connection	Jet fire	1.20E-10
		VCE	4.32E-10
		Flash fire	6.47E-10
	Rupture of Loading Hose	Jet fire	8.40E-06
		VCE	3.02E-05
		Flash fire	4.54E-05
	Leak of Loading Hose	Jet fire	8.40E-05
		VCE	3.02E-04
		Flash fire	4.54E-04
BLEVE (hot)	BLEVE	1.22E-08	

LPG Tanker Event Frequencies'

**ITEM 10**

*Section 6.5.16 Table 49 RT event frequency for a hot BLEVE frequency is incorrect. The failure rate in section 3.1.2 TLUPG is per hour, not per year – revise report.*

**ITEM 10 RESPONSE**

This has been updated in Table 49 and in the risk model for the proposed development.

**ITEM 11**

*Explanation of how the various types of events described in Section 6 have been characterised in RiskCurves to get the final risks is required, this cannot be verified [as noted in other points there is more than 1 turbine, LPG tank on site, therefore the report must clearly show that the total frequency has been applied in the risk calculation] – revise report.*

**ITEM 11 RESPONSE**

Appendix A to this response letter contains the input frequencies print out from RiskCurves for the indoor and outdoor risk models. The print out details the frequencies corresponding to the

major accident hazards at the proposed development. Where there are multiple installations of the same consequences, e.g. gas turbines or LPG tanks, the risk calculation is centred at each individual installation and the frequency of the relevant scenario is applied. The frequencies incorporate that D5 conditions are assumed to occur 80% of the time, with F2 occurring for the remaining 20% and that persons are assumed to be indoors 90% of the time and outdoors 10% of the time.

**ITEM 12**

*In section 8 there should be a consideration of societal risk, if only to say why an assessment has not been undertaken. Further, in section 8 (and elsewhere). There should be more detailed consideration of the risk at the R400 road, and why it is considered acceptable. The report identifies a number of flash fires and VCE events that impact the road, but it says that this would only cause injury, not fatality – this needs clear justification and describe exactly what are the most significant risk events at the R400 road – revise report.*

**ITEM 12 RESPONSE**

The Land Use Planning assessment has been updated to include a societal risk assessment. Section 9.0 of the updated report is as follows:

“The purpose of this societal risk study is to generate advice on the types/nature and scale of development that is likely to be acceptable to the HSA. The R400 road is within the consequence zone of major accidents at the proposed development. The Table below, corresponding to Table 72 of the updated LUP, lists the major accidents at the proposed development with potential for consequence at the R400 road.

Scenarios
Horizontal Pipeline Rupture and Jet fire
Horizontal Pipeline Rupture and Flash Fire
OCGT VCE
LPG Tank Rupture and VCE
LPG Tanker Rupture and Fireball
LPG Tanker Rupture and VCE
LPG Tanker Rupture and Flash Fire
LPG Tanker Release through Largest Connection and Jet Fire
LPG Tanker Release through Largest Connection and Flash Fire
LPG Tanker Hose Rupture and Jet Fire
LPG Tanker Hose Rupture and Flash Fire
LPG Tanker Hot BLEVE and Fireball

Major Accident Scenarios with Consequences at R400 Road

A traffic survey, carried out by Innovative Data Solutions in 2023 (see Appendix A), found that there were 2700 passenger car units (PCUs) passing the proposed development on the R400 road in a 12-hour period. This equates to 225 PCUs per hour. The speed limit along the R400 road is 80 km/hr.

The HSA has no guidance on fatality to persons in cars from major accidents; therefore, for the purposes of this Societal Risk calculation, a worst-case scenario was used. Consequences, due to thermal radiation, corresponding to fatality outdoors were used and consequences, due to overpressure, corresponding to fatality indoors CIA Cat. 3 were used.

The occupancy of the road is based on the length of the road within the consequence zone and uses the 80 km/hr speed limit to calculate time spent, per PCU, in the zone. The number of cars in hazard range value, in Table 74, is the average number of PCUs, at any given moment, in the consequence zone corresponding to the major accident hazard. It is assumed that there are 2 persons per PCU.

The Table below details the base frequency per year and chances per million (CPM), which incorporate the adjustments for weather conditions, for scenarios with potential fatalities at the R400 road.

Scenario	Base Freq	Modifier (directional)	Modifier (weather)	Total Freq	CPM
OCGT LPG Tanker Hose Rupture and Flash Fire	6.48E-06			6.48E-06	6.48E+00
OCGT LPG Tanker Hose Rupture and Jet Fire	1.20E-06			1.20E-06	1.20E+00
Horizontal Pipeline Rupture and Flash Fire	5.40E-07	0.5	0.8	2.16E-07	2.16E-01
OCGT VCE	2.00E-05			2.00E-05	2.00E+01
Horizontal Pipeline Rupture and Jet fire	1.50E-07	0.25	1	3.75E-08	3.75E-02
OCGT LPG Tank Rupture and VCE	6.00E-08			6.00E-08	6.00E-02
LPG Tanker Rupture and Fireball	6.85E-11			6.85E-11	6.85E-05
LPG Tanker Rupture and VCE	4.11E-11			4.11E-11	4.11E-05
LPG Tanker Rupture and Flash Fire	6.16E-11			6.16E-11	6.16E-05
LPG Tanker Release through Largest Connection and Jet Fire	1.71E-11			1.71E-11	1.71E-05
LPG Tanker Release through Largest Connection and Flash Fire	9.25E-11			9.25E-11	9.25E-05
OCGT LPG Tanker Hot BLEVE and Fireball	1.74E-09			1.74E-09	1.74E-03

Societal Risk Frequencies in Chances per Million (CPM)

The Table below details the Societal Risk calculation for the proposed scheme. The Expectation Value (EV) at the proposed scheme is calculated to be **19.5**.

Section 1.7 of the TLUP (HSA, 2023) states:

*‘for new developments near an establishment, where the calculated off-site EV at the development greater than 2,000, further assessment of societal risk will be required.’*

The total Expectation Value (EV) at the proposed scheme is **19.5**. This is <2,000; therefore, no further risk calculation is required.”

Major Accident	Distance from road (m)	Road Coverage of 1% Fatality	No. PCUs in Hazard Range	Overpressure (mbar)	Vul to overpressure (CIA 3)	Thermal Radiation (kW/m2) *Thermal Dose	Vul to Thermal Radiation (Outdoors)	Vul to Flashfire	Occupants	Fatalities	Frequency (cpm)	Expectation Value
OCGT LPG Tanker Hose Rupture and Flash Fire	160	475	1.35	0	0	0	0	1	2.7	2.7	6.5	17.50
OCGT LPG Tanker Hose Rupture and Jet Fire	160	185	0.52	0	0	106	1	0	1.0	1.0	1.2	1.25
Horizontal Pipeline Rupture and Flash Fire	90	505	1.41	0	0	0	0	1	2.8	2.8	0.22	0.61
OCGT VCE	120	85	0.24	50	0.01	0	0	0	0.5	0.0	20.0	0.10
Horizontal Pipeline Rupture and Jet fire	90	315	0.89	0	0	179	1	0	1.8	1.8	0.038	0.07
LPG Tank Rupture and VCE	160	280	0.79	75	0.025	0	0	0	1.6	0.0	0.060	0.00
LPG Tanker Rupture and Fireball	160	160	0.45	0	0	1300*	0.06	0	0.9	0.1	0.0001	0.00
LPG Tanker Rupture and VCE	160	725	2.04	150	0.112	0	0	0	4.1	0.5	0.00	0.00
LPG Tanker Rupture and Flash Fire	160	235	0.66	0	0	0	0	1	1.3	1.3	0.0001	0.00
LPG Tanker Release through Largest Connection and Jet Fire	160	185	0.52	0	0	106	1	0	1.0	1.0	0.00	0.00
LPG Tanker Release through Largest Connection and Flash Fire	160	475	1.34	0	0	0	0	1	2.7	2.7	0.0001	0.00
LPG Tanker Hot BLEVE and Fireball	160	235	0.66	0	0	1300*	0.06	0	1.3	0.1	0.0017	0.00
<b>Total</b>												<b>19.5</b>

Societal Risk Calculation

**ITEM 13**

*Appendix 16.3 Section 7.7.1 It is noted that the frequency of a MATTE event takes account of the total frequency as 2.5 E-5 per year based on the number of tanks, yet the cumulative frequency for all other scenarios in the report does not, e.g. total number of turbines onsite, the risk is calculated as per turbine – revise report and calculate risk as stated in points above.*

**ITEM 13 RESPONSE**

Section 7.7.1 of the Land Use Planning Report has been updated, to include the cumulative frequency for all relevant scenarios on site, as follows:

“There are 2 No. bulk storage tanks on site that contain distillate that is classified as hazardous to the aquatic environment and that could cause a MATTE if a significant release occurred.

The design includes for 2 No. bulk storage tanks that contain fuel oil that is classified as hazardous to the aquatic environment and that could cause a MATTE if a significant release occurred. The tanks will comply with EN14015 and the pipework to EN13480 (or equivalent). Fuel storage conditions are at atmospheric temperature and pressure.

There are 2 No. storage tanks containing ammonia and 1 No. storage tank containing sodium hypochlorite.

The HSA’s Guidance on Technical Land Use Planning Advice (HSA, 2023) states a frequency of 5E-06 per year for instantaneous failure of a tank (per tank); therefore, 2.5E-05 per year for all of the storage tanks at the proposed development.

The hazardous material storage tanks on-site can also rupture as a result of overpressure effects from an explosion on-site. The overpressure level that could cause tank rupture is 200 mbar (see Table 9). The ammonia and sodium hypochlorite storage tanks are not within the 200mbar contour of any explosion event at the proposed development.

The Table below details the major accident installations that result in an overpressure of 200 mbar at the proposed storage tanks.

Installation	Frequency
CCGT LPG Tank Instantaneous Failure and VCE	6.00E-08
LPG Tanker (at CCGT) Instantaneous Failure and VCE	2.88E-10
LPG Tanker (at CCGT) Loss of contents through largest connection	4.32E-10
LPG Tanker (at CCGT) Rupture of Loading Hose and VCE	3.05E-05

Domino Effects with Potential to Cause Tank Rupture

Therefore, the total initiating event frequency for a MATTE scenario is 5.56E-05 per year.”

## REFERENCES

Health and Safety Authority (HSA) Guidance on Technical Land-Use Planning Advice, for planning authorities and COMAH establishment operators, 2023

“ALL MEASURES NECESSARY” – Environmental Aspects (April 2016), UK HSE

237501.0530RR01a Derrygreenagh Land Use Planning, 2024

**APPENDIX A**  
**RiskCurves Frequency Printouts**

## Indoor Frequency Risk Curves

Selection overview for Calculation set

	Frequency [1/year]
<b>Aux Boil 1/2 pipeline</b>	
Nat gas pipeline rup Fireball	6.75E-07
Rup pipeline vert VCE D5	2.92E-06
Rup pipeline vert VCE F2	7.30E-07
<b>Aux Boil 2/2 pipeline</b>	
Nat gas pipeline rup Fireball	6.75E-07
Rup pipeline vert VCE D5	2.92E-06
Rup pipeline vert VCE F2	7.30E-07
<b>BG CCGT 1/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 2/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 3/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 4/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08

<b>BG CCGT 5/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 6/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 7/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>BG CCGT 8/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	8.16E-08
Leak Nat Gas pipeline FF F2	2.04E-08
Leak Nat gas pipeline Fireball	2.84E-07
Leak Nat gas pipeline VCE D5	1.22E-06
Leak Nat gas pipeline VCE F2	3.06E-07
Rup Nat Gas pipeline FF D5	1.64E-08
Rup Nat Gas pipeline FF F2	4.10E-09
Rup Nat gas pipeline Fireball	5.68E-08
Rup Nat gas pipeline VCE D5	2.46E-07
Rup Nat gas pipeline VCE F2	6.14E-08
<b>CCGT Above Ground Pipeline</b>	
Leak Nat gas pipeline Fireball Vert	6.75E-07
Leak Nat gas pipeline horz VCE	1.83E-06
Leak Nat gas pipeline vert VCE	1.83E-06
Pipeline Leak Flash fire D5	4.86E-09
Pipeline Leak Flash fire F2	1.22E-09
Pipeline Rup Flash fire D5	3.89E-08
Pipeline Rup Flash fire F2	9.72E-09
Rup Nat gas pipeline Fireball	1.35E-07
Rup Nat gas pipeline horz VCE D5	2.92E-07
Rup Nat gas pipeline horz VCE F2	7.29E-08
Rup Nat gas pipeline vert VCE D5	2.92E-07
Rup Nat gas pipeline vert VCE F2	7.29E-08

<b>CCGT Tanker: 28t Propane</b>	
Connection Leak Flash fire Horz D5	2.00E-11
Connection Leak Flash fire Horz F2	4.99E-12
Connection Leak Jet Fire Horz D5	3.70E-11
Connection Leak Jet Fire Horz F2	9.25E-12
Connection Leak Jet Fire Vert D5	3.70E-11
Connection Leak Jet Fire Vert F2	9.25E-12
Connection Leak VCE Horz D5	1.33E-10
Connection Leak VCE Horz F2	3.33E-11
Connection Leak VCE Vert D5	1.33E-10
Connection Leak VCE Vert F2	3.33E-11
Hose Leak Flash fire Horz D5	2.80E-05
Hose Leak Flash fire Horz F2	2.80E-05
Hose Leak Jet Fire Horz D5	5.18E-05
Hose Leak Jet Fire Horz F2	1.30E-05
Hose Leak VCE Horz D5	1.86E-04
Hose Leak VCE Horz F2	4.66E-05
Hose Rup Flash fire Horz D5	2.80E-06
Hose Rup Flash fire Horz F2	7.00E-07
Hose Rup Jet Fire Horz D5	5.18E-06
Hose Rup Jet Fire Horz F2	1.30E-06
Hose Rup VCE Horz D5	1.86E-05
Hose Rup VCE Horz F2	4.66E-06
Hot BLEVE fireball	9.40E-09
Rupture fireball	3.70E-10
Rupture Flash fire D5	2.66E-11
Rupture Flash fire F2	6.66E-12
Rupture VCE D5	1.78E-10
Rupture VCE F2	4.44E-11
<b>CCGT VCE</b>	
VCE Blast Damage Set	1.80E-05
<b>H2 Cylinder</b>	
Rup VCE	4.50E-06
10mm Cylinder Leak VCE	1.35E-04
10mm Skid leak jet fire	1.58E-04
Release 10 min jet fire	6.30E-06
Release 10 min VCE	2.70E-06
<b>H2 Pipeline 1</b>	
Rup VCE	5.40E-06
Pipe rupture JF	3.15E-05
Pipeline Rup Flash fire	4.05E-07
<b>H2 Pipeline 2</b>	
Rup VCE	5.40E-06
Pipe rupture JF	3.15E-06
Pipeline Rup Flash fire	4.05E-07
<b>LPG Pipeline 01: Pipeline Release</b>	
Pipeline Rup Flash fire Horz D5	5.84E-07
Pipeline Rup Flash fire Horz F2	1.46E-07
Pipeline Rup JF Horz D5	1.62E-06
Pipeline Rup JF Horz F2	4.05E-07
Pipeline Rup JF Vert D5	1.62E-06
Pipeline Rup JF Vert F2	4.05E-07
Pipeline rup VCE Horz D5	8.76E-06
Pipeline rup VCE Horz F2	2.19E-06
Pipeline rup VCE Vert D5	8.76E-05
Pipeline rup VCE Vert F2	2.19E-06

**LPG Pipeline 02: Pipeline Release**

Pipeline Rup Flash fire Horz D5	6.48E-07
Pipeline Rup Flash fire Horz F2	1.62E-07
Pipeline Rup JF Horz D5	1.80E-06
Pipeline Rup JF Horz F2	4.50E-07
Pipeline Rup JF Vert D5	1.80E-06
Pipeline Rup JF Vert F2	4.50E-07
Pipeline rup VCE Horz D5	9.72E-06
Pipeline rup VCE Horz F2	2.43E-06
Pipeline rup VCE Vert D5	9.72E-05
Pipeline rup VCE Vert F2	2.43E-06

**OCGT 1/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.10E-07
Leak Nat Gas pipeline FF F2	2.76E-08
Leak Nat gas pipeline VCE D5	1.66E-06
Leak Nat gas pipeline VCE F2	4.14E-07
Nat gas pipeline leak Fireball	3.83E-07
Nat gas pipeline rup Fireball	7.65E-08
Rup Nat Gas pipeline FF D5	2.20E-08
Rup Nat Gas pipeline FF F2	5.50E-09
Rup Nat gas pipeline VCE D5	3.30E-07
Rup Nat gas pipeline VCE F2	8.26E-08

**OCGT 2/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.10E-07
Leak Nat Gas pipeline FF F2	2.76E-08
Leak Nat gas pipeline VCE D5	1.66E-06
Leak Nat gas pipeline VCE F2	4.14E-07
Nat gas pipeline leak Fireball	3.83E-07
Nat gas pipeline rup Fireball	7.65E-08
Rup Nat Gas pipeline FF D5	2.20E-08
Rup Nat Gas pipeline FF F2	5.50E-09
Rup Nat gas pipeline VCE D5	3.30E-07
Rup Nat gas pipeline VCE F2	8.26E-08

**OCGT 3/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.10E-07
Leak Nat Gas pipeline FF F2	2.76E-08
Leak Nat gas pipeline VCE D5	1.66E-06
Leak Nat gas pipeline VCE F2	4.14E-07
Nat gas pipeline leak Fireball	3.83E-07
Nat gas pipeline rup Fireball	7.65E-08
Rup Nat Gas pipeline FF D5	2.20E-08
Rup Nat Gas pipeline FF F2	5.50E-09
Rup Nat gas pipeline VCE D5	3.30E-07
Rup Nat gas pipeline VCE F2	8.26E-08

**OCGT 4/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.10E-07
Leak Nat Gas pipeline FF F2	2.76E-08
Leak Nat gas pipeline VCE D5	1.66E-06
Leak Nat gas pipeline VCE F2	4.14E-07
Nat gas pipeline leak Fireball	3.83E-07
Nat gas pipeline rup Fireball	7.65E-08
Rup Nat Gas pipeline FF D5	2.20E-08
Rup Nat Gas pipeline FF F2	5.50E-09
Rup Nat gas pipeline VCE D5	3.30E-07
Rup Nat gas pipeline VCE F2	8.26E-08

<b>OCGT Tanker: 28t Propane</b>	
Connection Leak Flash fire Horz D5	3.33E-12
Connection Leak Flash fire Horz F2	8.32E-13
Connection Leak Jet Fire Horz D5	6.16E-12
Connection Leak Jet Fire Horz F2	1.54E-12
Connection Leak Jet Fire Vert D5	6.16E-12
Connection Leak Jet Fire Vert F2	1.54E-12
Connection Leak VCE Horz D5	2.22E-11
Connection Leak VCE Horz F2	5.55E-12
Connection Leak VCE Vert D5	2.22E-11
Connection Leak VCE Vert F2	5.55E-12
Hose Leak Flash fire Horz D5	4.66E-06
Hose Leak Flash fire Horz F2	4.66E-06
Hose Leak Jet Fire Horz D5	8.64E-06
Hose Leak Jet Fire Horz F2	2.16E-06
Hose Leak VCE Horz D5	3.11E-05
Hose Leak VCE Horz F2	7.72E-06
Hose Rup Flash fire Horz D5	4.66E-07
Hose Rup Flash fire Horz F2	1.17E-07
Hose Rup Jet Fire Horz D5	8.64E-07
Hose Rup Jet Fire Horz F2	2.16E-07
Hose Rup VCE Horz D5	3.11E-06
Hose Rup VCE Horz F2	7.78E-07
Hot BLEVE fireball	1.57E-09
Rupture fireball	6.16E-11
Rupture Flash fire D5	4.44E-12
Rupture Flash fire F2	1.11E-12
Rupture VCE D5	2.96E-11
Rupture VCE F2	7.40E-12
<b>OCGT VCE 1</b>	
VCE Blast Damage Set	1.80E-05
<b>OCGT VCE 2</b>	
VCE Blast Damage Set	1.80E-05
<b>Tank01: 1t Propane</b>	
10min leak Flash fire Horz D5	3.24E-09
10min leak Flash fire Horz F2	8.10E-09
10min leak Jet Fire Horz D5	1.26E-07
10min leak Jet Fire Horz F2	3.15E-08
10min leak Jet Fire Vert D5	1.26E-07
10min leak Jet Fire Vert F2	3.15E-08
10min leak VCE Horz D5	2.16E-08
10min leak VCE Horz F2	5.40E-09
10mm leak Flash fire Horz D5	6.48E-08
10mm leak Flash fire Horz F2	1.62E-08
10mm leak Jet Fire Horz D5	2.52E-06
10mm leak Jet Fire Horz F2	6.30E-07
10mm leak Jet Fire Vert D5	6.30E-07
10mm leak Jet Fire Vert F2	6.30E-07
10mm leak VCE Horz D5	4.32E-07
10mm leak VCE Horz F2	1.08E-07
Rupture Fireball	3.15E-07
Rupture Flash fire D5	6.48E-09
Rupture Flash fire F2	1.62E-09
Rupture VCE D5	4.32E-08
Rupture VCE F2	1.08E-08

**Tank01: 1t Propane**

10min leak Flash fire Horz D5	3.24E-09
10min leak Flash fire Horz F2	8.10E-09
10min leak Jet Fire Horz D5	1.26E-07
10min leak Jet Fire Horz F2	3.15E-08
10min leak Jet Fire Vert D5	1.26E-07
10min leak Jet Fire Vert F2	3.15E-08
10min leak VCE Horz D5	2.16E-08
10min leak VCE Horz F2	5.40E-09
10mm leak Flash fire Horz D5	6.48E-08
10mm leak Flash fire Horz F2	1.62E-08
10mm leak Jet Fire Horz D5	2.52E-06
10mm leak Jet Fire Horz F2	6.30E-07
10mm leak Jet Fire Vert D5	6.30E-07
10mm leak Jet Fire Vert F2	6.30E-07
10mm leak VCE Horz D5	4.32E-07
10mm leak VCE Horz F2	1.08E-07
Rupture Fireball	3.15E-07
Rupture Flash fire D5	6.48E-09
Rupture Flash fire F2	1.62E-09
Rupture VCE D5	4.32E-08
Rupture VCE F2	1.08E-08

**Tank02: 1t Propane**

10min leak Flash fire Horz D5	3.24E-09
10min leak Flash fire Horz F2	8.10E-09
10min leak Jet Fire Horz D5	1.26E-07
10min leak Jet Fire Horz F2	3.15E-08
10min leak Jet Fire Vert D5	1.26E-07
10min leak Jet Fire Vert F2	3.15E-08
10min leak VCE Horz D5	2.16E-08
10min leak VCE Horz F2	5.40E-09
10mm leak Flash fire Horz D5	6.48E-08
10mm leak Flash fire Horz F2	1.62E-08
10mm leak Jet Fire Horz D5	2.52E-06
10mm leak Jet Fire Horz F2	6.30E-07
10mm leak Jet Fire Vert D5	6.30E-07
10mm leak Jet Fire Vert F2	6.30E-07
10mm leak VCE Horz D5	4.32E-07
10mm leak VCE Horz F2	1.08E-07
Rupture Fireball	3.15E-07
Rupture Flash fire D5	6.48E-09
Rupture Flash fire F2	1.62E-09
Rupture VCE D5	4.32E-08
Rupture VCE F2	1.08E-08

## Outdoor Frequency Risk Curves

**Selection overview for Calculation set**

	<b>Frequency [1/year]</b>
<b>Aux Boil 1/2 pipeline</b>	
Nat gas pipeline rup Fireball	7.50E-08
Rup pipeline vert VCE D5	3.60E-07
Rup pipeline vert VCE F2	9.00E-08
<b>Aux Boil 2/2 pipeline</b>	
Nat gas pipeline rup Fireball	7.50E-08
Rup pipeline vert VCE D5	3.60E-07
Rup pipeline vert VCE F2	9.00E-08
<b>BG CCGT 1/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 2/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 3/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 4/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09

<b>BG CCGT 5/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 6/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 7/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>BG CCGT 8/8 pipeline rupture</b>	
Leak Nat Gas pipeline FF D5	9.12E-08
Leak Nat Gas pipeline FF F2	2.28E-08
Leak Nat gas pipeline Fireball	3.16E-08
Leak Nat gas pipeline VCE D5	1.36E-07
Leak Nat gas pipeline VCE F2	3.40E-08
Rup Nat Gas pipeline FF D5	1.82E-08
Rup Nat Gas pipeline FF F2	4.54E-09
Rup Nat gas pipeline Fireball	6.31E-09
Rup Nat gas pipeline VCE D5	2.73E-08
Rup Nat gas pipeline VCE F2	6.82E-09
<b>CCGT Above Ground Pipeline</b>	
Leak Nat gas pipeline Fireball Vert	7.50E-08
Leak Nat gas pipeline horz VCE	2.03E-07
Leak Nat gas pipeline vert VCE	2.03E-07
Pipeline Leak Flash fire D5	5.40E-09
Pipeline Leak Flash fire F2	1.35E-09
Pipeline Rup Flash fire D5	4.32E-08
Pipeline Rup Flash fire F2	1.08E-08
Rup Nat gas pipeline horz VCE D5	3.24E-08
Rup Nat gas pipeline horz VCE F2	8.10E-09
Rup Nat gas pipeline vert Fireball	1.50E-08
Rup Nat gas pipeline vert VCE D5	3.24E-08
Rup Nat gas pipeline vert VCE F2	8.10E-09

<b>CCGT Tanker: 28t Propane</b>	
Connection Leak Flash fire Horz D5	2.22E-11
Connection Leak Flash fire Horz F2	5.55E-12
Connection Leak Jet Fire Horz D5	4.12E-12
Connection Leak Jet Fire Horz F2	1.03E-12
Connection Leak Jet Fire Vert D5	4.12E-12
Connection Leak Jet Fire Vert F2	1.03E-12
Connection Leak VCE Horz D5	1.48E-11
Connection Leak VCE Horz F2	3.70E-12
Connection Leak VCE Vert D5	1.48E-11
Connection Leak VCE Vert F2	3.70E-12
Hose Leak Flash fire Horz D5	3.11E-05
Hose Leak Flash fire Horz F2	3.11E-05
Hose Leak Jet Fire Horz D5	5.76E-06
Hose Leak Jet Fire Horz F2	1.44E-06
Hose Leak VCE Horz D5	2.07E-05
Hose Leak VCE Horz F2	5.18E-06
Hose Rup Flash fire Horz D5	3.11E-06
Hose Rup Flash fire Horz F2	7.78E-07
Hose Rup Jet Fire Horz D5	5.76E-07
Hose Rup Jet Fire Horz F2	1.44E-07
Hose Rup VCE Horz D5	2.07E-06
Hose Rup VCE Horz F2	5.18E-07
Hot BLEVE fireball	9.40E-09
Rupture fireball	4.11E-11
Rupture Flash fire D5	2.96E-11
Rupture Flash fire F2	7.40E-12
Rupture VCE D5	1.98E-11
Rupture VCE F2	4.94E-12
<b>CCGT VCE</b>	
VCE Blast Damage Set	2.00E-06
<b>H2 Cylinder</b>	
Rup VCE	5.00E-07
10mm Cylinder Leak VCE	1.50E-05
10mm Skid leak jet fire	1.75E-05
Release 10 min jet fire	7.00E-07
Release 10 min VCE	3.00E-07
<b>H2 Pipeline 1</b>	
Rup VCE	6.00E-07
Pipe rupture JF	3.50E-06
Pipeline Rup Flash fire	4.50E-07
<b>H2 Pipeline 2</b>	
Rup VCE	6.00E-07
Pipe rupture JF	3.50E-06
Pipeline Rup Flash fire	4.50E-07
<b>LPG Pipeline 01: Pipeline Release</b>	
Pipeline Rup Flash fire Horz D5	6.48E-07
Pipeline Rup Flash fire Horz F2	1.62E-07
Pipeline Rup JF Horz D5	1.80E-07
Pipeline Rup JF Horz F2	4.50E-08
Pipeline Rup JF Vert D5	1.80E-07
Pipeline Rup JF Vert F2	4.50E-08
Pipeline rup VCE Horz D5	6.48E-07
Pipeline rup VCE Horz F2	1.62E-07
Pipeline rup VCE Vert D5	6.48E-06
Pipeline rup VCE Vert F2	1.62E-07

**LPG Pipeline 02: Pipeline Release**

Pipeline Rup Flash fire Horz D5	7.20E-07
Pipeline Rup Flash fire Horz F2	1.80E-07
Pipeline Rup JF Horz D5	2.00E-07
Pipeline Rup JF Horz F2	5.00E-08
Pipeline Rup JF Vert D5	2.00E-07
Pipeline Rup JF Vert F2	5.00E-08
Pipeline rup VCE Horz D5	1.08E-06
Pipeline rup VCE Horz F2	2.70E-07
Pipeline rup VCE Vert D5	1.08E-05
Pipeline rup VCE Vert F2	2.70E-07

**OCGT 1/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.22E-07
Leak Nat Gas pipeline FF F2	3.06E-08
Leak Nat gas pipeline VCE D5	1.84E-07
Leak Nat gas pipeline VCE F2	4.60E-08
Nat gas pipeline leak Fireball	4.25E-08
Nat gas pipeline rup Fireball	8.50E-09
Rup Nat Gas pipeline FF D5	2.45E-08
Rup Nat Gas pipeline FF F2	6.12E-09
Rup Nat gas pipeline VCE D5	3.67E-08
Rup Nat gas pipeline VCE F2	9.18E-09

**OCGT 2/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.22E-07
Leak Nat Gas pipeline FF F2	3.06E-08
Leak Nat gas pipeline VCE D5	1.84E-07
Leak Nat gas pipeline VCE F2	4.60E-08
Nat gas pipeline leak Fireball	4.25E-08
Nat gas pipeline rup Fireball	8.50E-09
Rup Nat Gas pipeline FF D5	2.45E-08
Rup Nat Gas pipeline FF F2	6.12E-09
Rup Nat gas pipeline VCE D5	3.67E-08
Rup Nat gas pipeline VCE F2	9.18E-09

**OCGT 3/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.22E-07
Leak Nat Gas pipeline FF F2	3.06E-08
Leak Nat gas pipeline VCE D5	1.84E-07
Leak Nat gas pipeline VCE F2	4.60E-08
Nat gas pipeline leak Fireball	4.25E-08
Nat gas pipeline rup Fireball	8.50E-09
Rup Nat Gas pipeline FF D5	2.45E-08
Rup Nat Gas pipeline FF F2	6.12E-09
Rup Nat gas pipeline VCE D5	3.67E-08
Rup Nat gas pipeline VCE F2	9.18E-09

**OCGT 4/4 pipeline rupture**

Leak Nat Gas pipeline FF D5	1.22E-07
Leak Nat Gas pipeline FF F2	3.06E-08
Leak Nat gas pipeline VCE D5	1.84E-07
Leak Nat gas pipeline VCE F2	4.60E-08
Nat gas pipeline leak Fireball	4.25E-08
Nat gas pipeline rup Fireball	8.50E-09
Rup Nat Gas pipeline FF D5	2.45E-08
Rup Nat Gas pipeline FF F2	6.12E-09
Rup Nat gas pipeline VCE D5	3.67E-08
Rup Nat gas pipeline VCE F2	9.18E-09

<b>OCGT Tanker: 28t Propane</b>	
Connection Leak Flash fire Horz D5	3.70E-12
Connection Leak Flash fire Horz F2	9.25E-13
Connection Leak Jet Fire Horz D5	6.84E-13
Connection Leak Jet Fire Horz F2	1.71E-13
Connection Leak Jet Fire Vert D5	6.84E-13
Connection Leak Jet Fire Vert F2	1.71E-13
Connection Leak VCE Horz D5	2.46E-12
Connection Leak VCE Horz F2	6.16E-13
Connection Leak VCE Vert D5	2.46E-12
Connection Leak VCE Vert F2	6.16E-13
Hose Leak Flash fire Horz D5	5.18E-06
Hose Leak Flash fire Horz F2	5.18E-06
Hose Leak Jet Fire Horz D5	9.60E-07
Hose Leak Jet Fire Horz F2	2.40E-07
Hose Leak VCE Horz D5	3.46E-06
Hose Leak VCE Horz F2	8.64E-07
Hose Rup Flash fire Horz D5	5.18E-07
Hose Rup Flash fire Horz F2	1.30E-07
Hose Rup Jet Fire Horz D5	9.60E-08
Hose Rup Jet Fire Horz F2	2.40E-08
Hose Rup VCE Horz D5	3.46E-07
Hose Rup VCE Horz F2	8.64E-08
Hot BLEVE fireball	1.74E-10
Rupture fireball	6.85E-12
Rupture Flash fire D5	4.93E-12
Rupture Flash fire F2	1.23E-12
Rupture VCE D5	3.29E-12
Rupture VCE F2	8.22E-13
<b>OCGT VCE 1</b>	
VCE Blast Damage Set	2.00E-06
<b>OCGT VCE 2</b>	
VCE Blast Damage Set	2.00E-06
<b>Tank01: 1t Propane</b>	
10min leak Flash fire Horz D5	3.60E-09
10min leak Flash fire Horz F2	9.00E-10
10min leak Jet Fire Horz D5	1.40E-08
10min leak Jet Fire Horz F2	3.50E-09
10min leak Jet Fire Vert D5	1.40E-08
10min leak Jet Fire Vert F2	3.50E-09
10min leak VCE Horz D5	2.40E-09
10min leak VCE Horz F2	6.00E-10
10mm leak Flash fire Horz D5	7.20E-08
10mm leak Flash fire Horz F2	1.80E-08
10mm leak Jet Fire Horz D5	2.80E-07
10mm leak Jet Fire Horz F2	7.00E-08
10mm leak Jet Fire Vert D5	7.00E-08
10mm leak Jet Fire Vert F2	7.00E-08
10mm leak VCE Horz D5	4.80E-08
10mm leak VCE Horz F2	1.20E-08
Rupture Fireball	3.50E-08
Rupture Flash fire D5	7.20E-09
Rupture Flash fire F2	1.80E-09
Rupture VCE D5	4.80E-09
Rupture VCE F2	1.20E-09

<b>Tank01: 1t Propane</b>	
10min leak Flash fire Horz D5	3.60E-09
10min leak Flash fire Horz F2	9.00E-10
10min leak Jet Fire Horz D5	1.40E-08
10min leak Jet Fire Horz F2	3.50E-09
10min leak Jet Fire Vert D5	1.40E-08
10min leak Jet Fire Vert F2	3.50E-09
10min leak VCE Horz D5	2.40E-09
10min leak VCE Horz F2	6.00E-10
10mm leak Flash fire Horz D5	7.20E-08
10mm leak Flash fire Horz F2	1.80E-08
10mm leak Jet Fire Horz D5	2.80E-07
10mm leak Jet Fire Horz F2	7.00E-08
10mm leak Jet Fire Vert D5	7.00E-08
10mm leak Jet Fire Vert F2	7.00E-08
10mm leak VCE Horz D5	4.80E-08
10mm leak VCE Horz F2	1.20E-08
Rupture Fireball	3.50E-08
Rupture Flash fire D5	7.20E-09
Rupture Flash fire F2	1.80E-09
Rupture VCE D5	4.80E-09
Rupture VCE F2	1.20E-09

<b>Tank02: 1t Propane</b>	
10min leak Flash fire Horz D5	3.60E-09
10min leak Flash fire Horz F2	9.00E-10
10min leak Jet Fire Horz D5	1.40E-08
10min leak Jet Fire Horz F2	3.50E-09
10min leak Jet Fire Vert D5	1.40E-08
10min leak Jet Fire Vert F2	3.50E-09
10min leak VCE Horz D5	2.40E-09
10min leak VCE Horz F2	6.00E-10
10mm leak Flash fire Horz D5	7.20E-08
10mm leak Flash fire Horz F2	1.80E-08
10mm leak Jet Fire Horz D5	2.80E-07
10mm leak Jet Fire Horz F2	7.00E-08
10mm leak Jet Fire Vert D5	7.00E-08
10mm leak Jet Fire Vert F2	7.00E-08
10mm leak VCE Horz D5	4.80E-08
10mm leak VCE Horz F2	1.20E-08
Rupture Fireball	3.50E-08
Rupture Flash fire D5	7.20E-09
Rupture Flash fire F2	1.80E-09
Rupture VCE D5	4.80E-09
Rupture VCE F2	1.20E-09