Annex 5G

Consequence Analysis

5G CONSEQUENCE ANALYSIS

This *Annex* provides the details of the consequence analysis as follows:

- ***Section 5G.1*** – General Consequence Analysis; and
- ***Section 5G.2*** – Subsea Pipeline Consequence Analysis.

5G.1 GENERAL CONSEQUENCE ANALYSIS

This section summarises the approaches to model the major hazardous scenarios from the continuous and catastrophic releases considered in the QRA Study. Consequence analysis comprises the following items:

- Source term modelling, which involves determining the release rate variation with time and thermodynamic properties of the released fluids;
- Physical effects modelling, which involves estimating the effect zone of the various hazardous scenarios; and
- Consequence end-point criteria, which involves assessing of the impact of hazardous scenarios on the exposed population.

5G.1.1 Sources Term Modelling

Sources term modelling was carried out to determine the maximum (e.g. initial) release rate that may be expected should a loss of containment occur.

Release Duration

For LNG unloading arm failure at the LNG Terminal, as per the previous EIA Report that was approved by the EPD and other relevant authorities [1], two (2) release durations were considered:

- 30 seconds release; and
- 2 minutes release.

A shorter release time (i.e. 30 seconds) was adopted in the QRA Study due to the presence of personnel in the vicinity who can initiate emergency shutdown successfully on top of the fire and gas detection system, and also due to the provision of detectors for excessive movement of the unloading arm which will initiate an automatic shutdown. The 2-minute release duration represents the case of failure of isolation of one unloading arm. Duration longer than 2

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

minutes was not considered significant given that the transfer pumps on the LNG can be stopped, which will stop any further release.

For other process facilities in the Project (including FSRU Vessel and the proposed GRSs at the BPPS and LPS), with reference to Purple Book [1], the closing time of an automatic blocking system is two (2) minutes, representing the release duration for isolation success case. Detection and shutdown system may however fail due to some reasons, also as per Purple Book [1], the release duration is limited to a maximum of thirty (30) minutes. The release duration of thirty (30) minutes was conservatively adopted in the QRA Study as the release duration for isolation failure case.

Release Direction

The orientation of a release can have some effects on the hazard footprint calculated by *PHAST*. The models take into account the momentum of the release, air entrainment, vaporization rate and liquid rainout fraction.

For a horizontal, non-impinging release, momentum effects tend to dominate for most releases giving a jet fire as the most serious outcome. If a release is vertically upwards, the hazard footprint will be significantly less compared to a horizontal release. Also, if a release impinges on the ground or other obstacles, the momentum of the release and air entrainment is reduced, thereby reducing the hazard footprint but also increasing the liquid rainout fraction. In this scenario, a pool fire may become more likely.

Therefore, for all pool fire scenarios, the release orientation was set to "*downward impinging release*" in order to obtain the worst-case consequence pool fire, while "*horizontal non-impinging*" was representatively selected for modelling fire effects such as jet fire and flash fire as a conservative approach.

5G.1.2 Physical Effects Modelling

The physical effects modelling by *PHAST* assessed the effects zones for the following hazardous scenarios in the QRA Study:

- Jet fire;
- Flash fire;
- Pool fire;
- Fireball; and
- Vapour cloud explosion.

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

Jet Fire

A jet fire results from an ignited release of the pressurised flammable gas (i.e. natural gas). The momentum of the release carries the flammable materials forward in form of a long plume entraining air to give a flammable mixture. Combustion in a jet fire occurs in the form of a strong turbulent diffusion flame that is strongly influenced by the momentum of the release.

A jet fire was modelled for a pressurised flammable gas release. The default jet fire correlation model in *PHAST* was selected, and the release orientation was set as a horizontal non-impinging release.

Flash Fire

If there is no immediate ignition, the flammable gas such as natural gas, diesel and marine diesel oil may disperse before subsequently encountering an ignition source giving a jet fire or pool fire. The vapour cloud will then burn with a flash back to the source of the leak. A flash fire is assumed to be fatal to anyone caught within the flash fire envelope, although the short duration of a flash fire means that radiation effects are negligible. The fatality probability is therefore zero for persons outside the flash fire envelope.

Dispersion modelling was conducted by *PHAST* to calculate the extent of the flammable vapour cloud. This takes into account both the direct vaporisation from the release, and also the vapour formed from evaporating pools. The extent of the flash fire was assumed to be the dispersion distance to 0.85 LFL in the QRA Study.

Pool Fire

In case of an early ignition of a liquid pool such as LNG, diesel, marine diesel and lubricating oil pool, an early pool fire will be formed and the maximum pool diameter can be obtained by matching the burning rate with the release rate. Under such a condition, the size of the pool fire will not increase further and will be steady. In case of a delay ignition, the maximum pool radius is reached when the pool thickness at the centre of the pool reaches the maximum thickness.

Fireball

Immediate ignition of release caused by a catastrophic rupture of process equipment or a full bore rupture of a pipeline may give rise to a fireball. The consequence analysis for a fireball scenario was conducted by Roberts (HSE) method [(1)] in *PHAST* as the calculation method.

The flammable mass for fireball modelling was conservatively estimated by the initial flow rate continuing for ten (10) seconds even though the initial release

(1) DNV, PHAST version 6.7.

rate is decreasing rapidly in case of a full bore rupture scenario of a pipeline. This approach is consistent with the approved study, Safety Case Report [1].

The fatality rate within the fireball diameter is assumed to be 100%.

Vapour Cloud Explosion (VCE)

Explosions may only occur in areas of high congestion, or high confinement. An ignition in the open may only result in a flash fire or an unconfined VCE yielding relatively a lower damaging overpressure.

When a large amount of flammable gas is rapidly released, a vapour cloud forms and disperses in the surrounding air. The release can occur from the Jetty topsides, FSRU Vessel and proposed GRSs at the BPPS and LPS. If this cloud is ignited before the cloud is diluted below its LFL, a VCE or flash fire will occur. The main consequence of a VCE is damage to surrounding structures while the main consequence of a flash fire is a direct flame contact. The resulting outcome, either a flash fire or a VCE depends on a number of parameters.

Pietersen and Huerta (1985) [2] has summarised some key features of 80 flash fires and AIChE/CCPS (2000) [2] provides an excellent summary of vapour cloud behaviour. They describe four features which must be present in order for a VCE to occur. First, the release material must be flammable. Second, a cloud of sufficient size must form prior to an ignition, with ignition delays of 1 to 5 minutes considered the most probable for generating VCEs. Lenoir and Davenport (1992) [2] analysed historical data on ignition delays, and found delay times from six (6) seconds to as long as sixty (60) minutes. Third, a sufficient amount of the cloud must be within the flammable range. Fourth, sufficient confinement or turbulent mixing of a portion of the vapour cloud must be present.

The blast effects produced depend on whether a deflagration or detonation results, with a deflagration being, by far, the most likely. A transition from deflagration to detonation is unlikely in the open air. The ability for an explosion to result in a detonation is also dependent on the energy of the ignition source, with larger ignition sources increasing the likelihood of a direct detonation.

In order to calculate the distances to given overpressures, the Baker-Strehlow-Tang (BST) model [3], which is a congestion based model, was adopted in the QRA Study. The volume of flammable material in congested areas was estimated as well as the flame expansion characteristics, and then the BST

(1) DNV, *Safety Case Report for Black Point Gas Supply Project*, Report No.: PP019678, Revision No.2, August 2013.

(2) Center for Chemical Process Safety of the American Institute of Chemical Engineer, *Guidelines for Chemical Process Quantitative Risk Analysis*, Second Edition, 2000.

(3) Pierorazio et al., *An Update to the Baker-Strehlow-Tang Vapour Cloud Explosion Prediction Methodology Flame Speed Table*, 4 January 2005, Wiley InterScience, DOI 10.1002/prs.10048.

model predicts the overpressures at a given distance. The BST model predicts the blast levels based on:

- Mass of flammable material involved in an explosion (determined based on dispersion modelling by *PHAST*);
- Reactivity of the flammable material (high, medium, or low)
- Degree of freedom for the flame expansion (1D, 2D, 2.5D or 3D); and
- Congestion level of a potential explosion site (high, medium, low).

To apply the BST model, the LNG Terminal was identified with two (2) potential explosion sites based on the facility layout. Leaks from the isolatable sections of the LNG Terminal facilities were then modelled to cause explosion in the nearest potential explosion site.

Similar to thermal radiation levels, overpressure levels, corresponding to specific fatality levels, were taken from the data published by Purple Book (1) for indoor/ outdoor population. The various overpressure levels considered in the QRA Study are presented in ***Table 5G.3***.

Table 5G.1 summarises the input parameters, such as level of congestion, reactivity of material, etc., to the BST model performed by *PHAST*.

Table 5G.1 Identified PESs at the LNG Terminal

Tag	PES Location	Reactivity of Material	Degree of Freedom for Flame Expansion	Level of Congestion	Length (m)	Width (m)	Height (m)	Estimated PES Volume (m^3)
PES 1	The Jetty	Low	2D	Medium	50	68	12	40,800
PES 2	Re-gasification Module at the FSRU Vessel	Low	2D	Medium	40	46	12	22,080

5G.1.3 Consequence End-Point Criteria

The estimation of the fatality/ injury caused by a physical effect such as thermal radiation requires the use of probit equations, which describe the probability of fatality as a function of some physical effects. The probit equation takes the general form:

$$Y = a + b \ln V$$

where:

Y is the probit
a, b are constants determined from experiments
V is a measure of the physical effect such as thermal dose

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

The probit is an alternative way of expressing the probability of fatality and is derived from a statistical transformation of the probability of fatality.

Thermal Radiation

The following probit equation [1] is used to determine impacts of thermal radiation from a jet fire, pool fire or fireball to persons unprotected by clothing for the risk summation.

$$Y = -36.38 + 2.56 \ln (t\, I^{4/3})$$

where:
Y is the probit
I is the radiant thermal flux (W m^{-2})
t is duration of exposure (s)

This equation gives the thermal radiation levels presented in ***Table 5G.2,*** assuming a 20-second exposure time. For areas lying between any two radiation flux contours, the equivalent fatality level is estimated as follows for the risk summation using ERM's proprietary software Riskplot™:

- For areas beyond the 50% fatality contour, the equivalent fatality is calculated using a 2/3 weighting towards the lower contour. For example, the equivalent fatality between the 1% and 50% contours is calculated as 2/3 × 1 + 1/3 × 50 = 17%; and

- For areas within the 50% contour, the equivalent fatality is calculated with a 2/3 weighting towards the upper contour. For example, the equivalent fatality between the 90% and 50% contours is calculated as 2/3 × 90 + 1/3 × 50 = 77%.

The different approach above and below the 50% fatality contour is due to the sigmoid shape of the probit function.

Table 5G.2 Levels of Harm for 20-second Exposure Time to Heat Fluxes

Incident Thermal Flux (kWm^{-2})	Fatality Probability for 20-second Exposure Time	Equivalent Fatality Probability for Area between Radiation Flux Contours
9.8	1%	
		17%
19.5	50%	
		77%
28.3	90%	
		97%
35.5	99.9%	

(1) TNO, *Methods for the Determination of Possible Damage to People and Objects Resulting from Releases of Hazardous Materials (The Green Book)*, Report CPR 16E, The Netherlands Organisation of Applied Scientific Research, Voorburg, 1992.

Flash Fire

With regard to a flash fire, the criterion chosen is that a 100% fatality is assumed for any person outdoors within the flash fire envelope. The extent of the flash fire was adopted to be the dispersion to its 0.85 LFL as per the previous EIA Report that was approved by the EPD and other relevant authorities [1].

Overpressure

For an explosion, a relatively high overpressure is necessary to lead to significant fatalities for persons outdoors. Persons indoor have a high harm probability due to the risk of building collapse and flying debris such as breaking windows. ***Table 5G.3*** presents the explosion overpressure levels suggested by the Purple Book [2].

Table 5G.3 Effect of Overpressure

Explosion Overpressure (barg)	Fraction of People Dying	
	Indoor	Outdoor
> 0.3	1.000	1.000
> 0.1 to 0.3	0.025	0.000

5G.1.4 *Consequence Results*

The effect zones for the hazardous scenarios considered presents in the format in ***Figure 5G.1***.

- *d*: maximum downwind distance;
- *c*: maximum crosswind width;
- *s*: offset distance (distance between source and upwind end of effects zone). It is noted that a negative offset distance indicates that the upwind end of the effects zone is located upwind of the source, as would occur for thermal radiation and overpressure contours, for example; and
- *m*: distance between release source and location of maximum crosswind width.

All consequence results are summarised in ***Annex 5G-1*** *to* ***Annex 5G-4***, while the consequence modelling parameters summary for the LNG Terminal, GRS facilities at the BPPS and LPS are summarised in ***Annex 5G-5*** to ***Annex 5G-7***.

5G.2 SUBSEA PIPELINE CONSEQUENCE ANALYSIS

In the event of loss of containment from either of the subsea pipelines, the natural gas which is flammable will bubble to the surface of the sea, and then

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

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

disperse. The only possible hazardous scenario associated with any leakage or rupture of either of the subsea pipelines is flash fire if the dispersing flammable gas cloud comes in contact with an ignition source, most likely a passing marine vessel.

If a marine vessel passes into a flammable gas plume, leading to an ignition, then there is the possibility of fatalities on that marine vessel due to the flash fire. If a marine vessel passes through the area of the release which has been ignited, the marine vessel may be affected by the fire and the consequences may be more severe. If the flammable gas release is ignited, it is presumed that no further marine vessels will be involved because the fire would be visible and other marine vessels will naturally avoid the area. In other words, it is assumed that at most, only one (1) marine vessel will be affected.

5G.2.1 Source Term Modelling

The flammable gas release rate is estimated based on standard equations for discharge through an orifice. The empirical correlation developed by Bell and modified by Wilson (1) was adopted, as per the previous EIA Report that was approved by the EPD and other relevant authorities (2).

For holes with equivalent diameter smaller than about 100 mm, the discharge rate diminishes rather slowly because of large inventory in the proposed subsea pipelines (more than 1,000 tonnes). For half and full bore failures, the discharge rate diminishes more quickly over a period of about 30 - 60 minutes.

5G.2.2 Dispersion Modelling For Subsea Releases

In the event of a flammable gas release from the proposed subsea pipelines, the flammable gas will bubble to the surface of the sea, and disperse. The simplest form of modelling applied to subsea pipeline releases is to assume that the dispersing bubble plume (driven by gas buoyancy) can be represented by a cone of fixed angle (refer to ***Figure 5G.2***). The typical cone angle is between 10° and 12°. However, Billeter and Fannelop (1) suggested that the 'release area' (where bubbles breakthrough the surface) is about twice the diameter of the bubble plume. Hence, an angle of 23° was recommended and used in the QRA Study for the subsea pipelines, as per the previous EIA Report that has been approved by the EPD and other relevant authorities (3).

The water depth is between 5 – 15 m for much of the proposed subsea pipelines, including both the BPPS and LPS Pipelines, increasing to about 20 m in Urmston Road and about 25 m in the Southwest of Fan Lau. The shallowest water occurs on the West of BPPS and West Lamma Channel, east, is less than

(1) P J Rew, P Gallagher, D M Deaves, Dispersion of Subsea Release: Review of Prediction Methodologies, Health and Safety Executive, 1995.

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

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

5 m deep. For this range of water depths, the cone model predicted the 'release area' to be in the range of 0.6 to 10 m diameter.

5G.2.3 *Dispersion above Sea Surface*

Any flammable gas will begin to disperse into atmosphere upon reaching the surface of the sea. The distance to which the flammable gas envelope extends will depend on ambient conditions such as wind speed and atmospheric stability as well as source conditions. The extent of the flammable area was taken as the distance to 0.85 LFL, as per the previous EIA Report (1) that was approved by the EPD and other relevant authorities. *PHAST* was used to model the plume dispersion as an area source on the surface of the ocean.

5G.2.4 *Impact Criteria*

Impact on Population on Marine Vessels

The impact assessment on population on marine vessels was conducted as per the previous EIA Report that was approved by the EPD and other relevant authorities (1). The hazardous distance was taken to be the distance to 0.85 LFL. It was assumed that marine vessels would be at risk for thirty (30) minutes before warning could be issued to advise marine vessels to avoid the area. Knowing the marine vessel traffic (in marine ships per day per km of subsea pipeline), the probability that a passing marine vessel will cross through the flammable plume during this thirty (30) minutes as:

Probability = Traffic (/km/day) × Length of Plume (km) × 0.5 (hour) / 24 (hour/ day)

If a marine vessel comes in contact with the flammable plume and causes an ignition, the resulting flash fire may lead to fatalities depending on the type of marine vessel. Small open marine vessels such as fishing boats are expected to provide less protection to its occupants. Large ocean-going vessels will provide better protection.

Fatality factors were therefore applied to each class of marine vessel to take into account the protection offered by the marine vessel. As per the previous EIA Report that was approved by the EPD and other relevant authorities (1), the fatalities factors used in the QRA Study are as given in ***Table 5G.4.***.

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

Table 5G.4 Fatality Probability for Subsea Pipelines' MAEs

Marine Vessel Class	**Fatality**	
	Release area	**Cloud area**
Fishing vessels	1	0.9
Rivertrade coastal vessel	1	0.3
Ocean-going vessels	1	0.1
Fast launches	1	0.9
Fast ferries	1	0.4
Others	1	0.3

If a marine vessel passes into the 'release area', leading to the ignition of the flammable gas cloud, the marine vessel is more likely to be caught in the ensuing fire. This is assumed to result in more severe consequence with potential for 100% fatality of occupants. The analysis limits the number of marine vessels involved to one (1). It is assumed that once the flammable gas plume is ignited, other marine vessels will avoid the area.

Impact on Road Traffic Population on Hong Kong-Zhuhai-Macao Bridge

The Hong Kong – Zhuhai – Macao Bridge (HZMB) will straddle the proposed subsea pipeline connecting to the BPPS within the West of Tai O Section. It is noted also that the West of Tai O Section of the pipeline will be provided with 3 m of rock armour protection. The bridge, therefore is not expected to have any effect on pipeline failure frequencies during construction or operation.

If the BPPS Pipeline failure does occur for other reasons, such as external corrosion or anchor impact, the transit road traffic population on the bridge may be affected. This scenario was considered in the consequence analysis for the West of Tai O Section of the proposed BPPS Pipeline.

Based on the Presses Release "*LCQ17: Cross-boundary transport arrangements*" in January 2015 (1), the vehicle traffic expected on the bridge in 2020 is 15,350 per day, it was conservatively assumed that 20,000 vehicles per day will traverse the bridge. This is equivalent to about 50% of the vehicles crossing all land borders currently (2). The same vehicle mix was assumed as currently crossing the land borders, namely: 45% private cars, 9% coaches/ shuttle buses and 46% goods/ container vehicles. It was further assumed that cars and good vehicles have a traffic population of two (2), while buses have a traffic population of fifty (50).

The impact assessment on population on Hong Kong Zhuhai Macau Bridge was conducted as per the previous EIA Report that was approved by the EPD and other relevant authorities (3). Flash fire was modelled in the QRA Study.

(1) http://www.info.gov.hk/gia/general/201501/28/P201501280314.htm.

(2) Transport Department, Monthly Traffic and Transport Digest, May 2017, http://www.td.gov.hk/filemanager/en/content_4856/table81e.pdf.

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

Impact on Aircraft Approaching Hong Kong International Airport

The West of HKIA Section of the proposed subsea pipeline connecting to the BPPS passes within about 3.7 km of the threshold for runways 07L and 4.5 km from runway 07R at Hong Kong International Airport (HKIA). Commercial aircraft have an approach angle of about 3° which puts their altitude above 200 m. Large gas releases from the pipeline, such as those that occur from a full bore or half bore rupture, have the potential to procedure a gas cloud that extends higher than 200 m. It is therefore possible that aircraft on the approach to landing may pass through a gas cloud within the flammability limits. This scenario was considered in the QRA Study. Aircraft taking off from runways 25L and 25R are not a concern because modern commercial jets gain altitude very quickly.

If a commercial airliner does pass through a flammable gas cloud, it could be impacted in several ways. The jet engines would very likely ignite the gas cloud but since the flame speed in natural gas is about 10 m/s and the aircraft speed on approach is typically 160 knots (80 m/s), the plane is unlikely to be caught in the flash fire. The difference in density of natural gas compared to air would impact the aircraft in a manner similar to turbulence. The flow of natural gas through the engines may also upset the combustion process although the concentration of natural gas at aircraft altitudes will be low. There is uncertainty in these issues so for the purpose of analysis, as a conservative approach, the released flammable gas cloud is assumed to cause sufficient upset to result in aircraft crash with 100% fatality.

The hazardous distance is taken as the maximum size of the gas cloud above 200 m from the sea surface. The probability that the gas cloud will cross the approach flight path is estimated from this hazard distance. If a gas cloud is present on the approach path, the probability that an aircraft will fly through the cloud is taken to be 1, since aircraft are landing every few minutes at Hong Kong International Airport. In similar manner as before, it is assumed that at most one aircraft will be affected.

A distribution of population is assumed in the QRA Study to take into account the varying size of aircraft using Hong Kong International Airport. According to the Civil Aviation Department 2015 – 2016 Annual Report (1), there are 410,065 take-off and lands per year and 69,303,711 passengers. This gives an average population of 169 passengers on each flight.

Impact on Macau Helicopters

Helicopters shuttling to and from Macau pass over the Southwest of Fan Lau Section of the proposed subsea pipeline connecting to the BPPS at about 500 feet (150 m) altitude. In the same way that accidental gas releases may affect aircraft on the approach to the airport, a release from the Southwest of Fan Lau Section may impact on helicopters. The hazard distance is taken to be the

(1) Civil Aviation Department, 2015-2016 Annual Report.

maximum width of the gas cloud above 150 m altitude. Although there is only one flight every thirty (30) minutes and the return flights pass further south missing the pipeline route, it is again assumed that one helicopter is certain to be affected if the gas cloud lies across the flight path. The methodology is the same as that used for aircraft. It is further assumed that all helicopters are filled to capacity with twelve (12) passengers and crew.

This is a very conservative approach for helicopters but given that they are not expected to make a significant contribution to the risk results, this simple approach is sufficient.

5G.2.5 Consequence Results

Hazard distances will be determined from the dispersion modelling for marine vessels and other in the vicinity of the proposed subsea pipelines. Given that natural gas is buoyant and tends to disperse from the sea surface, the hazard distance is defined as the gas cloud width near sea level where an ignition is possible by passing marine vessels. The hazard distance (maximum width within fifty (50) m of the sea surface) was then taken from *PHAST* modelling for the detailed risk assessment.

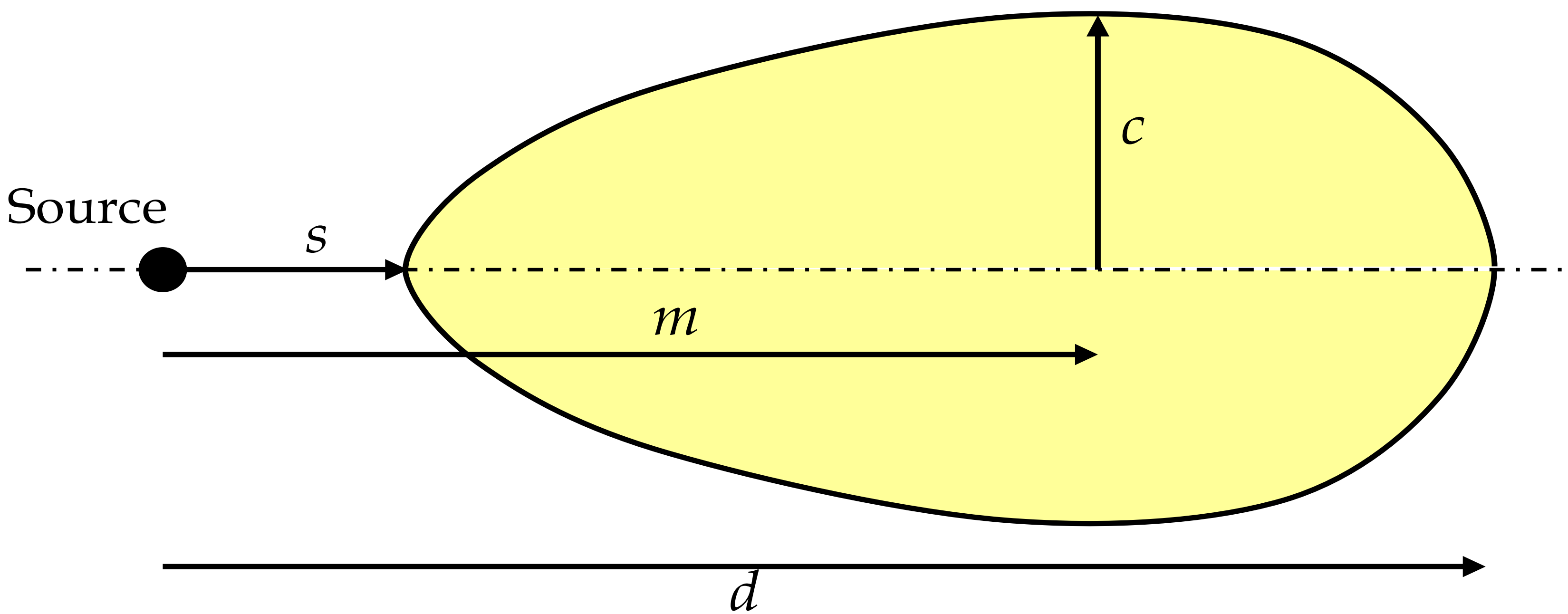

Figure 5G.1

Presentation of Consequence Results

Environmental Resources Management

ERM

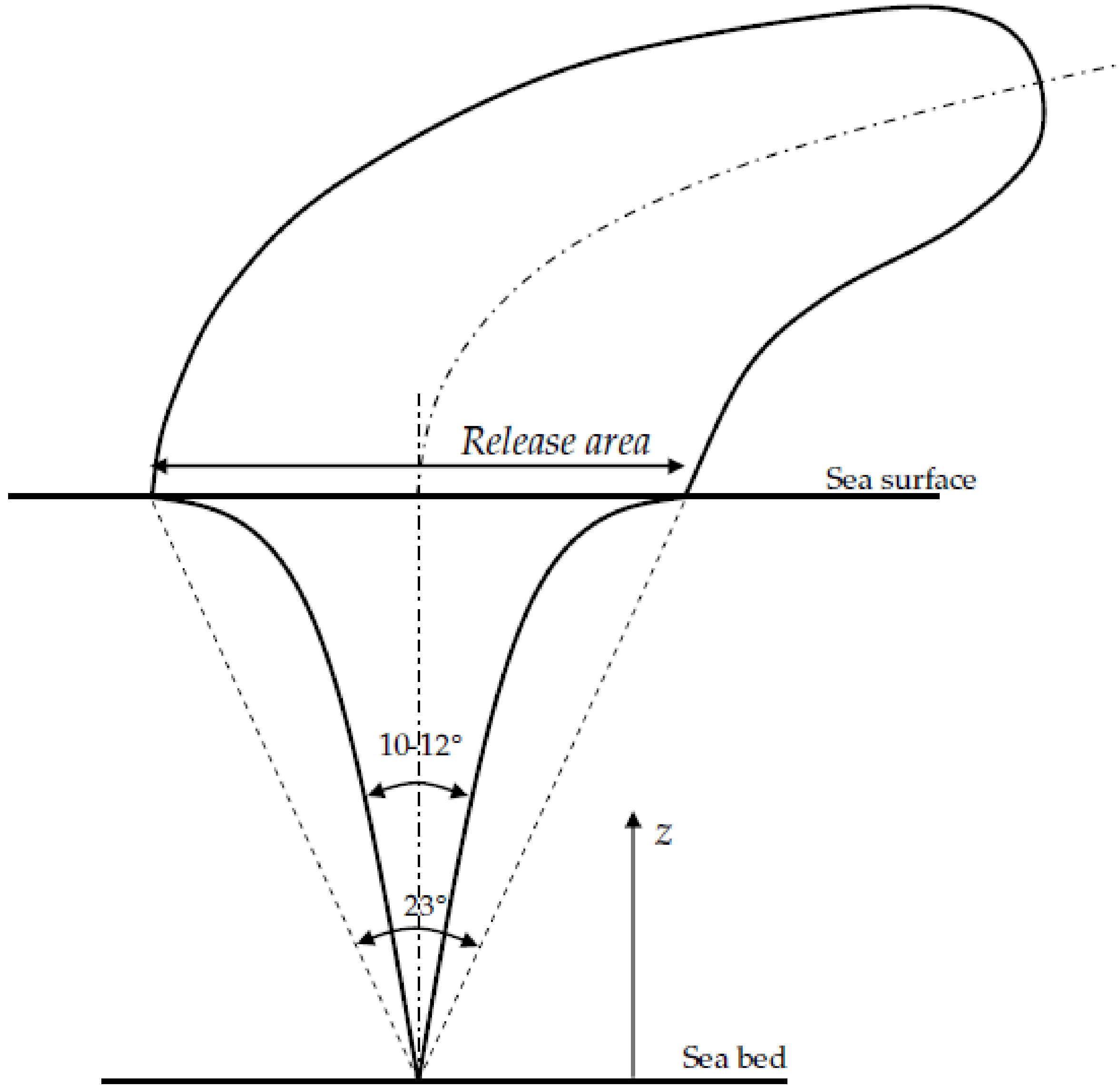

Figure 5G.2

Simple Cone Model for Subsea Dispersion

Environmental Resources Management ERM

Annex 5G-1

Consequence Analysis Results for Marine Transits of LNGC and FSRU Vessel to the LNG Terminal

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
L_LNGC_Collision_250	250 mm hole size leak due to collision release for Large LNGC	L	250	Pool Fire	35.35 kW/m^2	78	86	102	82
					28.3 kW/m^2	90	97	111	94
					19.5 kW/m^2	109	116	126	113
					9.8 kW/m^2	149	154	162	152
				Flash Fire	0.85 LFL	67	184	191	142
L_LNGC_Collision_750	750 mm hole size leak due to collision release for Large LNGC	L	750	Pool Fire	35.35 kW/m^2	182	197	232	190
					28.3 kW/m^2	208	224	256	217
					19.5 kW/m^2	254	268	294	262
					9.8 kW/m^2	348	359	376	354
				Flash Fire	0.85 LFL	77	272	256	229
L_LNGC_Collision_1500	1500 mm hole size leak due to collision release for Large LNGC	L	1,500	Pool Fire	35.35 kW/m^2	313	337	394	326
					28.3 kW/m^2	358	381	435	370
					19.5 kW/m^2	435	457	501	447
					9.8 kW/m^2	595	613	641	605
				Flash Fire	0.85 LFL	95	203	393	186
L_LNGC_Grounding_250	250 mm hole size leak due to groudning release for Large LNGC	L	250	Pool Fire	35.35 kW/m^2	65	72	86	69
					28.3 kW/m^2	75	82	95	79
					19.5 kW/m^2	93	99	108	96
					9.8 kW/m^2	128	132	139	130
				Flash Fire	0.85 LFL	64	175	87	90
S_LNGC_Collision_250	250 mm hole size leak due to collision release for Small LNGC	L	250	Pool Fire	35.35 kW/m^2	77	84	100	81
					28.3 kW/m^2	88	96	109	92
					19.5 kW/m^2	107	114	124	111
					9.8 kW/m^2	147	151	159	149
				Flash Fire	0.85 LFL	66	183	186	139
S_LNGC_Collision_750	750 mm hole size leak due to collision release for Small LNGC	L	750	Pool Fire	35.35 kW/m^2	178	194	229	187
					28.3 kW/m^2	204	220	251	213
					19.5 kW/m^2	249	264	289	257
					9.8 kW/m^2	342	353	370	348
				Flash Fire	0.85 LFL	76	277	250	229
S_LNGC_Collision_1500	1500 mm hole size leak due to collision release for Small LNGC	L	1500	Pool Fire	35.35 kW/m^2	308	331	387	320
					28.3 kW/m^2	352	375	427	364

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	427	449	493	439
					9.8 kW/m^2	585	602	630	595
				Flash Fire	0.85 LFL	94	202	390	186
S_LNGC_Grounding_250	250 mm hole size leak due to groudning release for Small LNGC	L	250	Pool Fire	35.35 kW/m^2	63	70	83	66
					28.3 kW/m^2	73	79	92	76
					19.5 kW/m^2	89	95	104	93
					9.8 kW/m^2	124	127	135	126
				Flash Fire	0.85 LFL	64	169	84	88
VS_Diesel Storage System	10 mm hole size leak of Diesel (Heavy Fuel Oil) Storage System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
				Flash Fire	0.85 LFL	2	2	2	2
S_Diesel Storage System	25 mm hole size leak of Diesel (Heavy Fuel Oil) Storage System	L	25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29
				Flash Fire	0.85 LFL	7	7	7	7
M_Diesel Storage System	50 mm hole size leak of Diesel (Heavy Fuel Oil) Storage System	L	50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35
				Flash Fire	0.85 LFL	8	7	8	8
CR_Diesel Storage System	Catastrophic rupture of Diesel (Heavy Fuel Oil) Storage System	L	Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59
				Flash Fire	0.85 LFL	10	8	9	9

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
VS_Marine Diesel Oil System	10 mm hole size leak of Marine Diesel Oil System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
				Flash Fire	0.85 LFL	2	2	2	2
S_Marine Diesel Oil System	25 mm hole size leak of Marine Diesel Oil System	L	25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29
				Flash Fire	0.85 LFL	7	7	7	7
M_Marine Diesel Oil System	50 mm hole size leak of Marine Diesel Oil System	L	50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35
				Flash Fire	0.85 LFL	8	7	8	8
CR_Marine Diesel Oil System	Catastrophic rupture of Marine Diesel Oil System	L	Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59
				Flash Fire	0.85 LFL	10	8	9	9
VS_Lubricating Oil Storage System	10 mm hole size leak of Lubricating Oil Storage System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
S_Lubricating Oil Storage System	25 mm hole size leak of Lubricating Oil Storage System	L	25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
M_Lubricating Oil Storage System	50 mm hole size leak of Lubricating Oil Storage System	L	50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35
CR_Lubricating Oil Storage System	Catastrophic rupture of Lubricating Oil Storage System	L	Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59

Annex 5G-2

Consequence Analysis Results for the LNG Terminal

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
HKOLNGT_01	LNG Loadout from LNGC, via Jetty, to LNG Storage Tank in FSRU Vessel	L	10	Jet Fire	35.35 kW/m^2	21	22	20	17
					28.3 kW/m^2	22	23	21	18
					19.5 kW/m^2	23	24	22	19
					9.8 kW/m^2	26	27	25	22
				Flash Fire	0.85 LFL	14	26	23	24
			25	Jet Fire	35.35 kW/m^2	47	49	45	39
					28.3 kW/m^2	48	51	47	41
					19.5 kW/m^2	51	53	50	43
					9.8 kW/m^2	57	59	56	49
				Flash Fire	0.85 LFL	80	91	92	92
			50	Jet Fire	35.35 kW/m^2	85	89	82	71
					28.3 kW/m^2	89	92	85	74
					19.5 kW/m^2	94	98	91	79
					9.8 kW/m^2	105	109	102	90
				Flash Fire	0.85 LFL	200	184	209	242
			Full bore	Pool Fire	35.35 kW/m^2	176	168	182	212
					28.3 kW/m^2	198	189	203	230
					19.5 kW/m^2	234	226	239	260
					9.8 kW/m^2	309	301	311	327
				Flash Fire	0.85 LFL	316	619	432	645
HKOLNGT_02	LNG Storage Tanks	L	10	Pool Fire	35.35 kW/m^2	1	1	1	1
					28.3 kW/m^2	1	1	1	1
					19.5 kW/m^2	1	1	1	1
					9.8 kW/m^2	1	1	1	1
				Flash Fire	0.85 LFL	9	9	11	10
			25	Pool Fire	35.35 kW/m^2	4	10	11	0
					28.3 kW/m^2	4	10	11	12
					19.5 kW/m^2	4	11	11	12
					9.8 kW/m^2	4	13	13	13
				Flash Fire	0.85 LFL	37	66	40	37
			50	Pool Fire	35.35 kW/m^2	13	18	19	19
					28.3 kW/m^2	13	20	21	22
					19.5 kW/m^2	13	23	24	25

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					9.8 kW/m^2	13	28	28	28
				Flash Fire	0.85 LFL	155	186	161	120
			Full bore	Pool Fire	35.35 kW/m^2	418	327	350	407
					28.3 kW/m^2	418	370	393	445
					19.5 kW/m^2	418	443	466	509
					9.8 kW/m^2	418	597	615	643
				Flash Fire	0.85 LFL	4,703	5,451	5,131	5,143
HKOLNGT_03	LNG Transfer from LNG Storage Tank Pump to LNG Booster Pump	L	10	Jet Fire	35.35 kW/m^2	22	23	22	19
					28.3 kW/m^2	23	24	22	19
					19.5 kW/m^2	25	26	24	21
					9.8 kW/m^2	27	28	26	23
				Flash Fire	0.85 LFL	17	29	28	27
			25	Jet Fire	35.35 kW/m^2	50	52	48	42
					28.3 kW/m^2	52	54	50	43
					19.5 kW/m^2	55	57	53	46
					9.8 kW/m^2	61	63	59	52
				Flash Fire	0.85 LFL	88	95	98	101
			50	Jet Fire	35.35 kW/m^2	91	95	88	76
					28.3 kW/m^2	94	98	91	79
					19.5 kW/m^2	100	104	97	84
					9.8 kW/m^2	112	116	109	96
				Flash Fire	0.85 LFL	202	191	215	260
			Full bore	Pool Fire	35.35 kW/m^2	133	124	136	155
					28.3 kW/m^2	147	138	150	167
					19.5 kW/m^2	172	162	173	186
					9.8 kW/m^2	221	211	220	229
				Flash Fire	0.85 LFL	390	1560	470	464
HKOLNGT_04	LNG Booster Pump to Regasification Unit	L	10	Jet Fire	35.35 kW/m^2	33	35	32	28
					28.3 kW/m^2	34	36	33	28
					19.5 kW/m^2	36	37	35	30
					9.8 kW/m^2	40	41	38	34
				Flash Fire	0.85 LFL	37	40	41	42
			25	Jet Fire	35.35 kW/m^2	74	78	72	62
					28.3 kW/m^2	77	80	74	64

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	81	84	78	68
					9.8 kW/m^2	89	93	87	77
				Flash Fire	0.85 LFL	104	112	117	130
			50	Jet Fire	35.35 kW/m^2	137	143	132	114
					28.3 kW/m^2	141	147	136	118
					19.5 kW/m^2	148	154	143	126
					9.8 kW/m^2	165	171	160	143
				Flash Fire	0.85 LFL	234	236	246	277
			Full bore	Jet Fire	35.35 kW/m^2	200	209	193	168
					28.3 kW/m^2	206	215	199	174
					19.5 kW/m^2	218	227	211	186
					9.8 kW/m^2	244	252	237	213
				Flash Fire	0.85 LFL	411	379	434	532
HKOLNGT_05	Regasification Trains	V	10	Jet Fire	35.35 kW/m^2	12	12	13	14
					28.3 kW/m^2	14	14	14	15
					19.5 kW/m^2	14	14	15	15
					9.8 kW/m^2	17	17	17	17
				Flash Fire	0.85 LFL	12	13	13	12
			25	Jet Fire	35.35 kW/m^2	32	31	32	36
					28.3 kW/m^2	33	33	34	37
					19.5 kW/m^2	36	36	37	39
					9.8 kW/m^2	42	41	42	44
				Flash Fire	0.85 LFL	35	36	36	37
			50	Jet Fire	35.35 kW/m^2	58	57	58	66
					28.3 kW/m^2	61	60	62	69
					19.5 kW/m^2	67	66	68	73
					9.8 kW/m^2	78	78	79	82
				Flash Fire	0.85 LFL	77	78	79	83
			Full bore	Fireball	FB Radius	41	41	41	41
					35.35 kW/m^2	104	104	104	104
					28.3 kW/m^2	118	118	118	118
					19.5 kW/m^2	142	142	142	142
					9.8 kW/m^2	198	198	198	198
				Flash Fire	0.85 LFL	237	238	241	257
HKOLNGT_06	Natural gas from Regasification	V	10	Jet Fire	35.35 kW/m^2	12	12	12	13

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
	Unit, via metering, to Jetty (including HP Gas Loading Arm)				28.3 kW/m^2	13	13	13	14
					19.5 kW/m^2	14	14	14	15
					9.8 kW/m^2	16	16	17	17
				Flash Fire	0.85 LFL	12	13	12	11
			25	Jet Fire	35.35 kW/m^2	31	31	32	35
					28.3 kW/m^2	32	32	33	37
					19.5 kW/m^2	36	35	36	39
					9.8 kW/m^2	41	41	41	43
				Flash Fire	0.85 LFL	34	35	35	36
			50	Jet Fire	35.35 kW/m^2	57	57	57	65
					28.3 kW/m^2	60	59	61	68
					19.5 kW/m^2	66	65	67	72
					9.8 kW/m^2	77	77	77	80
				Flash Fire	0.85 LFL	75	76	78	82
			Full bore	Fireball	FB Radius	40	40	40	40
					35.35 kW/m^2	103	103	103	103
					28.3 kW/m^2	116	116	116	116
					19.5 kW/m^2	140	140	140	140
					9.8 kW/m^2	196	196	196	196
				Flash Fire	0.85 LFL	231	233	237	251
HKOLNGT_07	Natural gas in Jetty to ESDV of Riser for BPPS Subsea Pipeline	V	10	Jet Fire	35.35 kW/m^2	12	12	12	13
					28.3 kW/m^2	13	13	13	14
					19.5 kW/m^2	14	14	14	15
					9.8 kW/m^2	16	16	17	17
				Flash Fire	0.85 LFL	12	13	12	11
			25	Jet Fire	35.35 kW/m^2	31	31	32	35
					28.3 kW/m^2	32	32	33	37
					19.5 kW/m^2	36	35	36	39
					9.8 kW/m^2	41	41	41	43
				Flash Fire	0.85 LFL	34	35	35	36
			50	Jet Fire	35.35 kW/m^2	57	57	57	65
					28.3 kW/m^2	60	59	61	68
					19.5 kW/m^2	66	65	67	72
					9.8 kW/m^2	77	77	77	80

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	75	76	78	82
			Full bore	Fireball	FB Radius	40	40	40	40
					35.35 kW/m^2	103	103	103	103
					28.3 kW/m^2	116	116	116	116
					19.5 kW/m^2	140	140	140	140
					9.8 kW/m^2	196	196	196	196
				Flash Fire	0.85 LFL	231	233	237	251
HKOLNGT_08	Riser for BPPS Subsea Pipeline	V	10	Jet Fire	35.35 kW/m^2	12	12	12	13
					28.3 kW/m^2	13	13	13	14
					19.5 kW/m^2	14	14	14	15
					9.8 kW/m^2	16	16	17	17
				Flash Fire	0.85 LFL	12	13	12	11
			25	Jet Fire	35.35 kW/m^2	31	31	32	35
					28.3 kW/m^2	32	32	33	37
					19.5 kW/m^2	36	35	36	39
					9.8 kW/m^2	41	41	41	43
				Flash Fire	0.85 LFL	34	35	35	36
			Full bore	Fireball	FB Radius	40	40	40	40
					35.35 kW/m^2	103	103	103	103
					28.3 kW/m^2	116	116	116	116
					19.5 kW/m^2	140	140	140	140
					9.8 kW/m^2	196	196	196	196
				Flash Fire	0.85 LFL	231	233	237	251
HKOLNGT_10	Natural gas in Jetty to ESDV of Riser for LPS Subsea Pipeline	V	10	Jet Fire	35.35 kW/m^2	12	12	12	13
					28.3 kW/m^2	13	13	13	14
					19.5 kW/m^2	14	14	14	15
					9.8 kW/m^2	16	16	17	17
				Flash Fire	0.85 LFL	12	13	12	11
			25	Jet Fire	35.35 kW/m^2	31	31	32	35
					28.3 kW/m^2	32	32	33	37
					19.5 kW/m^2	36	35	36	39
					9.8 kW/m^2	41	41	41	43
				Flash Fire	0.85 LFL	34	35	35	36
			50	Jet Fire	35.35 kW/m^2	57	57	57	65
					28.3 kW/m^2	60	59	61	68

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	66	65	67	72
					9.8 kW/m^2	77	77	77	80
				Flash Fire	0.85 LFL	75	76	78	82
			Full bore	Fireball	FB Radius	40	40	40	40
					35.35 kW/m2	103	103	103	103
					28.3 kW/m2	116	116	116	116
					19.5 kW/m2	140	140	140	140
					9.8 kW/m2	196	196	196	196
				Flash Fire	0.85 LFL	231	233	237	251
HKOLNGT_11	Riser for LPS Subsea Pipeline	V	10	Jet Fire	35.35 kW/m^2	12	12	12	13
					28.3 kW/m^2	13	13	13	14
					19.5 kW/m^2	14	14	14	15
					9.8 kW/m^2	16	16	17	17
				Flash Fire	0.85 LFL	12	13	12	11
			25	Jet Fire	35.35 kW/m^2	31	31	32	35
					28.3 kW/m^2	32	32	33	37
					19.5 kW/m^2	36	35	36	39
					9.8 kW/m^2	41	41	41	43
				Flash Fire	0.85 LFL	34	35	35	36
			50	Jet Fire	35.35 kW/m^2	57	57	57	65
					28.3 kW/m^2	60	59	61	68
					19.5 kW/m^2	66	65	67	72
					9.8 kW/m^2	77	77	77	80
				Flash Fire	0.85 LFL	75	76	78	82
			Full bore	Fireball	FB Radius	40	40	40	40
					35.35 kW/m2	103	103	103	103
					28.3 kW/m2	116	116	116	116
					19.5 kW/m2	140	140	140	140
					9.8 kW/m2	196	196	196	196
				Flash Fire	0.85 LFL	231	233	237	251
HKOLNGT_13	LNG Transfer from LNG Storage Tank to Vaporisation Unit	L	10	Jet Fire	35.35 kW/m^2	22	23	22	19
					28.3 kW/m^2	23	24	22	19
					19.5 kW/m^2	25	26	24	21
					9.8 kW/m^2	27	28	26	23
				Flash Fire	0.85 LFL	17	29	28	27

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
			25	Jet Fire	35.35 kW/m^2	50	52	48	42
					28.3 kW/m^2	52	54	50	43
					19.5 kW/m^2	55	57	53	46
					9.8 kW/m^2	61	63	59	52
				Flash Fire	0.85 LFL	88	95	98	101
			50	Jet Fire	35.35 kW/m^2	91	95	88	76
					28.3 kW/m^2	94	98	91	79
					19.5 kW/m^2	100	104	97	84
					9.8 kW/m^2	112	116	109	96
				Flash Fire	0.85 LFL	202	191	215	260
			Full bore	Pool Fire	35.35 kW/m^2	103	97	106	123
					28.3 kW/m^2	115	109	117	132
					19.5 kW/m^2	135	129	137	148
					9.8 kW/m^2	175	170	175	184
				Flash Fire	0.85 LFL	226	439	325	402
HKOLNGT_14	Natural gas in Vaporisation Unit for Fuel Gas Generation	V	10	Jet Fire	35.35 kW/m^2	4	4	4	4
					28.3 kW/m^2	4	4	4	4
					19.5 kW/m^2	4	4	4	4
					9.8 kW/m^2	4	4	4	4
				Flash Fire	0.85 LFL	4	4	4	4
			25	Jet Fire	35.35 kW/m^2	9	9	9	9
					28.3 kW/m^2	9	9	9	9
					19.5 kW/m^2	9	9	9	9
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	8	8	8	8
			50	Jet Fire	35.35 kW/m^2	17	17	17	19
					28.3 kW/m^2	18	17	18	19
					19.5 kW/m^2	19	19	19	20
					9.8 kW/m^2	22	22	22	23
				Flash Fire	0.85 LFL	16	17	17	16
			Full bore	Jet Fire	35.35 kW/m^2	47	46	47	53
					28.3 kW/m^2	49	48	50	55
					19.5 kW/m^2	54	53	54	59
					9.8 kW/m^2	62	62	63	65

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	56	58	58	61
HKOLNGT_15	BOG from LNG Storage Tank to BOG Compressor	V	10	Jet Fire	35.35 kW/m^2	3	3	3	3
					28.3 kW/m^2	3	3	3	3
					19.5 kW/m^2	3	3	3	3
					9.8 kW/m^2	3	3	3	3
				Flash Fire	0.85 LFL	3	3	3	3
			25	Jet Fire	35.35 kW/m^2	6	6	6	6
					28.3 kW/m^2	6	6	6	6
					19.5 kW/m^2	6	6	6	6
					9.8 kW/m^2	6	6	6	6
				Flash Fire	0.85 LFL	5	6	6	5
			50	Jet Fire	35.35 kW/m^2	10	10	10	10
					28.3 kW/m^2	10	10	10	12
					19.5 kW/m^2	10	10	10	13
					9.8 kW/m^2	12	11	12	14
				Flash Fire	0.85 LFL	10	11	10	10
			Full bore	Jet Fire	35.35 kW/m^2	24	23	25	32
					28.3 kW/m^2	25	25	26	33
					19.5 kW/m^2	27	26	28	33
					9.8 kW/m^2	33	32	33	36
				Flash Fire	0.85 LFL	37	37	38	38
HKOLNGT_16	Compressed BOG for fuel gas use in power generation	V	10	Jet Fire	35.35 kW/m^2	4	4	4	4
					28.3 kW/m^2	4	4	4	4
					19.5 kW/m^2	4	4	4	4
					9.8 kW/m^2	4	4	4	4
				Flash Fire	0.85 LFL	3	4	4	4
			25	Jet Fire	35.35 kW/m^2	9	9	9	8
					28.3 kW/m^2	9	9	9	8
					19.5 kW/m^2	9	9	9	8
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	8	8	8	8
			50	Jet Fire	35.35 kW/m^2	17	17	17	18
					28.3 kW/m^2	18	17	18	19
					19.5 kW/m^2	19	19	19	21

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	16	17	16	15
			Full bore	Jet Fire	35.35 kW/m^2	46	46	46	53
					28.3 kW/m^2	49	48	50	55
					19.5 kW/m^2	54	53	54	58
					9.8 kW/m^2	62	62	62	65
				Flash Fire	0.85 LFL	55	57	58	60
HKOLNGT_17	Compressor BOG to Reliquefyer	V	10	Jet Fire	35.35 kW/m^2	4	4	4	4
					28.3 kW/m^2	4	4	4	4
					19.5 kW/m^2	4	4	4	4
					9.8 kW/m^2	4	4	4	4
				Flash Fire	0.85 LFL	4	4	4	4
			25	Jet Fire	35.35 kW/m^2	10	10	10	10
					28.3 kW/m^2	10	10	10	10
					19.5 kW/m^2	10	10	10	10
					9.8 kW/m^2	11	11	11	11
				Flash Fire	0.85 LFL	9	9	9	8
			50	Jet Fire	35.35 kW/m^2	18	18	18	20
					28.3 kW/m^2	19	19	19	20
					19.5 kW/m^2	20	20	21	22
					9.8 kW/m^2	23	23	23	24
				Flash Fire	0.85 LFL	18	18	18	17
			Full bore	Jet Fire	35.35 kW/m^2	50	49	50	57
					28.3 kW/m^2	52	51	53	59
					19.5 kW/m^2	57	57	58	62
					9.8 kW/m^2	67	66	67	70
				Flash Fire	0.85 LFL	63	64	65	68
HKOLNGT_18	LNG from Reliquefyer to LNG Storage Tank	L	10	Jet Fire	35.35 kW/m^2	22	23	21	18
					28.3 kW/m^2	22	23	22	19
					19.5 kW/m^2	24	25	23	20
					9.8 kW/m^2	27	28	26	23
				Flash Fire	0.85 LFL	15	27	26	26
			25	Jet Fire	35.35 kW/m^2	48	51	47	40
					28.3 kW/m^2	50	52	48	42

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	53	55	51	45
					9.8 kW/m^2	59	61	58	51
				Flash Fire	0.85 LFL	84	93	96	97
			50	Jet Fire	35.35 kW/m^2	89	92	85	74
					28.3 kW/m^2	92	96	88	77
					19.5 kW/m^2	97	101	94	82
					9.8 kW/m^2	109	113	106	94
				Flash Fire	0.85 LFL	199	186	211	251
			Full bore	Pool Fire	35.35 kW/m^2	73	69	75	87
					28.3 kW/m^2	82	77	83	94
					19.5 kW/m^2	95	91	96	104
					9.8 kW/m^2	123	118	122	128
				Flash Fire	0.85 LFL	816	692	827	512
HKOLNGT_19	BOG in Gas Combustion Unit	V	10	Jet Fire	35.35 kW/m^2	3	3	3	3
					28.3 kW/m^2	3	3	3	3
					19.5 kW/m^2	3	3	3	3
					9.8 kW/m^2	3	3	3	3
				Flash Fire	0.85 LFL	3	3	3	3
			25	Jet Fire	35.35 kW/m^2	6	6	6	6
					28.3 kW/m^2	6	6	6	6
					19.5 kW/m^2	6	6	6	6
					9.8 kW/m^2	6	6	6	6
				Flash Fire	0.85 LFL	5	6	6	5
			50	Jet Fire	35.35 kW/m^2	10	9	10	10
					28.3 kW/m^2	10	9	10	12
					19.5 kW/m^2	10	9	10	13
					9.8 kW/m^2	12	11	12	14
				Flash Fire	0.85 LFL	10	11	10	10
			Full bore	Jet Fire	35.35 kW/m^2	24	23	25	32
					28.3 kW/m^2	25	25	26	33
					19.5 kW/m^2	27	26	28	33
					9.8 kW/m^2	33	32	33	36
				Flash Fire	0.85 LFL	37	37	38	38
HKOLNGT_20	LNGC Vapour (BOG) return line	V	10	Jet Fire	35.35 kW/m^2	3	3	3	3

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
	during loadout operation				28.3 kW/m^2	3	3	3	3
					19.5 kW/m^2	3	3	3	3
					9.8 kW/m^2	3	3	3	3
				Flash Fire	0.85 LFL	3	3	3	3
			25	Jet Fire	35.35 kW/m^2	7	7	7	7
					28.3 kW/m^2	7	7	7	7
					19.5 kW/m^2	7	7	7	7
					9.8 kW/m^2	7	7	7	8
				Flash Fire	0.85 LFL	6	7	7	6
			50	Jet Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	15
					19.5 kW/m^2	14	13	14	15
					9.8 kW/m^2	16	16	16	17
				Flash Fire	0.85 LFL	12	13	13	12
			Full bore	Jet Fire	35.35 kW/m^2	33	33	34	40
					28.3 kW/m^2	34	34	35	42
					19.5 kW/m^2	38	37	39	44
					9.8 kW/m^2	45	44	45	48
				Flash Fire	0.85 LFL	46	46	47	49
HKOLNGT_21	FSRU Vapour (BOG) return line during loadout operation	V	10	Jet Fire	35.35 kW/m^2	3	3	3	3
					28.3 kW/m^2	3	3	3	3
					19.5 kW/m^2	3	3	3	3
					9.8 kW/m^2	3	3	3	3
				Flash Fire	0.85 LFL	3	3	3	3
			25	Jet Fire	35.35 kW/m^2	7	7	7	7
					28.3 kW/m^2	7	7	7	7
					19.5 kW/m^2	7	7	7	7
					9.8 kW/m^2	7	7	7	8
				Flash Fire	0.85 LFL	6	7	7	6
			50	Jet Fire	35.35 kW/m^2	12	12	12	13
					28.3 kW/m^2	12	12	12	15
					19.5 kW/m^2	14	13	14	15
					9.8 kW/m^2	16	16	16	17
				Flash Fire	0.85 LFL	12	13	13	12

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
			Full bore	Jet Fire	35.35 kW/m^2	33	33	34	40
					28.3 kW/m^2	34	34	35	42
					19.5 kW/m^2	38	37	39	44
					9.8 kW/m^2	45	44	45	48
				Flash Fire	0.85 LFL	46	46	47	49
HKOLNGT_22	Fuel gas line from Regasification Unit	V	10	Jet Fire	35.35 kW/m^2	4	4	4	4
					28.3 kW/m^2	4	4	4	4
					19.5 kW/m^2	4	4	4	4
					9.8 kW/m^2	4	4	4	4
				Flash Fire	0.85 LFL	4	4	4	4
			25	Jet Fire	35.35 kW/m^2	9	9	9	9
					28.3 kW/m^2	9	9	9	9
					19.5 kW/m^2	9	9	9	9
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	8	8	8	8
			50	Jet Fire	35.35 kW/m^2	17	17	17	19
					28.3 kW/m^2	18	17	18	19
					19.5 kW/m^2	19	19	19	20
					9.8 kW/m^2	22	22	22	23
				Flash Fire	0.85 LFL	16	17	17	16
HKOLNGT_23	Diesel (Heavy Fuel Oil) Storage System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
				Flash Fire	0.85 LFL	2	2	2	2
			25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29
				Flash Fire	0.85 LFL	7	7	7	7
			50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	8	7	8	8
			Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59
				Flash Fire	0.85 LFL	10	8	9	9
HKOLNGT_24	Marine Diesel Oil Storage System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
				Flash Fire	0.85 LFL	5	5	6	6
			25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29
				Flash Fire	0.85 LFL	7	7	7	7
			50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35
				Flash Fire	0.85 LFL	8	7	8	8
			Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59
				Flash Fire	0.85 LFL	10	8	9	9
HKOLNGT_25	Lubricating Oil Storage System	L	10	Pool Fire	35.35 kW/m^2	10	10	11	12
					28.3 kW/m^2	11	11	12	15
					19.5 kW/m^2	14	14	15	16
					9.8 kW/m^2	17	17	18	19
			25	Pool Fire	35.35 kW/m^2	14	14	14	15
					28.3 kW/m^2	14	14	15	15
					19.5 kW/m^2	18	17	19	21
					9.8 kW/m^2	26	25	27	29

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
			50	Pool Fire	35.35 kW/m^2	12	12	12	12
					28.3 kW/m^2	12	12	12	12
					19.5 kW/m^2	21	21	21	22
					9.8 kW/m^2	30	29	31	35
			Catastrophic Rupture	Pool Fire	35.35 kW/m^2	36	36	36	36
					28.3 kW/m^2	36	36	36	36
					19.5 kW/m^2	47	47	47	48
					9.8 kW/m^2	53	52	55	59

Annex 5G-3

Consequence Analysis Results for GRSs at BPPS

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_GRS_01	Above ground piping from shore end to pig receiver of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_02	Piping from receiver to slug catcher of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_03	Piping from slug catcher to inlet gas filter separators of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_04	Piping from inlet gas filter separator to gas heater of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_05	Piping from gas heaters to pressure reduction station, including PRS of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_06	Piping from pressure reduction station to outlet gas filter separator of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_07	Piping from outlet gas filter separator to manifold, including sales gas meter unit of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	8	0	0	8
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	7	7	6	6
			25	Jet Fire	35.35 kW/m^2	20	20	22	20
					28.3 kW/m^2	21	21	23	21
					19.5 kW/m^2	22	23	24	23
					9.8 kW/m^2	26	26	27	26
				Flash Fire	0.85 LFL	17	17	16	16
			50	Jet Fire	35.35 kW/m^2	38	39	44	38
					28.3 kW/m^2	40	41	45	40
					19.5 kW/m^2	44	45	48	44
					9.8 kW/m^2	50	51	53	51
				Flash Fire	0.85 LFL	37	37	38	36
			100	Pool Fire	35.35 kW/m^2	68	69	78	69
					28.3 kW/m^2	71	73	81	72
					19.5 kW/m^2	79	80	86	80
					9.8 kW/m^2	93	94	97	94
				Flash Fire	0.85 LFL	81	81	85	78
			Full bore	Fireball	Fireball Radius	83	83	83	83
					35.35 kW/m^2	204	204	204	204
					28.3 kW/m^2	229	229	229	229
					19.5 kW/m^2	277	277	277	277
					9.8 kW/m^2	387	387	387	387

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	472	477	501	426
BPPS_GRS_08	Pig receiver of Y13-1 GRS	V	10	Jet Fire	35.35 kW/m^2	17	17	18	17
					28.3 kW/m^2	17	18	19	18
					19.5 kW/m^2	19	19	20	19
					9.8 kW/m^2	22	22	22	22
				Flash Fire	0.85 LFL	14	14	13	13
			25	Jet Fire	35.35 kW/m^2	39	40	45	39
					28.3 kW/m^2	41	42	47	42
					19.5 kW/m^2	45	46	50	46
					9.8 kW/m^2	53	53	55	53
				Flash Fire	0.85 LFL	40	40	40	39
			50	Jet Fire	35.35 kW/m^2	70	71	81	71
					28.3 kW/m^2	73	76	84	75
					19.5 kW/m^2	82	83	89	82
					9.8 kW/m^2	97	98	101	97
				Flash Fire	0.85 LFL	86	87	92	85
			100	Jet Fire	35.35 kW/m^2	125	126	139	126
					28.3 kW/m^2	131	132	145	131
					19.5 kW/m^2	144	147	156	146
					9.8 kW/m^2	176	178	180	177
				Flash Fire	0.85 LFL	183	184	195	179
			Full bore	Fireball	Fireball Radius	135	135	135	135
					35.35 kW/m^2	320	320	320	320
					28.3 kW/m^2	361	361	361	361
					19.5 kW/m^2	435	435	435	435
					9.8 kW/m^2	605	605	605	605

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	835	829	875	767
BPPS_GRS_11	Above ground piping from shore end to pig receiver of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	95	95	95	95
					35.35 kW/m^2	231	231	231	231
					28.3 kW/m^2	260	260	260	260
					19.5 kW/m^2	315	315	315	315
					9.8 kW/m^2	439	439	439	439

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	**D, 3 m/s**	**D, 7m/s**	**B, 2.5m/s**
				Flash Fire	0.85 LFL	344	349	366	309
BPPS_GRS_12	Piping from receiver to gas filter of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	94	94	94	94
					35.35 kW/m^2	229	229	229	229
					28.3 kW/m^2	259	259	259	259
					19.5 kW/m^2	312	312	312	312
					9.8 kW/m^2	435	435	435	435

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	339	343	360	303
BPPS_GRS_13	Filter & inlet/outlet piping of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	65	65	65	65
					35.35 kW/m^2	163	163	163	163
					28.3 kW/m^2	182	182	182	182
					19.5 kW/m^2	219	219	219	219
					9.8 kW/m^2	308	308	308	308

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	364	368	389	335
BPPS_GRS_14	Piping from filter to metering station of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	94	94	94	94
					35.35 kW/m^2	229	229	229	229
					28.3 kW/m^2	259	259	259	259
					19.5 kW/m^2	312	312	312	312
					9.8 kW/m^2	435	435	435	435

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	339	343	360	303
BPPS_GRS_15	Piping from metering station to heaters, including metering runs of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	94	94	94	94
					35.35 kW/m^2	229	229	229	229
					28.3 kW/m^2	259	259	259	259
					19.5 kW/m^2	312	312	312	312
					9.8 kW/m^2	435	435	435	435

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	339	343	360	303
BPPS_GRS_16	Heater Piping of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	59	59	59	59
					35.35 kW/m^2	149	149	149	149
					28.3 kW/m^2	168	168	168	168
					19.5 kW/m^2	203	203	203	203
					9.8 kW/m^2	283	283	283	283
				Flash Fire	0.85 LFL	328	331	348	300

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_GRS_17	Piping from heater to PRS, including PRS of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	94	94	94	94
					35.35 kW/m^2	229	229	229	229
					28.3 kW/m^2	259	259	259	259
					19.5 kW/m^2	312	312	312	312
					9.8 kW/m^2	435	435	435	435
				Flash Fire	0.85 LFL	339	343	360	303

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_GRS_18	Piping from PRS to manifold, including HIPPS of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	8	8	0	8
					9.8 kW/m^2	9	9	10	9
				Flash Fire	0.85 LFL	6	6	6	6
			25	Jet Fire	35.35 kW/m^2	20	20	22	20
					28.3 kW/m^2	20	21	22	20
					19.5 kW/m^2	22	22	24	22
					9.8 kW/m^2	25	25	26	25
				Flash Fire	0.85 LFL	16	16	15	16
			50	Jet Fire	35.35 kW/m^2	37	15	43	37
					28.3 kW/m^2	39	15	44	39
					19.5 kW/m^2	43	44	47	43
					9.8 kW/m^2	49	50	52	50
				Flash Fire	0.85 LFL	36	36	37	35
			100	Jet Fire	35.35 kW/m^2	67	68	77	67
					28.3 kW/m^2	70	72	80	70
					19.5 kW/m^2	77	79	85	78
					9.8 kW/m^2	92	93	96	92
				Flash Fire	0.85 LFL	78	79	82	75
			Full bore	Fireball	Fireball Radius	81	81	81	81
					35.35 kW/m^2	201	201	201	201
					28.3 kW/m^2	226	226	226	226
					19.5 kW/m^2	272	272	272	272
					9.8 kW/m^2	381	381	381	381
				Flash Fire	0.85 LFL	252	257	270	230

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_GRS_19	Pig receiver of Dachan GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	11	11	11	11
					9.8 kW/m^2	12	12	12	12
				Flash Fire	0.85 LFL	8	8	7	8
			25	Jet Fire	35.35 kW/m^2	24	25	27	24
					28.3 kW/m^2	25	25	28	25
					19.5 kW/m^2	27	28	30	27
					9.8 kW/m^2	31	31	33	31
				Flash Fire	0.85 LFL	21	21	20	20
			50	Jet Fire	35.35 kW/m^2	45	46	52	45
					28.3 kW/m^2	47	48	54	48
					19.5 kW/m^2	52	53	57	52
					9.8 kW/m^2	60	61	63	60
				Flash Fire	0.85 LFL	46	47	48	45
			100	Jet Fire	35.35 kW/m^2	79	81	49	80
					28.3 kW/m^2	83	85	49	84
					19.5 kW/m^2	92	94	49	93
					9.8 kW/m^2	110	111	49	110
				Flash Fire	0.85 LFL	100	100	106	96
			Full bore	Fireball	Fireball Radius	104	104	104	104
					35.35 kW/m^2	252	252	252	252
					28.3 kW/m^2	284	284	284	284
					19.5 kW/m^2	340	340	340	340
					9.8 kW/m^2	475	475	475	475
				Flash Fire	0.85 LFL	394	398	417	351

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_01	Above ground piping from shore end to pig receiver of New GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Jet Fire	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	120	120	120	120
					35.35 kW/m^2	199	199	199	199
					28.3 kW/m^2	248	248	248	248
					19.5 kW/m^2	330	330	330	330
					9.8 kW/m^2	503	503	503	503
				Flash Fire	0.85 LFL	803	803	854	745

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_02	Piping from Pig Receiving Station to Gas Filter of New GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Pool Fire	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	115	115	115	115
					35.35 kW/m^2	191	191	191	191
					28.3 kW/m^2	239	239	239	239
					19.5 kW/m^2	317	317	317	317
					9.8 kW/m^2	483	483	483	483
				Flash Fire	0.85 LFL	769	770	814	709

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	**D, 3 m/s**	**D, 7m/s**	**B, 2.5m/s**
BPPS_NGRS_03	Piping from Gas Filter to Metering Station of New GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Jet Fire	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	115	115	115	115
					35.35 kW/m^2	191	191	191	191
					28.3 kW/m^2	239	239	239	239
					19.5 kW/m^2	317	317	317	317
					9.8 kW/m^2	483	483	483	483
				Flash Fire	0.85 LFL	769	770	814	709

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_04	Piping from Metering Station to WBH of New GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Fireball	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	115	115	115	115
					35.35 kW/m^2	191	191	191	191
					28.3 kW/m^2	239	239	239	239
					19.5 kW/m^2	317	317	317	317
					9.8 kW/m^2	483	483	483	483
				Flash Fire	0.85 LFL	769	770	814	709

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_05	WBH piping of New GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Fireball	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	92	92	92	92
					35.35 kW/m^2	159	159	159	159
					28.3 kW/m^2	197	197	197	197
					19.5 kW/m^2	261	261	261	261
					9.8 kW/m^2	396	396	396	396
				Flash Fire	0.85 LFL	608	614	655	566

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_06	Piping from WBH to Pressure Reduction Station of New GRS	V	10	Jet Fire	35.35 kW/m^2	9	0	0	0
					28.3 kW/m^2	12	12	13	12
					19.5 kW/m^2	13	13	14	13
					9.8 kW/m^2	15	15	16	15
				Flash Fire	0.85 LFL	11	11	10	11
			25	Jet Fire	35.35 kW/m^2	29	29	32	29
					28.3 kW/m^2	30	31	34	30
					19.5 kW/m^2	33	34	36	33
					9.8 kW/m^2	38	38	40	38
				Flash Fire	0.85 LFL	32	32	32	30
			50	Jet Fire	35.35 kW/m^2	53	54	61	53
					28.3 kW/m^2	55	57	63	56
					19.5 kW/m^2	61	63	67	62
					9.8 kW/m^2	72	72	75	72
				Flash Fire	0.85 LFL	69	69	72	66
			100	Fireball	35.35 kW/m^2	93	95	106	94
					28.3 kW/m^2	97	100	110	98
					19.5 kW/m^2	108	110	118	109
					9.8 kW/m^2	130	132	135	131
				Flash Fire	0.85 LFL	140	141	149	130
			Full bore	Fireball	Fireball Radius	89	89	89	89
					35.35 kW/m^2	155	155	155	155
					28.3 kW/m^2	191	191	191	191
					19.5 kW/m^2	253	253	253	253
					9.8 kW/m^2	384	384	384	384
				Flash Fire	0.85 LFL	489	493	520	435

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_07	Piping from Pressure Reduction Station to Mixing Station of New GRS	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	8	0	0	8
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	8	8	7	7
			25	Jet Fire	35.35 kW/m^2	20	20	22	20
					28.3 kW/m^2	21	21	23	21
					19.5 kW/m^2	22	23	24	23
					9.8 kW/m^2	26	26	27	26
				Flash Fire	0.85 LFL	20	20	19	20
			50	Jet Fire	35.35 kW/m^2	38	39	44	38
					28.3 kW/m^2	40	41	45	40
					19.5 kW/m^2	44	45	48	44
					9.8 kW/m^2	51	51	53	51
				Flash Fire	0.85 LFL	45	46	47	44
			100	Jet Fire	35.35 kW/m^2	68	69	78	69
					28.3 kW/m^2	71	73	81	72
					19.5 kW/m^2	79	81	86	80
					9.8 kW/m^2	93	94	97	94
				Flash Fire	0.85 LFL	97	98	104	93
			Full bore	Fireball	Fireball Radius	86	86	86	86
					35.35 kW/m^2	150	150	150	150
					28.3 kW/m^2	186	186	186	186
					19.5 kW/m^2	246	246	246	246
					9.8 kW/m^2	372	372	372	372
				Flash Fire	0.85 LFL	520	527	561	474

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
BPPS_NGRS_08	Pig Receiver of Newe GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	16	16
				Flash Fire	0.85 LFL	12	12	11	11
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	31	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	34	34	33
			50	Jet Fire	35.35 kW/m^2	55	56	64	56
					28.3 kW/m^2	58	60	66	59
					19.5 kW/m^2	64	65	70	65
					9.8 kW/m^2	75	76	79	76
				Flash Fire	0.85 LFL	75	76	80	73
			100	Jet Fire	35.35 kW/m^2	98	99	110	98
					28.3 kW/m^2	102	104	115	102
					19.5 kW/m^2	113	115	123	114
					9.8 kW/m^2	137	138	141	137
				Flash Fire	0.85 LFL	158	159	169	151
			Full bore	Fireball	Fireball Radius	125	125	125	125
					35.35 kW/m^2	206	206	206	206
					28.3 kW/m^2	257	257	257	257
					19.5 kW/m^2	343	343	343	343
					9.8 kW/m^2	522	522	522	522
				Flash Fire	0.85 LFL	838	837	889	778

Annex 5G-4

Consequence Analysis Results for GRSs at LPS

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
LPS_GRS_01	Above ground existing piping from shore to existing GRS Trains	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	33	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56
					28.3 kW/m^2	57	60	67	59
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115
					9.8 kW/m^2	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	93	93	93	93
					35.35 kW/m^2	160	160	160	160
					28.3 kW/m^2	198	198	198	198
					19.5 kW/m^2	263	263	263	263
					9.8 kW/m^2	398	398	398	398
				Flash Fire	0.85 LFL	625	632	673	584
LPS_GRS_02	Piping from Filter Skid to Metering Skid (GT57 Stream)	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					28.3 kW/m^2	33	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56
					28.3 kW/m^2	57	60	67	59
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115
					9.8 kW/m^2	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	54	54	54	54
					35.35 kW/m^2	100	100	100	100
					28.3 kW/m^2	198	198	198	198
					19.5 kW/m^2	262	262	262	262
					9.8 kW/m^2	242	242	242	242
				Jet Fire	35.35 kW/m^2	194	196	210	195
					28.3 kW/m^2	204	205	221	205
					19.5 kW/m^2	222	226	239	224
					9.8 kW/m^2	274	277	280	275
				Flash Fire	0.85 LFL	329	333	353	306
LPS_GRS_03	Piping from Metering Skid to Heater (GT57 Stream)	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	33	32	36	32

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56
					28.3 kW/m^2	57	60	67	59
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115
					9.8 kW/m^2	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	54	54	54	54
					35.35 kW/m^2	100	100	100	100
					28.3 kW/m^2	198	198	198	198
					19.5 kW/m^2	262	262	262	262
					9.8 kW/m^2	242	242	242	242
				Jet Fire	35.35 kW/m^2	194	196	210	195
					28.3 kW/m^2	204	205	221	205
					19.5 kW/m^2	222	226	239	224
					9.8 kW/m^2	274	277	280	275
				Flash Fire	0.85 LFL	329	333	353	306
LPS_GRS_04	Piping from Heater to Pressure Reduction Station (GT57 Stream)	V	10	Jet Fire	35.35 kW/m^2	10	10	0	10
					28.3 kW/m^2	12	12	13	12
					19.5 kW/m^2	13	13	14	13
					9.8 kW/m^2	15	15	16	15
				Flash Fire	0.85 LFL	11	11	10	11
			25	Jet Fire	35.35 kW/m^2	29	30	33	30
					28.3 kW/m^2	30	31	34	30
					19.5 kW/m^2	33	34	36	34

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					9.8 kW/m^2	38	39	40	38
				Flash Fire	0.85 LFL	32	32	32	31
			50	Jet Fire	35.35 kW/m^2	53	55	62	54
					28.3 kW/m^2	56	58	64	57
					19.5 kW/m^2	62	63	68	63
					9.8 kW/m^2	72	73	76	73
				Flash Fire	0.85 LFL	70	71	74	67
			100	Jet Fire	35.35 kW/m^2	94	96	107	95
					28.3 kW/m^2	98	101	111	99
					19.5 kW/m^2	109	112	119	111
					9.8 kW/m^2	132	133	136	132
				Flash Fire	0.85 LFL	144	145	154	135
			Full bore	Fireball	Fireball Radius	67	67	0	0
					35.35 kW/m^2	121	121	0	0
					28.3 kW/m^2	149	149	0	0
					19.5 kW/m^2	196	196	0	0
					9.8 kW/m^2	296	296	0	0
				Jet Fire	35.35 kW/m^2	265	268	284	267
					28.3 kW/m^2	280	282	299	281
					19.5 kW/m^2	305	306	326	305
					9.8 kW/m^2	372	377	385	374
				Flash Fire	0.85 LFL	376	382	405	339
LPS_GRS_05	Piping from Pressure Reduction Station (GT57 Stream) to GT57	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	0	0	0	0
					9.8 kW/m^2	8	8	8	8
				Flash Fire	0.85 LFL	7	7	6	7
			25	Jet Fire	35.35 kW/m^2	18	18	20	18
					28.3 kW/m^2	18	19	20	19
					19.5 kW/m^2	20	20	21	20
					9.8 kW/m^2	23	23	24	23
				Flash Fire	0.85 LFL	18	17	16	17

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
			50	Jet Fire	35.35 kW/m^2	34	14	39	34
					28.3 kW/m^2	35	14	40	36
					19.5 kW/m^2	39	14	43	39
					9.8 kW/m^2	45	14	47	45
				Flash Fire	0.85 LFL	39	40	40	38
			100	Jet Fire	35.35 kW/m^2	61	63	71	62
					28.3 kW/m^2	64	66	73	65
					19.5 kW/m^2	71	73	78	72
					9.8 kW/m^2	84	85	88	84
				Flash Fire	0.85 LFL	85	86	91	82
			Full bore	Fireball	Fireball Radius	51	51	51	51
					35.35 kW/m^2	95	95	95	95
					28.3 kW/m^2	116	116	116	116
					19.5 kW/m^2	152	152	152	152
					9.8 kW/m^2	229	229	229	229
				Jet Fire	35.35 kW/m^2	179	181	194	180
					28.3 kW/m^2	188	189	204	189
					19.5 kW/m^2	205	209	221	207
					9.8 kW/m^2	253	255	258	254
				Flash Fire	0.85 LFL	288	291	309	264
LPS_GRS_06	Piping from Filter Skid to Metering Skid (L9 Stream)	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	33	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m) Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					28.3 kW/m^2	57	60	67	59
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115
					9.8 kW/m^2	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	73	73	73	73
					35.35 kW/m^2	131	131	131	131
					28.3 kW/m^2	161	161	161	161
					19.5 kW/m^2	213	213	213	213
					9.8 kW/m^2	322	322	322	322
				Jet Fire	35.35 kW/m^2	302	306	323	304
					28.3 kW/m^2	319	321	340	320
					19.5 kW/m^2	349	349	371	349
					9.8 kW/m^2	422	428	439	425
				Flash Fire	0.85 LFL	484	491	519	450
LPS_GRS_07	Piping from Metering Skid to Heater (L9 Stream)	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	33	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56
					28.3 kW/m^2	57	60	67	59

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115
					9.8 kW/m^2	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	86	86	86	86
					35.35 kW/m^2	151	151	151	151
					28.3 kW/m^2	28	28	28	28
					19.5 kW/m^2	247	247	247	247
					9.8 kW/m^2	374	374	374	374
				Jet Fire	35.35 kW/m^2	380	385	404	383
					28.3 kW/m^2	403	406	427	405
					19.5 kW/m^2	442	442	466	442
					9.8 kW/m^2	529	537	555	534
				Flash Fire	0.85 LFL	582	589	623	542
LPS_GRS_08	Piping from Heater to Pressure Reduction Station (L9 Stream)	V	10	Jet Fire	35.35 kW/m^2	11	11	11	11
					28.3 kW/m^2	12	13	13	13
					19.5 kW/m^2	13	14	14	13
					9.8 kW/m^2	15	16	16	16
				Flash Fire	0.85 LFL	12	11	10	11
			25	Jet Fire	35.35 kW/m^2	29	30	33	30
					28.3 kW/m^2	30	31	35	31
					19.5 kW/m^2	34	34	37	34
					9.8 kW/m^2	39	39	41	39
				Flash Fire	0.85 LFL	33	33	33	32
			50	Jet Fire	35.35 kW/m^2	54	55	62	55
					28.3 kW/m^2	56	58	65	57
					19.5 kW/m^2	63	64	69	63
					9.8 kW/m^2	73	74	77	74

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
				Flash Fire	0.85 LFL	71	72	76	69
			100	Jet Fire	35.35 kW/m^2	95	96	108	96
					28.3 kW/m^2	99	102	112	100
					19.5 kW/m^2	110	113	120	112
					9.8 kW/m^2	133	134	137	134
				Flash Fire	0.85 LFL	148	149	159	139
			Full bore	Fireball	Fireball Radius	84	84	84	84
					35.35 kW/m^2	148	148	148	148
					28.3 kW/m^2	183	183	183	183
					19.5 kW/m^2	241	241	241	241
					9.8 kW/m^2	366	366	366	366
				Jet Fire	35.35 kW/m^2	368	372	391	370
					28.3 kW/m^2	389	392	413	391
					19.5 kW/m^2	427	427	451	427
					9.8 kW/m^2	512	520	536	516
				Flash Fire	0.85 LFL	504	509	542	457
LPS_GRS_09	Piping from Pressure Reduction Station (L9 Stream) to L9	V	10	Jet Fire	35.35 kW/m^2	0	0	0	0
					28.3 kW/m^2	0	0	0	0
					19.5 kW/m^2	0	9	9	9
					9.8 kW/m^2	10	10	10	10
				Flash Fire	0.85 LFL	8	8	8	8
			25	Jet Fire	35.35 kW/m^2	21	22	23	21
					28.3 kW/m^2	22	22	24	22
					19.5 kW/m^2	24	24	26	24
					9.8 kW/m^2	27	27	28	27
				Flash Fire	0.85 LFL	22	21	21	21
			50	Jet Fire	35.35 kW/m^2	40	41	46	40
					28.3 kW/m^2	42	43	47	42
					19.5 kW/m^2	46	47	50	46
					9.8 kW/m^2	53	54	56	53
				Flash Fire	0.85 LFL	48	48	50	47
			100	Jet Fire	35.35 kW/m^2	71	72	81	71

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					28.3 kW/m^2	74	76	85	75
					19.5 kW/m^2	82	84	90	83
					9.8 kW/m^2	98	99	102	98
				Flash Fire	0.85 LFL	103	104	111	99
			Full bore	Fireball	Fireball Radius	57	57	57	57
					35.35 kW/m^2	105	105	105	105
					28.3 kW/m^2	128	128	128	128
					19.5 kW/m^2	169	169	169	169
					9.8 kW/m^2	254	254	254	254
				Jet Fire	35.35 kW/m^2	210	212	226	211
					28.3 kW/m^2	221	222	238	222
					19.5 kW/m^2	240	244	259	241
					9.8 kW/m^2	296	299	304	297
				Flash Fire	0.85 LFL	338	343	363	310
LPS_GRS_10	Pig Receiver of the existing GRS	V	10	Jet Fire	35.35 kW/m^2	12	12	13	12
					28.3 kW/m^2	13	13	14	13
					19.5 kW/m^2	14	14	15	14
					9.8 kW/m^2	16	16	17	16
				Flash Fire	0.85 LFL	12	12	11	12
			25	Jet Fire	35.35 kW/m^2	30	31	34	31
					28.3 kW/m^2	33	32	36	32
					19.5 kW/m^2	35	35	38	35
					9.8 kW/m^2	40	40	42	40
				Flash Fire	0.85 LFL	34	35	35	34
			50	Jet Fire	35.35 kW/m^2	56	56	64	56
					28.3 kW/m^2	57	60	67	59
					19.5 kW/m^2	64	66	71	65
					9.8 kW/m^2	76	76	79	76
				Flash Fire	0.85 LFL	76	77	81	74
			100	Jet Fire	35.35 kW/m^2	98	99	111	99
					28.3 kW/m^2	102	105	116	103
					19.5 kW/m^2	114	116	124	115

Section		Phase	Leak Size (mm)	Hazard Effects	End Point Criteria	Hazard Extent (m)			
						Weather Conditions			
						F, 2 m/s	D, 3 m/s	D, 7m/s	B, 2.5m/s
					$9.8\ kW/m^2$	137	139	142	138
				Flash Fire	0.85 LFL	160	161	171	154
			Full bore	Fireball	Fireball Radius	93	93	93	93
					$35.35\ kW/m^2$	160	160	160	160
					$28.3\ kW/m^2$	198	198	198	198
					$19.5\ kW/m^2$	263	263	263	263
					$9.8\ kW/m^2$	398	398	398	398
				Flash Fire	0.85 LFL	625	632	673	584

Annex 5G-5

Consequence Modelling Parameters for the LNG Terminal

0391939 - CLP HK Offshore LNG Terminal Haza

HKOLNGT

Discharge Parameters

Continuous Critical Weber number	12.5	
Instantaneous Critical Weber number	12.5	
Venting equation constant	24.82	
Relief valve safety factor	1.2	
Minimum RV diameter ratio	1	
Critical pressure greater than flow phase	0.3447	bar
Maximum release velocity	500	m/s
Minimum drop diameter allowed	0.01	um
Maximum drop diameter allowed	1E4	um
Default Liquid Fraction	1	fraction
Continuous Drop Slip factor	1	
Instantaneous Drop Slip factor	1	
Number of Time Steps	100.00	
Maximum Number of Data Points	1,000.00	
Tolerance	0.0001	
Thermal coupling to the wall	No modelling of heat transfer	
Use Bernoulli for forced -phase liq-liq discharge	Use compressible flow eqn	
Capping of pipe flow rates	Use leak scenario cap, disallow flashing	
Velocity capping method	FixedVelocity	
Droplet Method - continuous only	Modified CCPS	
Thermodynamic Option for Gas Pipellines	Non-ideal Gas	
Excess Flow Valve velocity head losses	0	
Non-Return Valve velocity head losses	0	
Shut-Off Valve velocity head losses	0	
Frequency of bends in long pipes	0	/m
Frequency of couplings in long pipes	0	/m
Frequency of junctions in long pipes	0	/m
Line length	10	m
Pipe roughness	0.0457	mm
Air changes	3	/hr
Elevation	1	m
Atmospheric Expansion Method	Closest to Initial Conditions	
Tank Roof Failure Model Effects	Instantaneous effects	
Frequency of Excess Flow Valves	0	/m
Frequency of Non-Return Valves	0	/m
Frequency of Shut-Off Valves	0	/m
Mechanism for forcing droplet breakup - Inst.	Use flashing correlation	
Mechanism for forcing droplet breakup - Cont	Do not force correlation	
Flashing in the orifice	No flashing in the orifice	
Handling of droplets	Not Trapped	
Indoor mass modification factor	3	
Vacuum Relief Valve	Operating	
Vacuum Relief Valve Set Point	0	bar

Dispersion Parameters

Expansion zone length/source diameter ratio	0.01	
Near Field Passive Entrainment Parameter	1	
Jet Model	Morton et.al.	
Jet entrainment coefficient alpha1	0.17	
Jet entrainment coefficient alpha2	0.35	

Drag coefficient between plume and air	0	
Dense cloud parameter gamma - continuous	0	
Dense cloud parameter gamma - instant	0.3	
Dense cloud parameter K - continuous	1.15	
Dense cloud parameter K - instantaneous	1.15	
Modeling of instantaneous expansion	Standard Method	
Maximum Cloud/Ambient Velocity Difference	0.1	
Maximum Cloud/Ambient Density Difference	0.015	
Maximum Non-passive entrainment fraction	0.3	
Maximum Richardson number	15	
Distance multiple for full passive entrainment	2	
Core Averaging Time	18.75	s
Ratio instantaneous/continuous sigma-y	1	
Ratio instantaneous/continuous sigma-z	1	
Droplet evaporation thermodynamics model	Rainout, Non-equilibrium	
Ratio Droplet/ expansion velocity for inst. release	0.8	
Expansion energy cutoff for droplet angle	0.69	kJ/kg
Coefficient of Initial Rainout	0	
Flag to reset rainout position	Do not reset rainout position	
Richardson Number for passive transition above pool	0.015	
Pool Vaporization entrainment parameter	1.5	
Richardson number criterion for cloud lift-off	-20	
Flag for Heat/Water vapor transfer	Heat and Water	
Surface over which the dispersion occurs	Land	
Minimum temperature allowed	-262.1	degC
Maximum temperature allowed	626.9	degC
Minimum release velocity for cont. release	0.1	m/s
Minimum Continuous Release Height	0	m
Maximum distance for dispersion	5E4	m
Maximum height for dispersion	1000	m
Minimum cloud depth	0.02	m
Treatment of top mixing layer	Constrained	
Model In Use	Best Estimate	
Lee Length	Calculate	
Lee Half-Width	Calculate	
Lee Height	Calculate	
K-Factor	Calculate	
Switch Distance	Calculate	
Maximum Initial Step Size	10	m
Minimum Number of Steps per Zone	5.00	
Factor for Step Increase	1.2	
Maximum Number of Output Steps	1,000.00	
Flag for finite duration correction	QI without Duration Adjustment	
Quasi-instantaneous transition parameter	0.8	
Relative tolerance for dispersion calculations	0.001	
Relative tolerance for droplet calculations	0.001	
Initial integration step size - Instantaneous	0.01	s
Initial integration step size - Continuous	0.01	m
Maximum integration step size - Instantaneous	100	s
Maximum integration step size - Continuous	100	m
Impingement Option	Use Velocity Modification Factor	
Impinged velocity limit	500	m/s
Impinged Velocity Factor	0.25	
Dispersion Model to use	Version 2 model	
Fixed step size - Instantaneous	0.01	s

Fixed step size - Continuous	0.1	m
Number of fixed size output steps	20.00	
Multiplier for output step sizes	1.2	

Explosion Parameters

Over Pressure Level 1	1.1	bar
Over Pressure Level 2	1.3	bar
Over Pressure Level 3	1.5	bar
Explosion Location Criterion	Cloud Front (LFL Fraction)	
Minimum explosive mass	0	kg
Explosion efficiency	10	%
Air or Ground burst	Air burst	
Explosion Mass Modification Factor	3	
Use of mass modification factor	Early and late explosions	

Fireball and BLEVE Blast Parameters

Maximum surface emissive power	400	kW/m2
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
TNO model flame temperature	1727	degC
Mass Modification Factor	3	
Calculation method for fireball	DNV Recommended	
Fireball Maximum Exposure Duration	20	s
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	

Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	
Ground Reflection	Ground Burst	
Ideal Gas Modeling	Model as real gas	
Minimum Distance	0	m
Number of Distance Points	100.00	

Flammable Parameters

Height for calculation of flammable effects	0	m
Flammable result grid step in X-direction	10	m
LFL fraction to finish	0.5	
Angle of inclination	0	deg
Observer direction	Variable	
Flammable mass calculation method	Mass between LFL and UFL	
Flammable Base averaging time	18.75	s
Cut Off Time for Short Continuous Releases	20	s
Observer type radiation modelling flag	Planar	
Probit A Value	-36.38	
Probit B Value	2.56	
Probit N Value	1.333	
Height for reports	Centreline Height	
Angle of orientation	0	deg
Relative tolerance for radiation calculations	0.01	fraction
Number of Lethality Ellipses	5.00	
Ellipse linear spacing variable	Probit	
Minimum Probability Of Death	0.01	fraction
Number of radiation/distance points in linked radiation calculations	50.00	
Method for fitting ellipse to flash fire shape	ChiSq method	
Absolute tolerance for linked radiation calcs	1e-010	
Solar radiation	Exclude from calculations	
For time-varying releases	Don't Model Short Duration Effects	
Match fireball duration and mass released	No	

General Parameters

Maximum release duration	3600	s
Height for concentration output	0	m
Rotation	0	deg
Lower Elevation	0	m
Multicomponent aerosol behaviour	Single aerosol modelling	

Jet Fire Parameters

Maximum SEP for a Jet Fire	400	kW/m2
Jet Fire Averaging Time	20	s
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
Crosswind Angle	0	deg
Correlation	DNV Recommended	
Horizontal Options	Use standard method	

Rate Modification Factor	3	
Jet Fire Maximum Exposure Duration	20	s
Emissivity Method	E and F calculated	
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	

Pool Fire Parameters

Continuous releases	10	s
Calculate Dose	Not selected	
Calculate Probit	Not selected	
Calculate Lethality	Not selected	
MaxExposureDuration	20	s
Radiative fraction for general fires	0.4	fraction
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2

Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	

Pool Vaporization Parameters

Toxics cut-off rate for pool evaporation	0.001	kg/s
Flammable cut-off rate for pool evaporation	0.1	kg/s
Concentration power to use in pool rate load calculation	1	
Maximum number of pool evaporation rates	10.00	
Pool minimum thickness	5	mm
Surface thermal conductivity	0.00221	kJ/m.s.degK
Surface roughness factor	2.634	
Surface thermal diffusivity	9.48E-7	m2/s
Type of Bund Surface	Concrete	
Bund Height	0	m
Bund Failure Modeling	Bund cannot fail	

Toxic Parameters

Toxics: minimum probability of death	0.001	
Toxics: height for calculation of effects	0	m
Toxics: results grid step in Y-direction	2.5	m
Toxics: results grid step in X-direction	25	m

Multi-comp. toxic calc. method	Mixture Probit	
Toxic Averaging Time - New Parameter	600	s
Probit Calculation Method	Use Probit	
Building Exchange Rate	4	/hr
Tail Time	1800	s
Indoor Calculations	Unselected	
Wind Dependent Exchange Rate	Case Specified	
Set averaging time equal to exposure time	Use a fixed averaging time	
Cut-off fraction of toxic load for exposure time calculation	0.05	fraction
Cut-off concentration for exposure time calculations	0	fraction

Weather Parameters

Atmospheric pressure	1.013	bar
Atmospheric molecular weight	28.97	
Atmospheric specific heat at constant pressure	1.004	kJ/kg.degK
Wind speed reference height	10	m
Temperature reference height	0	m
Cut-off height for wind speed profile	1	m
Wind speed profile	Power Law	
Atmospheric T and P Profile	Temp.Logarithmic; Pres.Linear	
Atmospheric Temperature	23.3	degC
Relative Humidity	0.78	fraction
Parameter	0.1	
Length	183.2	mm
Surface Roughness	Use Parameter	
Surface Temperature for Dispersion Calculations	23.3	degC
Surface Temperature for Pool Calculations	23.3	degC
Solar Radiation Flux	0.5	kW/m2
Building Exchange Rate	4	/hr
Tail Time	1800	s
Surface Type	0.2mm - Open water	
Mixing Layer Height for Pasquil Stability A	1300	m
Mixing Layer Height for Pasquil Stability A/B	1080	m
Mixing Layer Height for Pasquil Stability B	920	m
Mixing Layer Height for Pasquil Stability B/C	880	m
Mixing Layer Height for Pasquil Stability C	840	m
Mixing Layer Height for Pasquil Stability C/D	820	m
Mixing Layer Height for Pasquil Stability D	800	m
Mixing Layer Height for Pasquil Stability E	400	m
Mixing Layer Height for Pasquil Stability F	100	m
Mixing Layer Height for Pasquil Stability G	100	m

Annex 5G-6

Consequence Modelling Parameters for GRS facilities at the BPPS

Task 4A

BPPS NGRS

Discharge Parameters

Continuous Critical Weber number	12.5	
Instantaneous Critical Weber number	12.5	
Venting equation constant	24.82	
Relief valve safety factor	1.2	
Minimum RV diameter ratio	1	
Critical pressure greater than flow phase	0.3447	bar
Maximum release velocity	500	m/s
Minimum drop diameter allowed	0.01	um
Maximum drop diameter allowed	1E4	um
Default Liquid Fraction	1	fraction
Continuous Drop Slip factor	1	
Instantaneous Drop Slip factor	1	
Number of Time Steps	100.00	
Maximum Number of Data Points	1,000.00	
Tolerance	0.0001	
Thermal coupling to the wall	No modelling of heat transfer	
Use Bernoulli for forced -phase liq-liq discharge	Use compressible flow eqn	
Capping of pipe flow rates	Use leak scenario cap, disallow flashing	
Velocity capping method	FixedVelocity	
Droplet Method - continuous only	Modified CCPS	
Thermodynamic Option for Gas Pipellines	Non-ideal Gas	
Excess Flow Valve velocity head losses	0	
Non-Return Valve velocity head losses	0	
Shut-Off Valve velocity head losses	0	
Frequency of bends in long pipes	0	/m
Frequency of couplings in long pipes	0	/m
Frequency of junctions in long pipes	0	/m
Line length	10	m
Pipe roughness	0.0457	mm
Air changes	3	/hr
Elevation	1	m
Atmospheric Expansion Method	Closest to Initial Conditions	
Tank Roof Failure Model Effects	Instantaneous effects	
Frequency of Excess Flow Valves	0	/m
Frequency of Non-Return Valves	0	/m
Frequency of Shut-Off Valves	0	/m
Mechanism for forcing droplet breakup - Inst.	Use flashing correlation	
Mechanism for forcing droplet breakup - Cont	Do not force correlation	
Flashing in the orifice	No flashing in the orifice	
Handling of droplets	Not Trapped	
Indoor mass modification factor	3	
Vacuum Relief Valve	Operating	
Vacuum Relief Valve Set Point	0	bar

Dispersion Parameters

Expansion zone length/source diameter ratio	0.01
Near Field Passive Entrainment Parameter	1
Jet Model	Morton et.al.
Jet entrainment coefficient alpha1	0.17
Jet entrainment coefficient alpha2	0.35

Drag coefficient between plume and air	0	
Dense cloud parameter gamma - continuous	0	
Dense cloud parameter gamma - instant	0.3	
Dense cloud parameter K - continuous	1.15	
Dense cloud parameter K - instantaneous	1.15	
Modeling of instantaneous expansion	Standard Method	
Maximum Cloud/Ambient Velocity Difference	0.1	
Maximum Cloud/Ambient Density Difference	0.015	
Maximum Non-passive entrainment fraction	0.3	
Maximum Richardson number	15	
Distance multiple for full passive entrainment	2	
Core Averaging Time	18.75	s
Ratio instantaneous/continuous sigma-y	1	
Ratio instantaneous/continuous sigma-z	1	
Droplet evaporation thermodynamics model	Rainout, Non-equilibrium	
Ratio Droplet/ expansion velocity for inst. release	0.8	
Expansion energy cutoff for droplet angle	0.69	kJ/kg
Coefficient of Initial Rainout	0	
Flag to reset rainout position	Do not reset rainout position	
Richardson Number for passive transition above pool	0.015	
Pool Vaporization entrainment parameter	1.5	
Richardson number criterion for cloud lift-off	-20	
Flag for Heat/Water vapor transfer	Heat and Water	
Surface over which the dispersion occurs	Land	
Minimum temperature allowed	-262.1	degC
Maximum temperature allowed	626.9	degC
Minimum release velocity for cont. release	0.1	m/s
Minimum Continuous Release Height	0	m
Maximum distance for dispersion	5E4	m
Maximum height for dispersion	1000	m
Minimum cloud depth	0.02	m
Treatment of top mixing layer	Constrained	
Model In Use	Best Estimate	
Lee Length	Calculate	
Lee Half-Width	Calculate	
Lee Height	Calculate	
K-Factor	Calculate	
Switch Distance	Calculate	
Maximum Initial Step Size	10	m
Minimum Number of Steps per Zone	5.00	
Factor for Step Increase	1.2	
Maximum Number of Output Steps	1,000.00	
Flag for finite duration correction	QI without Duration Adjustment	
Quasi-instantaneous transition parameter	0.8	
Relative tolerance for dispersion calculations	0.001	
Relative tolerance for droplet calculations	0.001	
Initial integration step size - Instantaneous	0.01	s
Initial integration step size - Continuous	0.01	m
Maximum integration step size - Instantaneous	100	s
Maximum integration step size - Continuous	100	m
Impingement Option	Use Velocity Modification Factor	
Impinged velocity limit	500	m/s
Impinged Velocity Factor	0.25	
Dispersion Model to use	Version 2 model	
Fixed step size - Instantaneous	0.01	s

Fixed step size - Continuous	0.1	m
Number of fixed size output steps	20.00	
Multiplier for output step sizes	1.2	

Explosion Parameters

Over Pressure Level 1	1.1	bar
Over Pressure Level 2	1.3	bar
Over Pressure Level 3	1.5	bar
Over Pressure Level 4	0.3	bar
Explosion Location Criterion	Cloud Front (LFL Fraction)	
Minimum explosive mass	0	kg
Explosion efficiency	10	%
Air or Ground burst	Air burst	
Explosion Mass Modification Factor	3	
Use of mass modification factor	Early and late explosions	

Fireball and BLEVE Blast Parameters

Maximum surface emissive power	400	kW/m2
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
TNO model flame temperature	1727	degC
Mass Modification Factor	3	
Calculation method for fireball	DNV Recommended	
Fireball Maximum Exposure Duration	20	s
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	

Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	
Ground Reflection	Ground Burst	
Ideal Gas Modeling	Model as real gas	
Minimum Distance	0	m
Number of Distance Points	100.00	

Flammable Parameters

Height for calculation of flammable effects	0	m
Flammable result grid step in X-direction	10	m
LFL fraction to finish	0.5	
Angle of inclination	0	deg
Observer direction	Variable	
Flammable mass calculation method	Mass between LFL and UFL	
Flammable Base averaging time	18.75	s
Cut Off Time for Short Continuous Releases	20	s
Observer type radiation modelling flag	Planar	
Probit A Value	-36.38	
Probit B Value	2.56	
Probit N Value	1.333	
Height for reports	Centreline Height	
Angle of orientation	0	deg
Relative tolerance for radiation calculations	0.01	fraction
Number of Lethality Ellipses	5.00	
Ellipse linear spacing variable	Probit	
Minimum Probability Of Death	0.01	fraction
Number of radiation/distance points in linked radiation calculations	50.00	
Method for fitting ellipse to flash fire shape	ChiSq method	
Absolute tolerance for linked radiation calcs	1e-010	
Solar radiation	Exclude from calculations	
For time-varying releases	Don't Model Short Duration Effects	
Match fireball duration and mass released	No	

General Parameters

Maximum release duration	3600	s
Height for concentration output	0	m
Rotation	0	deg
Lower Elevation	0	m
Multicomponent aerosol behaviour	Single aerosol modelling	

Jet Fire Parameters

Maximum SEP for a Jet Fire	400	kW/m2
Jet Fire Averaging Time	20	s
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
Crosswind Angle	0	deg
Correlation	DNV Recommended	

Horizontal Options	Use standard method	
Rate Modification Factor	3	
Jet Fire Maximum Exposure Duration	20	s
Emissivity Method	E and F calculated	
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	

Pool Fire Parameters

Continuous releases	10	s
Calculate Dose	Not selected	
Calculate Probit	Not selected	
Calculate Lethality	Not selected	
MaxExposureDuration	20	s
Radiative fraction for general fires	0.4	fraction
Intensity Levels (1)	4	kW/m2
Intensity Levels (2)	12.5	kW/m2
Intensity Levels (3)	37.5	kW/m2

Intensity Levels (4)	-9.95e+033	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	

Toxic Parameters

Toxics: minimum probability of death	0.001	
Toxics: height for calculation of effects	0	m
Toxics: results grid step in Y-direction	2.5	m
Toxics: results grid step in X-direction	25	m
Multi-comp. toxic calc. method	Mixture Probit	
Toxic Averaging Time - New Parameter	600	s
Probit Calculation Method	Use Probit	
Building Exchange Rate	4	/hr
Tail Time	1800	s
Indoor Calculations	Unselected	
Wind Dependent Exchange Rate	Case Specified	
Set averaging time equal to exposure time	Use a fixed averaging time	
Cut-off fraction of toxic load for exposure time calculation	0.05	fraction
Cut-off concentration for exposure time calculations	0	fraction

Weather Parameters

Atmospheric pressure	1.013	bar
Atmospheric molecular weight	28.97	
Atmospheric specific heat at constant pressure	1.004	kJ/kg.degK
Wind speed reference height	10	m
Temperature reference height	0	m
Cut-off height for wind speed profile	1	m
Wind speed profile	Power Law	
Atmospheric T and P Profile	Temp.Logarithmic; Pres.Linear	
Atmospheric Temperature	23.3	degC
Relative Humidity	0.78	fraction
Parameter	0.043	
Length	0.9121	mm
Surface Roughness	Use Parameter	
Surface Temperature for Dispersion Calculations	23.3	degC
Surface Temperature for Pool Calculations	23.3	degC
Solar Radiation Flux	0.5	kW/m2
Building Exchange Rate	4	/hr
Tail Time	1800	s
Surface Type	User-defined	
Mixing Layer Height for Pasquil Stability A	1300	m
Mixing Layer Height for Pasquil Stability A/B	1080	m
Mixing Layer Height for Pasquil Stability B	920	m
Mixing Layer Height for Pasquil Stability B/C	880	m
Mixing Layer Height for Pasquil Stability C	840	m
Mixing Layer Height for Pasquil Stability C/D	820	m
Mixing Layer Height for Pasquil Stability D	800	m
Mixing Layer Height for Pasquil Stability E	400	m
Mixing Layer Height for Pasquil Stability F	100	m
Mixing Layer Height for Pasquil Stability G	100	m

Annex 5G-7

Consequence Modelling Parameters for GRS facilities at the LPS

Task 4B NGRS 2020

LPS NGRS

Discharge Parameters

Continuous Critical Weber number	12.5	
Instantaneous Critical Weber number	12.5	
Venting equation constant	24.82	
Relief valve safety factor	1.2	
Minimum RV diameter ratio	1	
Critical pressure greater than flow phase	0.3447	bar
Maximum release velocity	500	m/s
Minimum drop diameter allowed	0.01	um
Maximum drop diameter allowed	1E4	um
Default Liquid Fraction	1	fraction
Continuous Drop Slip factor	1	
Instantaneous Drop Slip factor	1	
Number of Time Steps	100.00	
Maximum Number of Data Points	1,000.00	
Tolerance	0.0001	
Thermal coupling to the wall	No modelling of heat transfer	
Use Bernoulli for forced -phase liq-liq discharge	Use compressible flow eqn	
Capping of pipe flow rates	Use leak scenario cap, disallow flashing	
Velocity capping method	FixedVelocity	
Droplet Method - continuous only	Modified CCPS	
Thermodynamic Option for Gas Pipellines	Non-ideal Gas	
Excess Flow Valve velocity head losses	0	
Non-Return Valve velocity head losses	0	
Shut-Off Valve velocity head losses	0	
Frequency of bends in long pipes	0	/m
Frequency of couplings in long pipes	0	/m
Frequency of junctions in long pipes	0	/m
Line length	10	m
Pipe roughness	0.0457	mm
Air changes	3	/hr
Elevation	1	m
Atmospheric Expansion Method	Closest to Initial Conditions	
Tank Roof Failure Model Effects	Instantaneous effects	
Frequency of Excess Flow Valves	0	/m
Frequency of Non-Return Valves	0	/m
Frequency of Shut-Off Valves	0	/m
Mechanism for forcing droplet breakup - Inst.	Use flashing correlation	
Mechanism for forcing droplet breakup - Cont	Do not force correlation	
Flashing in the orifice	No flashing in the orifice	
Handling of droplets	Not Trapped	
Indoor mass modification factor	3	
Vacuum Relief Valve	Operating	
Vacuum Relief Valve Set Point	0	bar

Dispersion Parameters

Expansion zone length/source diameter ratio	0.01	
Near Field Passive Entrainment Parameter	1	
Jet Model	Morton et.al.	
Jet entrainment coefficient alpha1	0.17	
Jet entrainment coefficient alpha2	0.35	

Drag coefficient between plume and air	0	
Dense cloud parameter gamma - continuous	0	
Dense cloud parameter gamma - instant	0.3	
Dense cloud parameter K - continuous	1.15	
Dense cloud parameter K - instantaneous	1.15	
Modeling of instantaneous expansion	Standard Method	
Maximum Cloud/Ambient Velocity Difference	0.1	
Maximum Cloud/Ambient Density Difference	0.015	
Maximum Non-passive entrainment fraction	0.3	
Maximum Richardson number	15	
Distance multiple for full passive entrainment	2	
Core Averaging Time	18.75	s
Ratio instantaneous/continuous sigma-y	1	
Ratio instantaneous/continuous sigma-z	1	
Droplet evaporation thermodynamics model	Rainout, Non-equilibrium	
Ratio Droplet/ expansion velocity for inst. release	0.8	
Expansion energy cutoff for droplet angle	0.69	kJ/kg
Coefficient of Initial Rainout	0	
Flag to reset rainout position	Do not reset rainout position	
Richardson Number for passive transition above pool	0.015	
Pool Vaporization entrainment parameter	1.5	
Richardson number criterion for cloud lift-off	-20	
Flag for Heat/Water vapor transfer	Heat and Water	
Surface over which the dispersion occurs	Land	
Minimum temperature allowed	-262.1	degC
Maximum temperature allowed	626.9	degC
Minimum release velocity for cont. release	0.1	m/s
Minimum Continuous Release Height	0	m
Maximum distance for dispersion	5E4	m
Maximum height for dispersion	1000	m
Minimum cloud depth	0.02	m
Treatment of top mixing layer	Constrained	
Model In Use	Best Estimate	
Lee Length	Calculate	
Lee Half-Width	Calculate	
Lee Height	Calculate	
K-Factor	Calculate	
Switch Distance	Calculate	
Maximum Initial Step Size	10	m
Minimum Number of Steps per Zone	5.00	
Factor for Step Increase	1.2	
Maximum Number of Output Steps	1,000.00	
Flag for finite duration correction	QI without Duration Adjustment	
Quasi-instantaneous transition parameter	0.8	
Relative tolerance for dispersion calculations	0.001	
Relative tolerance for droplet calculations	0.001	
Initial integration step size - Instantaneous	0.01	s
Initial integration step size - Continuous	0.01	m
Maximum integration step size - Instantaneous	100	s
Maximum integration step size - Continuous	100	m
Impingement Option	Use Velocity Modification Factor	
Impinged velocity limit	500	m/s
Impinged Velocity Factor	0.25	
Dispersion Model to use	Version 2 model	
Fixed step size - Instantaneous	0.01	s

Fixed step size - Continuous	0.1	m
Number of fixed size output steps	20.00	
Multiplier for output step sizes	1.2	

Explosion Parameters

Over Pressure Level 1	0.02068	bar
Over Pressure Level 2	0.1379	bar
Over Pressure Level 3	0.2068	bar
Explosion Location Criterion	Cloud Front (LFL Fraction)	
Minimum explosive mass	0	kg
Explosion efficiency	10	%
Air or Ground burst	Air burst	
Explosion Mass Modification Factor	3	
Use of mass modification factor	Early and late explosions	

Fireball and BLEVE Blast Parameters

Maximum surface emissive power	400	kW/m2
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
TNO model flame temperature	1727	degC
Mass Modification Factor	3	
Calculation method for fireball	DNV Recommended	
Fireball Maximum Exposure Duration	20	s
Intensity Levels (1)	4	kW/m2
Intensity Levels (2)	12.5	kW/m2
Intensity Levels (3)	37.5	kW/m2
Intensity Levels (4)	-9.95e+033	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	

Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	
Ground Reflection	Ground Burst	
Ideal Gas Modeling	Model as real gas	
Minimum Distance	0	m
Number of Distance Points	100.00	

Flammable Parameters

Height for calculation of flammable effects	0	m
Flammable result grid step in X-direction	10	m
LFL fraction to finish	0.5	
Angle of inclination	0	deg
Observer direction	Variable	
Flammable mass calculation method	Mass between LFL and UFL	
Flammable Base averaging time	18.75	s
Cut Off Time for Short Continuous Releases	20	s
Observer type radiation modelling flag	Planar	
Probit A Value	-36.38	
Probit B Value	2.56	
Probit N Value	1.333	
Height for reports	Centreline Height	
Angle of orientation	0	deg
Relative tolerance for radiation calculations	0.01	fraction
Number of Lethality Ellipses	5.00	
Ellipse linear spacing variable	Probit	
Minimum Probability Of Death	0.01	fraction
Number of radiation/distance points in linked radiation calculations	50.00	
Method for fitting ellipse to flash fire shape	ChiSq method	
Absolute tolerance for linked radiation calcs	1e-010	
Solar radiation	Exclude from calculations	
For time-varying releases	Don't Model Short Duration Effects	
Match fireball duration and mass released	No	

General Parameters

Maximum release duration	3600	s
Height for concentration output	0	m
Rotation	0	deg
Lower Elevation	0	m
Multicomponent aerosol behaviour	Single aerosol modelling	

Jet Fire Parameters

Maximum SEP for a Jet Fire	400	kW/m2
Jet Fire Averaging Time	20	s
Calculate Dose	Unselected	
Calculate Probit	Unselected	
Calculate Lethality	Unselected	
Crosswind Angle	0	deg
Correlation	DNV Recommended	
Horizontal Options	Use standard method	

Rate Modification Factor	3	
Jet Fire Maximum Exposure Duration	20	s
Emissivity Method	E and F calculated	
Intensity Levels (1)	9.8	kW/m2
Intensity Levels (2)	19.5	kW/m2
Intensity Levels (3)	28.3	kW/m2
Intensity Levels (4)	35.5	kW/m2
Intensity Levels (5)	-9.95e+033	kW/m2
Intensity Levels (6)	-9.95e+033	kW/m2
Intensity Levels (7)	-9.95e+033	kW/m2
Intensity Levels (8)	-9.95e+033	kW/m2
Intensity Levels (9)	-9.95e+033	kW/m2
Intensity Levels (10)	-9.95e+033	kW/m2
Probit Levels (1)	2.73	
Probit Levels (2)	3.72	
Probit Levels (3)	7.5	
Probit Levels (4)	-9.95e+036	
Probit Levels (5)	-9.95e+036	
Probit Levels (6)	-9.95e+036	
Probit Levels (7)	-9.95e+036	
Probit Levels (8)	-9.95e+036	
Probit Levels (9)	-9.95e+036	
Probit Levels (10)	-9.95e+036	
Dose Levels (1)	1.27E6	
Dose Levels (2)	5.8E6	
Dose Levels (3)	2.51E7	
Dose Levels (4)	-9.95e+036	
Dose Levels (5)	-9.95e+036	
Dose Levels (6)	-9.95e+036	
Dose Levels (7)	-9.95e+036	
Dose Levels (8)	-9.95e+036	
Dose Levels (9)	-9.95e+036	
Dose Levels (10)	-9.95e+036	
Lethality Levels (1)	0.01	
Lethality Levels (2)	0.1	
Lethality Levels (3)	1	
Lethality Levels (4)	-9.95e+036	
Lethality Levels (5)	-9.95e+036	
Lethality Levels (6)	-9.95e+036	
Lethality Levels (7)	-9.95e+036	
Lethality Levels (8)	-9.95e+036	
Lethality Levels (9)	-9.95e+036	
Lethality Levels (10)	-9.95e+036	

Pool Vaporization Parameters

Toxics cut-off rate for pool evaporation	0.001	kg/s
Flammable cut-off rate for pool evaporation	0.1	kg/s
Concentration power to use in pool rate load calculation	1	
Maximum number of pool evaporation rates	10.00	
Pool minimum thickness	5	mm
Surface thermal conductivity	0.00221	kJ/m.s.degK
Surface roughness factor	2.634	
Surface thermal diffusivity	9.48E-7	m2/s
Type of Bund Surface	Concrete	
Bund Height	0	m

Bund Failure Modeling	Bund cannot fail	

Toxic Parameters

Toxics: minimum probability of death	0.001	
Toxics: height for calculation of effects	0	m
Toxics: results grid step in Y-direction	2.5	m
Toxics: results grid step in X-direction	25	m
Multi-comp. toxic calc. method	Mixture Probit	
Toxic Averaging Time - New Parameter	600	s
Probit Calculation Method	Use Probit	
Building Exchange Rate	4	/hr
Tail Time	1800	s
Indoor Calculations	Unselected	
Wind Dependent Exchange Rate	Case Specified	
Set averaging time equal to exposure time	Use a fixed averaging time	
Cut-off fraction of toxic load for exposure time calculation	0.05	fraction
Cut-off concentration for exposure time calculations	0	fraction

Weather Parameters

Atmospheric pressure	1.013	bar
Atmospheric molecular weight	28.97	
Atmospheric specific heat at constant pressure	1.004	kJ/kg.degK
Wind speed reference height	10	m
Temperature reference height	0	m
Cut-off height for wind speed profile	1	m
Wind speed profile	Power Law	
Atmospheric T and P Profile	Temp.Logarithmic; Pres.Linear	
Atmospheric Temperature	23.3	degC
Relative Humidity	0.78	fraction
Parameter	0.043	
Length	0.9121	mm
Surface Roughness	Use Parameter	
Surface Temperature for Dispersion Calculations	23.3	degC
Surface Temperature for Pool Calculations	23.3	degC
Solar Radiation Flux	0.5	kW/m2
Building Exchange Rate	4	/hr
Tail Time	1800	s
Surface Type	User-defined	
Mixing Layer Height for Pasquil Stability A	1300	m
Mixing Layer Height for Pasquil Stability A/B	1080	m
Mixing Layer Height for Pasquil Stability B	920	m
Mixing Layer Height for Pasquil Stability B/C	880	m
Mixing Layer Height for Pasquil Stability C	840	m
Mixing Layer Height for Pasquil Stability C/D	820	m
Mixing Layer Height for Pasquil Stability D	800	m
Mixing Layer Height for Pasquil Stability E	400	m
Mixing Layer Height for Pasquil Stability F	100	m
Mixing Layer Height for Pasquil Stability G	100	m