Appendix G – Quantitative Risk Assessment

MOTT MACDONALD

Application for Permission under Section 16 of the Town Planning Ordinance (Cap. 131) for Proposed "Flat" with "Commercial (1)" Zone of STTL626 and STTL627 in Shatin

Preliminary Quantitative Risk Assessment (QRA)

July 2026

[redacted]

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APPENDICES

1 INTRODUCTION

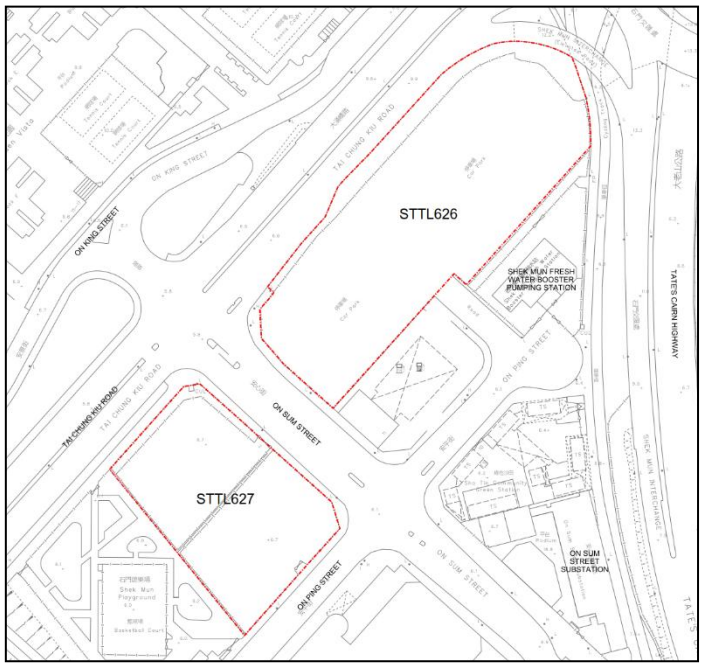
1.1 Study Background

1.1.1 The Government is committed to facilitating steady and continued land supply. The Government will continue to optimise the use of built-up land and its surrounding areas to meet the demand for housing and other development purposes in the short to medium term.

1.1.2 To achieve this objective, the Government has identified potential sites for conversion from commercial to residential use. Upon confirmation of the technical feasibility, a planning application will be submitted under section 16 of Town Planning Ordinance for consideration by the Town Planning Board.

1.1.3 On 15 August 2023, Mott MacDonald Hong Kong Limited (Mott) was commissioned by the CEDD's Housing Projects 3, Civil Engineering Office to undertake the "Term Consultancy for Site Formation and Infrastructure Works for Proposed Housing and Other Developments in Zone 1 (2023 – 2027) – Feasibility Study". Zone 1 mainly covers Shatin, Ma On Shan, Tsuen Wan and Kwai Ching, Lantau and outlying islands. On 31 October 2025, Task Order No. 4 (TO4) was instructed to conduct various technical assessments to support the town planning application for proposed private residential development at two development sites denoted as STTL626 (also known as ST-9353N) and STTL627 (also known as ST-9353S) respectively, located on the north and south sides of the section of On Sum Street between Tai Chung Kiu Road and On Ping Street in Shek Mun, Sha Tin. Location of the Site is shown in **Diagram 1-1**.

Diagram 1-1 Location of the Site

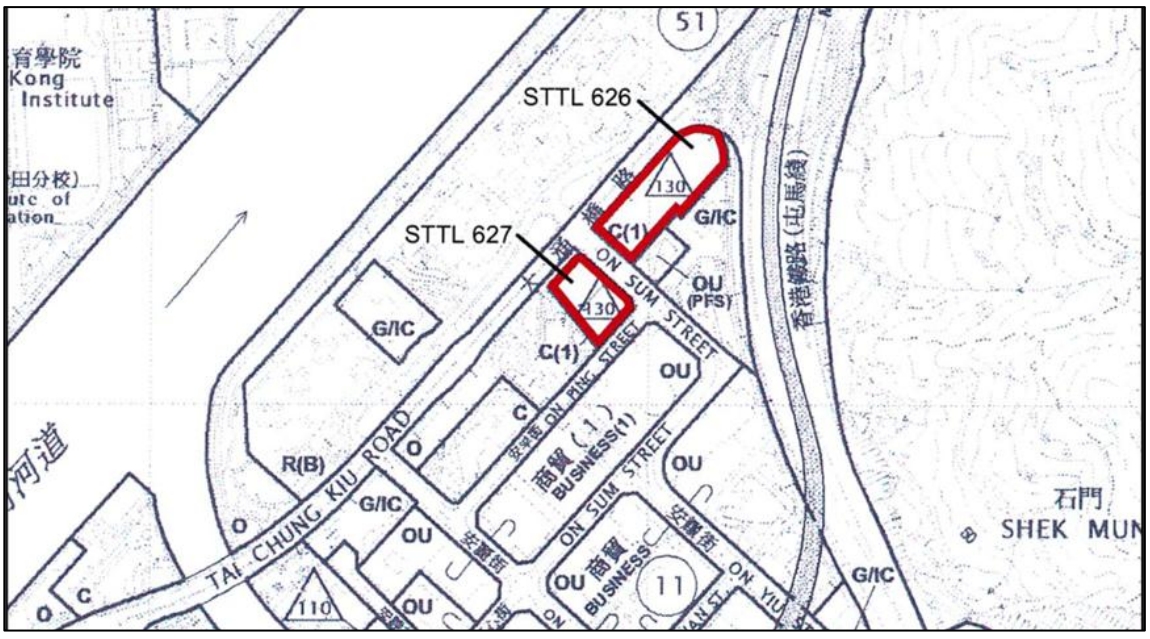


1.2 Site Description and Major Scope of Works

1.2.1 The two subject sites of this assignment STTL626 and STTL627, currently zoned "Commercial(1)" ("C(1)") on the approved Sha Tin Outline Zoning Plan (OZP) no. S/ST/40, cover a site area of approximately 0.80ha and 0.41ha respectively. Located at the northern fringe of the Shek Mun Business Area (Planning Area 11 in the OZP), the sites are generally bounded by Shek Mun Interchange to the north, Tai Chung Kiu Road (TCKR) to the northwest, Shek Mun Playground to the south, and On Ping Street (OPS) to the east, with On Sum Street (OSS) running along a corridor that separates the two sites. A hotel (Courtyard by Marriot Hong Kong Shatin) is located to the further southwest. Currently the STTL626 site is used as a fee-paying carpark (FPC) whereas the STTL627 site is vacant Government land. Both sites are formed flat ground, with an existing ground level at approximately +6mPD.

1.2.2 The proposed sites are covered by the approved Sha Tin Outline Zoning Plan (OZP) No. S/ST/40 and zoned as "C(1)", as shown in **Diagram 1-2**.

Diagram 1-2 Boundaries of the two sites under Approved Sha Tin Outline Zoning Plan (Plan No. S/ST/40)



Source: Sha Tin Outline Zoning Plan (Plan No. S/ST/40), Town Planning Board Portal

1.2.3 The design parameters of the Indicative Scheme for the Proposed Development are summarised in **Table 1.1** below.

Table 1.1 Target Design Parameters of the Indicative Scheme

	Development Parameters	
	STTL626	**STTL627**
Application Site Area	0.80Ha	0.41Ha
Planned Housing Type	Private Housing	
No. of Flats (Total No. of Flats : 1,456)	962	494

1.2.4 This EFS aims to conduct the necessary technical assessments to support the town planning application for the proposed private residential developments for the two sites STTL626 and STTL627 in Shek Mun. The scope of work includes the followings:

- To conduct the technical assessments related to traffic and transport, drainage, sewerage, water supply and utilities;
- To assess environmental impacts and conduct quantitative risk assessments; and
- To prepare a Planning Report and to provide all necessary inputs to support and complete the planning application procedure.

1.2.5 Based on the information available, the technical assessments are currently scheduled for completion in March 2026 to initiate the Section 16 town planning application procedure in Q2 or Q3 2026. It is targeted that both sites will be included in the 2026/27 Land Sale Programme for private housing development.

1.3 Scope and Structure of this Report

1.3.1 In accordance with Clause 6.23 of the Brief, this Preliminary Quantitative Risk Assessment Report was prepared to present the following:

(a) Conduct site surveys and obtain data related to design and operation of the gas installations from the operator, and populations, building heights and land use nature, traffic flows and wind characteristics in the vicinity of the gas installations from relevant B/Ds and public utilities companies as necessary;

(b) Develop a model with a software for risk assessment of fire, explosion and any other dangerous occurrences to the surrounding populations so as to obtain the individual risks and societal risks. The software model shall be able to be run on PhastRisk 6.7 or its more updated version;

(c) Compile the data collected for input into the model and run the model for the assessment with and without the Development(s). In case the risk outcomes, namely the individual risk and societal risk, of the assessment with and without the Development(s), are not acceptable (i.e. fall into the "UNACCEPTABLE" region), the Consultants shall propose and incorporate necessary mitigation measures in the model by taking account of cost-benefit analysis to reduce the risk levels so as to meet the Government Risk Guidelines and other requirements as may be specified by the DR and the DEMS. The Consultants shall identify and assess the risk mitigation measures based on practicality and cost as necessary;

(d) Prepare and submit a full report of risk assessment with necessary mitigation measures. The formats of the report shall be agreed by the DR and the DEMS; and

(e) The Consultants shall take into account any comments, if any, from the DR and the DEMS until the full report is to the satisfaction of the DR and the DEMS.

1.3.2 Following this introductory Section, this QRA has the following remaining Sections:

- **Section 2: -** presents the objective of QRA**;**
- **Section 3: -** list out the risk criteria adopted in this QRA;
- **Section 4: -** presents the methodology for carrying out this QRA;
- **Section 5**: - describes the proposed development and adjacent installation and infrastructures;
- **Section 6**: - identify hazards at the subject sites;
- **Section 7**: - examines the frequency and probability of hazardous events;
- **Section 8:** - describe the consequence assessment adopted in this QRA;
- **Section 9:** - presents the risk assessment results and possible mitigation measures;
- **Section 10**: **-** concludes the findings on the Preliminary Quantitative Risk Assessment.

1.4 Abbreviations

Abbreviations	Term
AADT	Annual Average Daily Traffic
ALARP	As Low As Reasonably Practicable
ATC	Annual Traffic Census
CEDD	Civil Engineering and Development Department
EFS	Engineering Feasibility Study
EIAO	Environmental Impact Assessment Ordinance
EPD	Environmental Protection Department
ETA	Event Tree Analysis
GESF	Guidelines for Estimating Sewage Flows
GLA	Government Land Allocation
HKPSG	Hong King Planning Standards and Guidelines
HPTGP	High Pressure Town Gas Pipeline
HPTGRS	High Pressure Towngas Regulating Station
IDLH	Immediately Dangerous to Life or Health
IR	Individual Risks
LFL	Lower Flammability Limit
Mott	Mott MacDonald Hong Kong Limited
OZP	Outline Zoning Plan
PR	Plot Ratio
QRA	Quantitative Risk Assessment
SR	Societal Risk
STT	Short-Term Tenancy
TPEDM	Territorial Population and Employment Data Matrix
UDM	Unified Dispersion Model

2 DETAILED OBJECTIVES OF THE QRA

2.1.1 The main objective of this Quantitative Risk Assessment (QRA) is to demonstrate the risk criteria set out in the Hong Kong Risk Guideline stipulated in Chapter 12 of the Hong Kong Planning Standards and Guidelines (HKPSG) will be met during the project period and to identify practical mitigation measures to reduce the risk, where required.

2.1.2 The detailed scope of QRA includes:

- Identification of all hazardous scenarios associated with the underground HP Towngas transmission pipelines;
- Preparation of a QRA to estimate the risks to the surrounding population in both individual and societal terms;
- Comparison of Individual Risks (IR) and Societal Risks (SR) against the EIAO-TM criteria to determine the acceptability of the Development(s) in terms of risk; and
- Identification and assessment of practicable and cost-effective risk mitigation measures, where necessary.

3 RISK CRITERIA

3.1.1 The guidelines for individual and societal risk specified in Annex 4 of the EIAO-TM are listed below:

Individual Risk (IR)

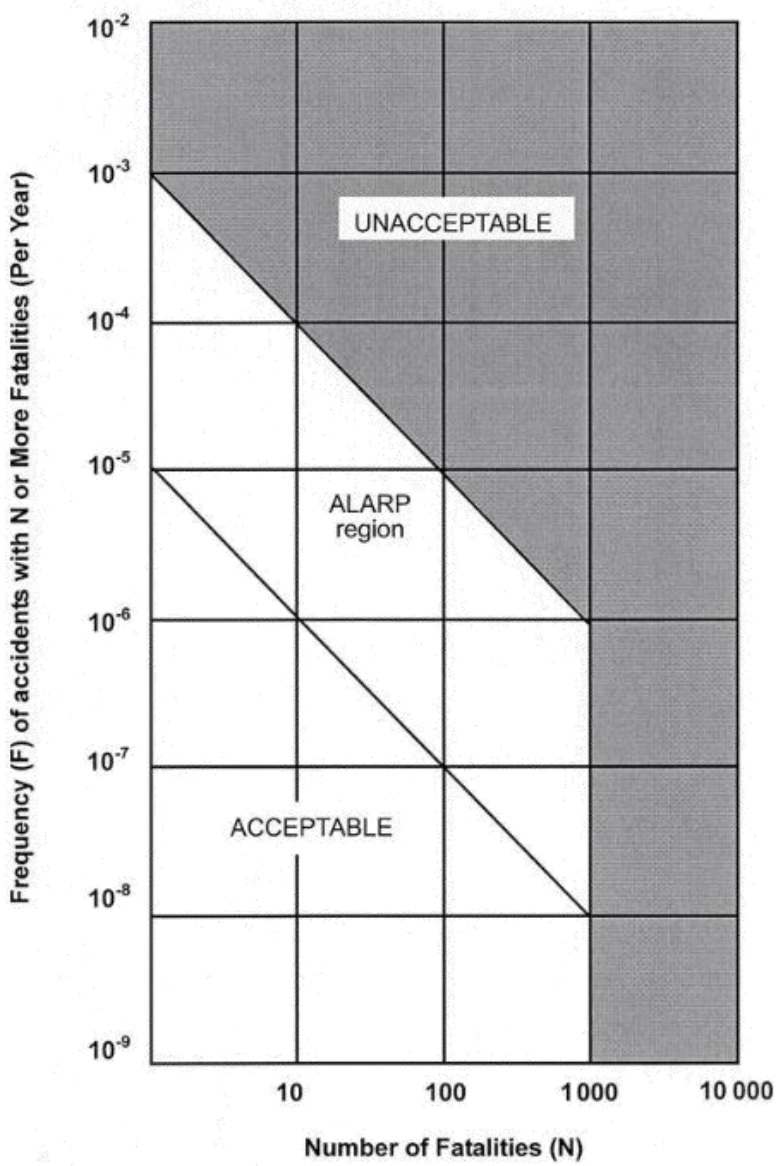
3.1.2 The maximum level of offsite individual risk should not exceed 1 in 100,000 per year (i.e. 1E-05/ year).

Societal Risk

3.1.3 Societal risk is expressed in the form of an F-N curve, which represents the cumulative frequency (F) of all event outcomes leading to N or more fatalities. The F-N curve criteria are shown in Diagram 3-1. The three different regions are defined as:

- Unacceptable region: where risk is so high that they should usually be reduced regardless of the cost or else the hazardous activity should not proceed;
- ALARP region: where risk is tolerable, provided that it has been reduced to a level As Low As Reasonably Practicable (ALARP); and
- Acceptable region: where risk is broadly acceptable and does not require further risk reduction.

Diagram 3-1 Societal Risk Criteria in Hong Kong

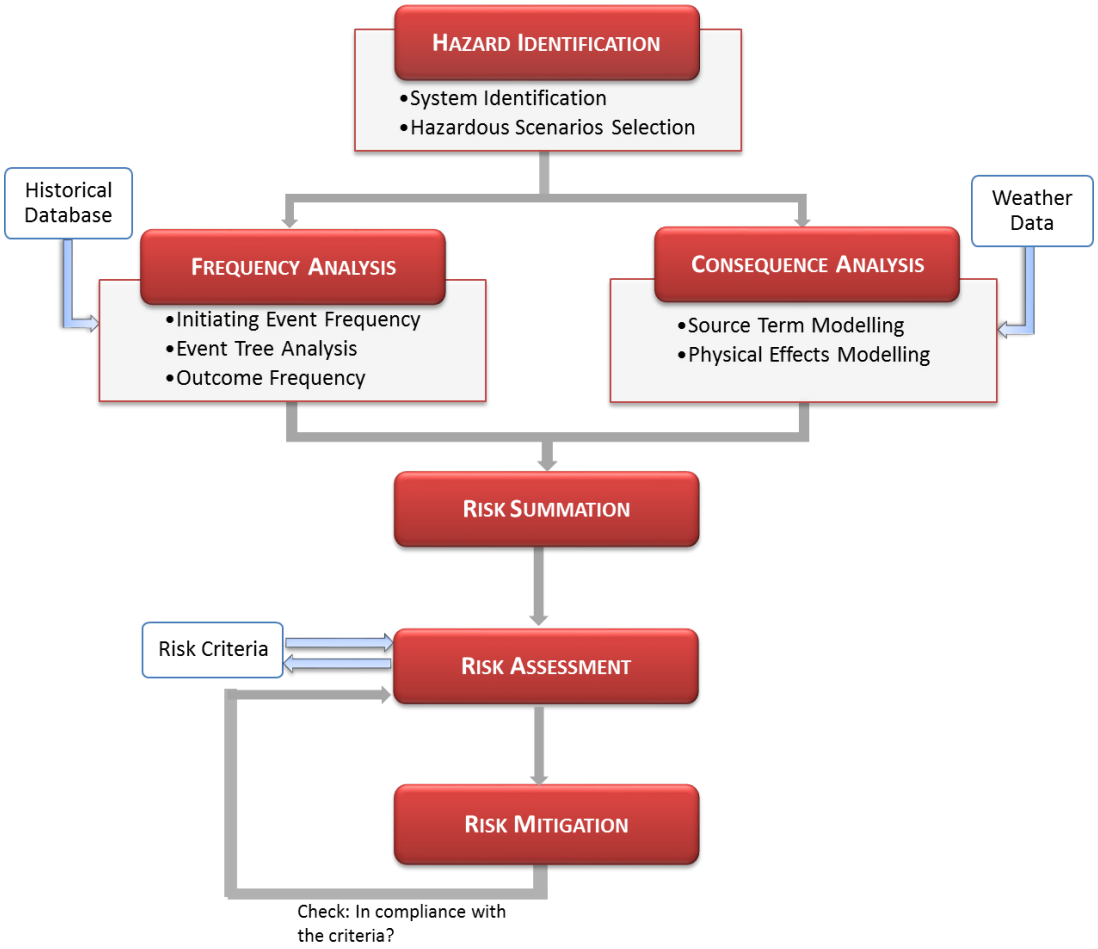


4 QRA METHODOLOGY

4.1.1 The key elements of a QRA study are outlined in Diagram 4-1, which comprises the following steps:

- Hazard Identification;
- Consequence Analysis;
- Frequency Analysis; and
- Risk Summation and Assessment.

Diagram 4-1 QRA Methodology



4.1.2 The Hazard Identification step involves a review of the hazardous material properties and a review of past accidents, with the objective of identifying potential hazards related to underground towngas transmission pipelines/ aboveground installations and understanding the ways in which those hazards may be realised.

4.1.3 Consequence analysis aims to obtain an estimate of the impact on people in loss of containment events of flammable substances. This includes the following primary components which are performed with consequence modelling software, PHAST SAFETI v9.0:

- Source term/ discharge modelling
- Dispersion modelling
- Fire and explosion modelling
- Effects modelling

4.1.4 In frequency analysis, the likelihood of each identified scenario is quantified taking into account the site-specific features and project activities. Reference has also been made to previous similar QRA study [1] in Hong Kong for frequency assessment of underground gas pipelines.

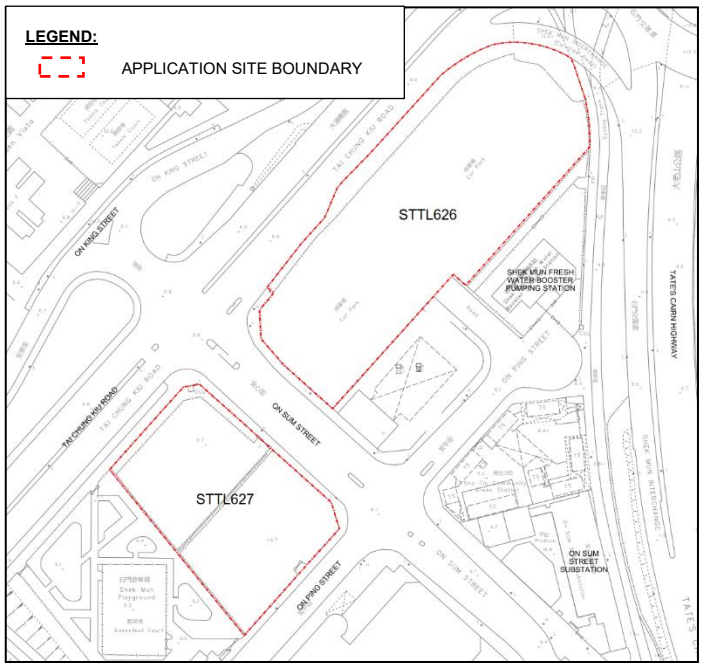
4.1.5 Risk summation then combines the estimates of likelihood and consequence for the identified hazardous events to produce the risk results, which are expressed in terms of individual risk and societal risk as per EIAO-TM. Risk mitigation measures are recommended, where required, to reduce the risk to As Low As Reasonably Practicable (ALARP).

5 DEVELOPMENT SITE AND SURROUNDINGS

5.1 The Proposed Development

5.1.1 The proposed development (STTL626 and STTL 627) is located in Shek Mun adjacent to Tai Chung Kiu Road. The proposed development is divided into two portions (STTL626 and STTL627) which provide 962 and 494 flats, respectively. This corresponds to ~2,501 and ~1,284 people, respectively, giving a total development population of 3,785 people. The proposed development area is presented in Diagram 5-1 below.

Diagram 5-1 Proposed Development Area



5.1.2 Besides the residential uses, both portions also provide clubhouses, car parks, retails and social welfare facility, which are presented in Diagram 5-2 and Diagram 5-3. The development parameter of both portions is shown in Table 5-1.

Table 5-1 Development Parameter of STTL626 and STTL627

	STTL626	STTL627
Building Height	130 mPD	130 mPD
Approximate Flat Production	962	494
Type of Social Welfare included	-	Integrated Children and Youth Services Centre (ICYSC) Sub-base
Total GFA for Retail	1,603 m^2	823 m^2
Total GFA for Social Welfare	-	163 m^2

Diagram 5-2 Facility Layout of STTL626

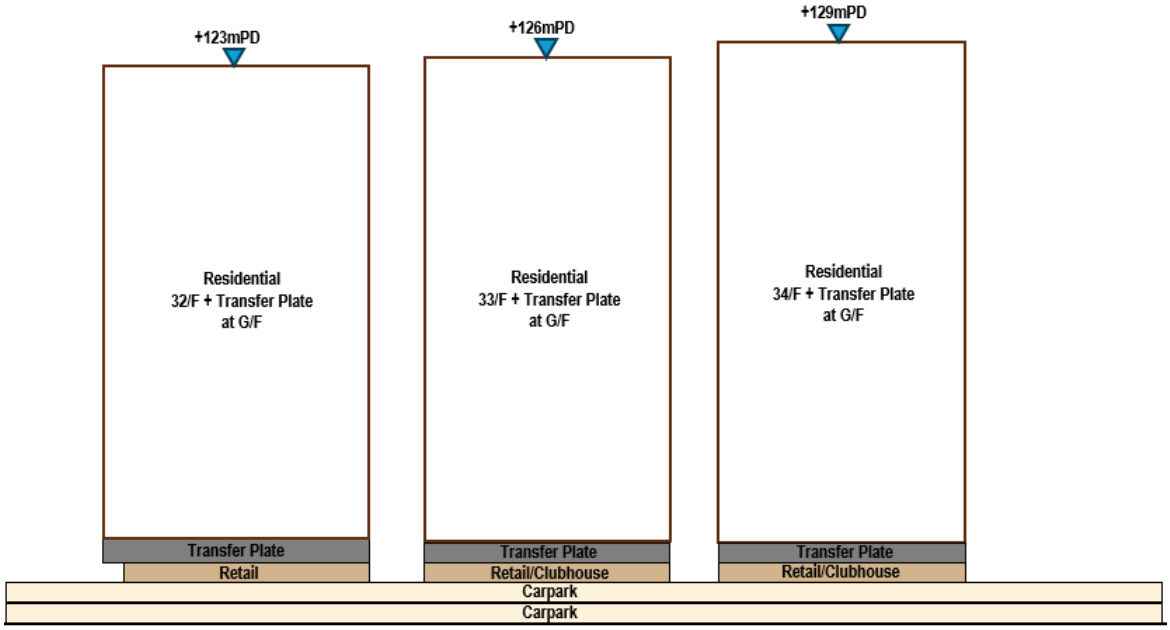
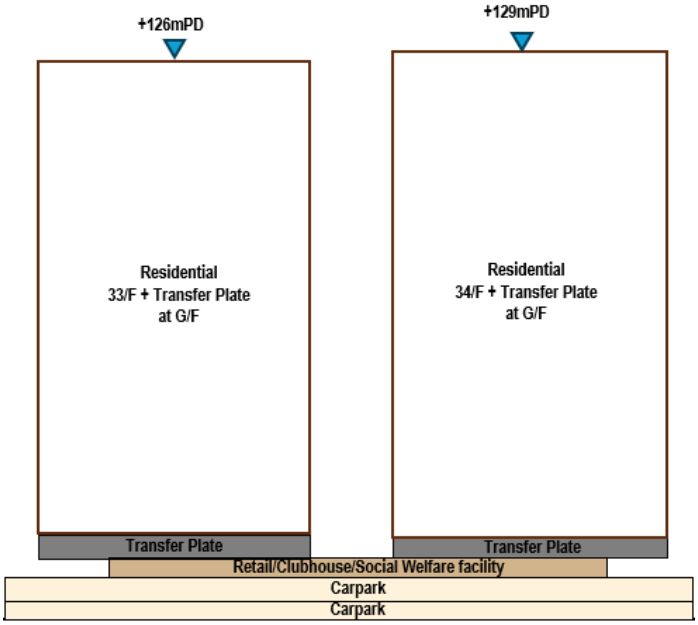


Diagram 5-3 Facility Layout of STTL627



5.2 Existing Hazards in Vicinity of the Sites

Underground Towngas HP Pipeline

5.2.1 The development sites located near the underground HP gas transmission pipeline operated by Towngas, which is installed along the Tate's Cairn highway. Diagram 5-4 presented the key technical specifications for the pipeline.

Diagram 5-4 Technical Specification for the Existing 600mm HPTGP

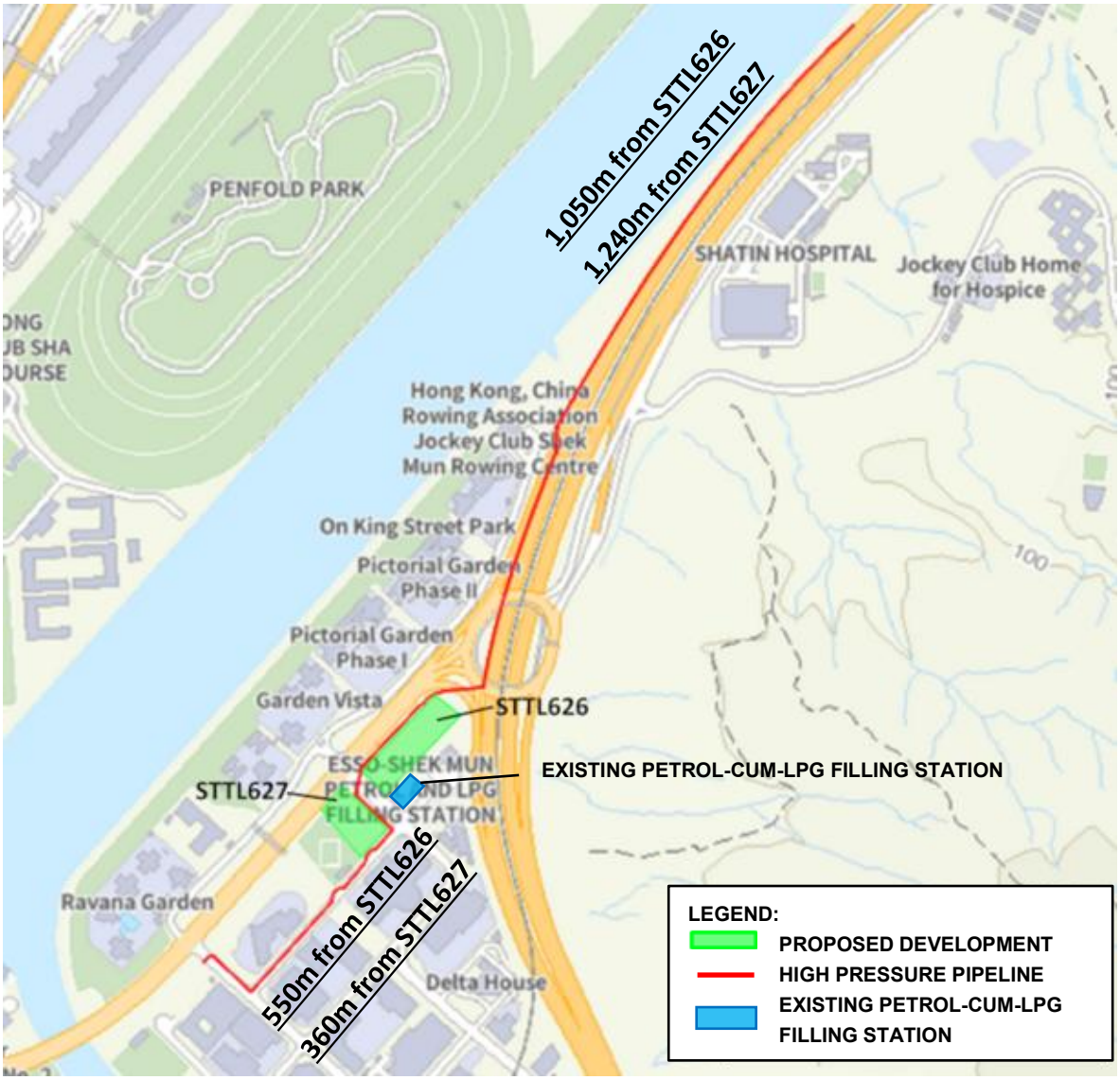
Parameter	Specification
Pipe Diameter (Nominal)	600mm
Pipe wall thickness	12.7mm
Design Pressure	35 barg
Maximum Operating Pressure	35 barg
Hydraulic Test Pressure	900 psi
Air Test Pressure	100 psi
Pipe Material	Steel
External Coating	400 micron of fusion bonded epoxy coating
Internal Coating	50 micron Two Pack Epoxy
Year of Construction	1987-1991
Backfilling Material	Surrounded by 150mm Thick Zone 2 fresh sand
Cathodic Protection	Sacrificial Anode at about 300 m Interval
Minimum Depth	1.1m
Material Grading (Pipe/ Fitting)	API 5L X42 / X52
Jointing Method	Butt Welding
Welding Specification	Welding complied with BGC/PS/P2
Non-Destructive Test of Jointing	100% X-Ray
Isolation Valves (Cameron Full Bore Ball Valve)	Upstream: Ball Valve near Ma On Shan Road Downstream: Valve in Shatin North Offtake and Pigging Station
Pipe Length between isolation valves	3.7km

5.2.2 For this assessment, a 1.6 km pipeline segment of HP pipeline has been considered as basis with reference to Section 3.2.1 of Guidance Note on Quantitative Risk Assessment Study for High Pressure Town Gas Installations in Hong Kong. The alignment of the underground pipelines is provided in Diagram 5-5.

5.2.3 For pipeline study, it generally follows that the higher the number of population in the vicinity, the higher the societal risk level is to the result. Since the selected 1.6 km pipeline segment already covers a number of highly populated residential precincts along the route as relevant to the project, the societal risk results are expected to be representative, presenting the highest risk segment.

5.2.4 Population's proximity to the pipeline is also an important factor that should be taken into consideration when selecting the representative pipeline segment for QRA. Pipelines that run close to busy roads and pedestrian paths are likely to be associated with higher risk than those which are not. In the current case, such component of the risk is, however, not considered to vary significantly along the pipeline route, since both of the pipelines were installed along the Tate's Cairn highway where the road population density is also considered to be similar along the route.

Diagram 5-5 Assessed Pipeline Segment of Underground HP Gas Transmission Pipelines



Existing Petrol-cum-LPG Filling Station

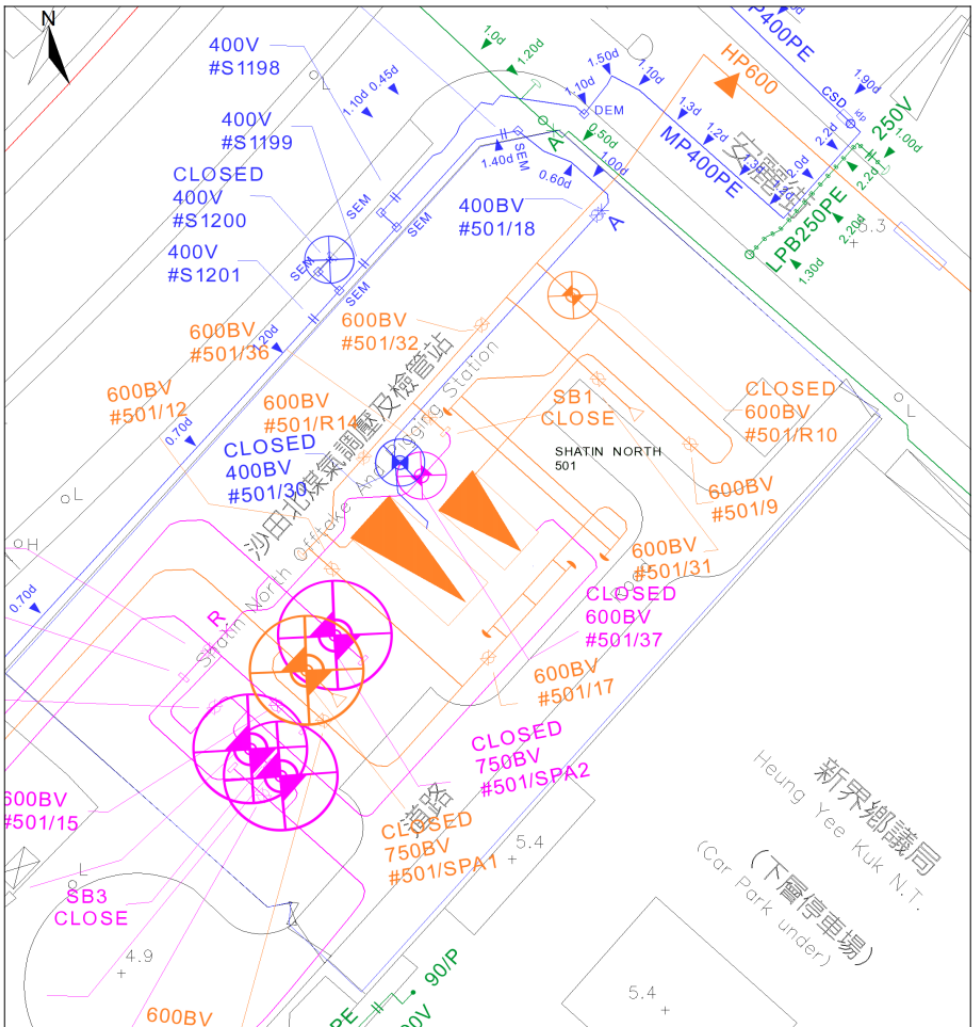
5.2.5 The development sites are located adjacent to an existing Petrol-cum-LPG Filling Station on On Ping Street (refer to Diagram 5-5). According to correspondence with Environment and Ecology Bureau (EEB), the LPG facilities of this station will be decommissioned and there will be no LPG supply at this station after 31 Jan 2029.

5.2.6 Consequently, the hazard associated with the LPG component of this Petrol-cum-LPG Filling Station will no longer exist after the population intake tentatively scheduled for 2031/2032. This quantitative risk assessment has therefore been conducted based on a no-LPG scenario.

Shatin North Offtake and Pigging Station

5.2.7 As per the requirement in the Guidance Note on QRA for HP Towngas Installations in HK [10], any High Pressure Towngas Regulating Station (HPTGRS) within the study zone should be considered in the QRA study. As such, the existing Shatin North Offtake and Pigging Station is also included in this QRA and the risk result is to be integrated with that of the pipeline. Diagram 5-6 below presented the layout of the station. There are 3 different systems with different operating pressures inside the station. Operating pressure for HP system is 35 barg, IPB system is 7 barg and MP system is 2.4 barg. Note that as per requirement, only the HP system is required to be modelling in QRA. Further information related to equipment details is presented in Annex C.

Diagram 5-6 Layout of the Shatin North Offtake and Pigging



5.3 Surrounding Population

5.3.1 For the purposes of QRA, a study zone of 200 m, based on Section 3.2 of Guidance Note on Quantitative Risk Assessment Study for High Pressure Town Gas Installations in Hong Kong,

has been considered around the 1.6 km pipeline segment as shown Diagram 5-7, in order to determine the potential population that can be affected in the event of a pipeline accident.

5.3.2 The QRA has considered two population scenarios for societal risk assessment:

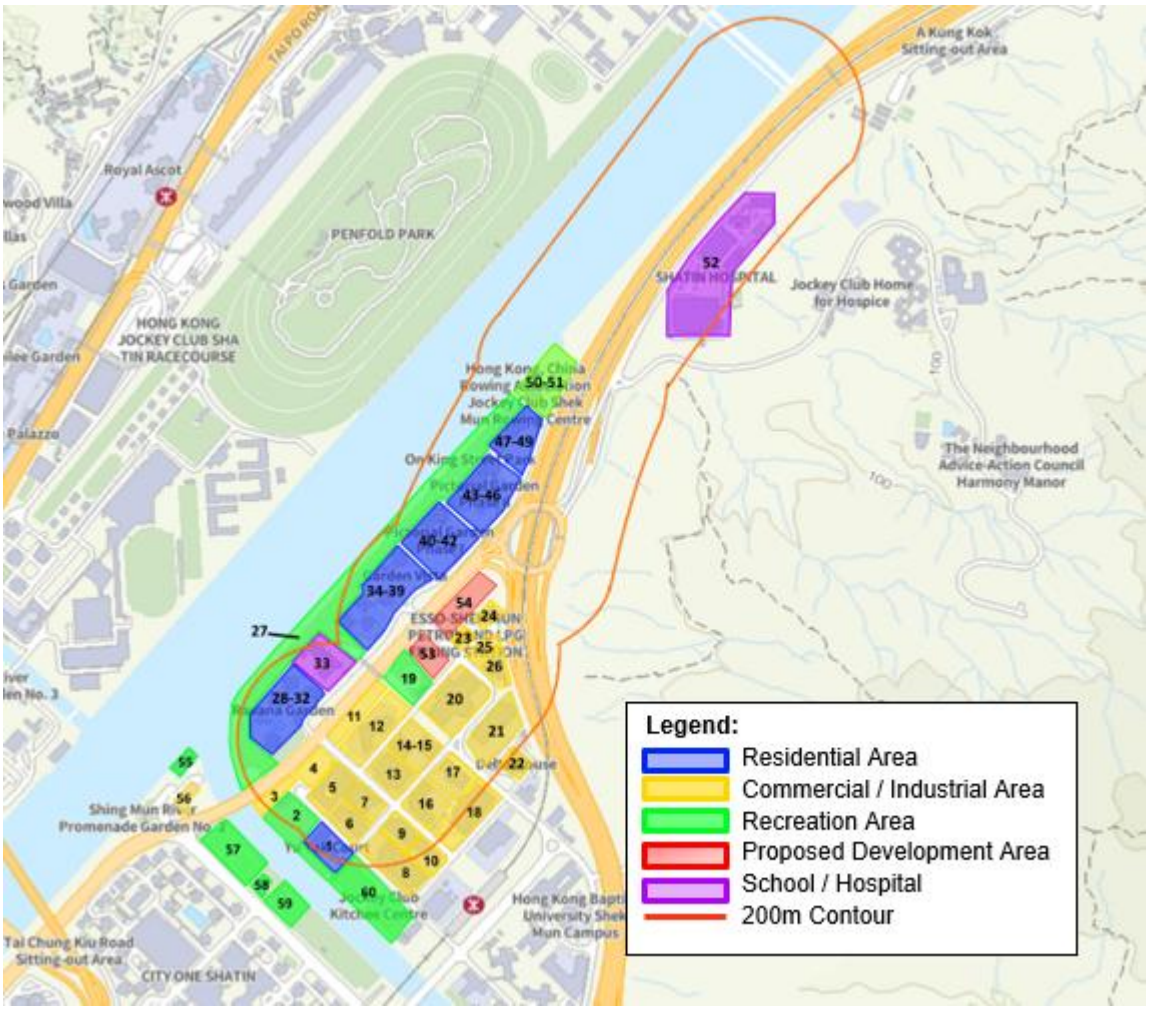
- Year 2025 before commencement of the Project (referred to as Current Case); and
- Year 2032 occupancy phase (referred to as Developed Case).

Average Population Growth Rate

5.3.3 Based on the population projection data acquired from the Planning Department of HKSAR (i.e. TPEDM data), the population in Sha Tin in 2019 was 483,000 and is expected to decrease to 442,950 by 2041. This translates to about 8.3% population decrease over a span of 22 years. However, to be conservative, the existing building populations in Sha Tin surrounding the proposed development site are assumed to remain the same (i.e. growth rate assumed to be 0).

5.3.4 While the following subsections present the approach for population estimate and the latest data collected (i.e. 2024), the population data collected has been further projected to 2025 and 2032 using the aforementioned growth rate. The detailed tabulation of projected population data, including the population between day and night, weekday and weekend, etc. is provided in Table A1 (Annexure A).

Diagram 5-7 Population Areas within the Study Zone



Building/Land Population

5.3.5 The building population within the study zone was estimated by determining the number of buildings in the area. GeoInfo Map by the Lands Department of HKSAR Government, and population data from the Planning Department of HKSAR Government were referenced for this estimate. Relevant information available from the property management website, if any, were also used as reference.

5.3.6 Site surveys were also conducted in December 2025 at various time of the day to supplement where there is uncertainty in the population estimates. For instances:

- On Muk Street Garden (#2) was estimated based on the number of people staying and walking by.
- Heung Yee Kuk Building (#5), which is 3-floor leisure facility was estimated based on the generic building assumption.

- CLP Power Hong Kong Limited Shatin Centre (#7), which is 15-floor multi-purposes of storage / telecommunication / CLP lecture room. Population was estimated based on the building assumption as large size commercial building.
- HSBC Shek Mun Building (#18), which is 12-floors industrial building was estimated based on the building assumption of M size industrial building.
- Shek Mun Playground (#19) was estimated based on the number of people staying and walking by.
- Shing Mun River Walking Path (#28) was estimated based on the number of cyclist people staying and walking by.
- HKCDBA Training Centre (#51) was estimated based on the number of people entering and exiting the site.
- STSA Water Sports Centre (#52) was estimated based on the number of people entering and exiting the site.

Table 5-2 Estimated Existing Building/Land Population within the Study Zone

No	Description	Occupancy Type	Population (2025)
1	Yu Tak Court	Residential	1,629
2	On Muk Street Garden	Recreation	18
3	Towngas Shatin Openyard	Industrial	0
4	Shatin North Offtake and Pigging Station	Industrial	0
5	Heung Yee Kuk Building	Industrial	50
6	Ever Gain Building	Industrial	680
7	CLP Power Hong Kong Limited Shatin Centre	Industrial	400
8	Ever Gain Entre	Industrial	760
9	New Commerce Centre	Industrial	630
10	Technology Park	Industrial	640
11	On Lai Street Car Park	Car Park	1
12	Courtyard By Marriott Hong Kong Sha Tin	Residential	2,096
13	Li Fung Centre	Industrial	600
14	New Trade Plaza Block A	Industrial	504
15	New Trade Plaza Block B	Industrial	528
16	Corporation Park	Industrial	1,500
17	Metropole Square	Industrial	988
18	HSBC Shek Mun Building	Commercial	720
19	Shek Mun Playground	Recreation	20
20	Grandtech Centre	Industrial	966
21	Topsail Plaza	Industrial	840
22	W Luxe	Commercial	960

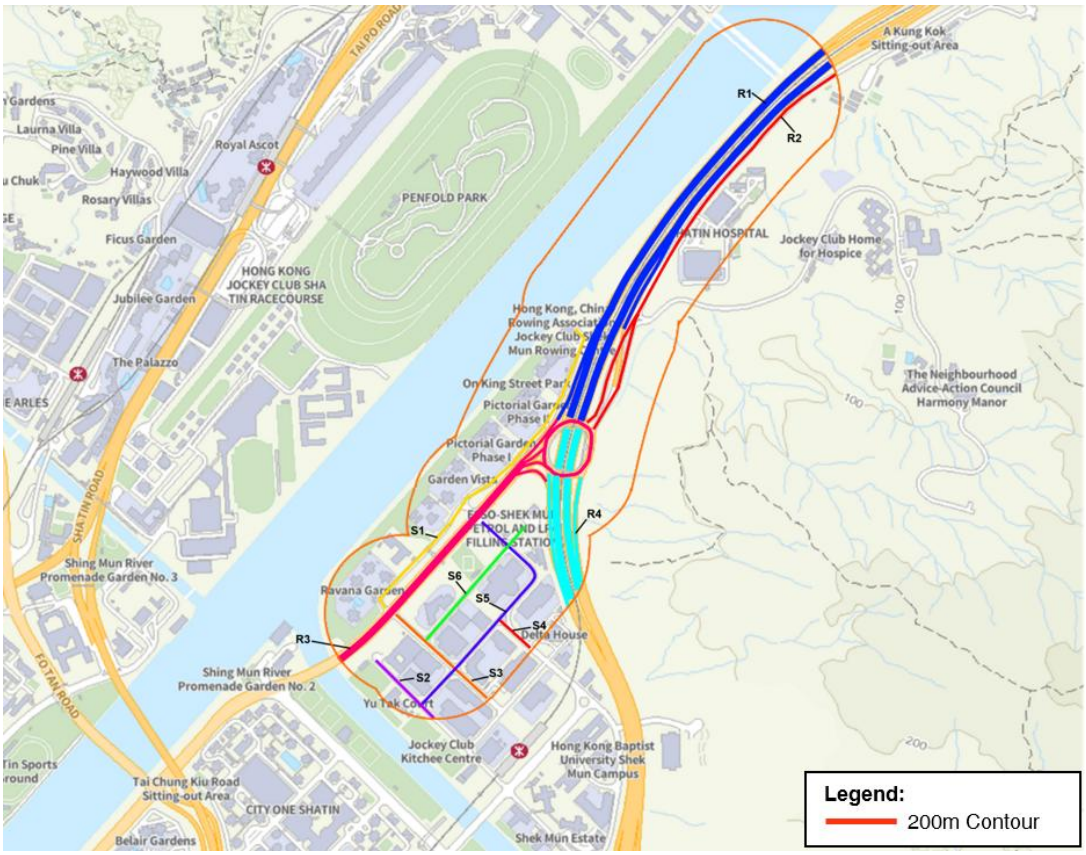
No	Description	Occupancy Type	Population (2025)
23	ESSO Shek Mun	LPG Station	2
24	Water Supplies Department Shek mun Fresh Water Booster Pumping Station	Industrial	0
25	Green @ Sha Tin	Industrial	2
26	CLP Power Hong Kong Limited On Sum Street Substation	Industrial	0
27	Shing Mun River walking path	Recreation	40
28	Ravana Garden Block 1	Residential	720
29	Ravana Garden Block 2	Residential	720
30	Ravana Garden Block 3	Residential	717
31	Ravana Garden Block 4	Residential	642
32	Ravana Garden Block 5	Residential	642
33	Leung Kui Kau Lutheran Primary School	School	956
34	Garden Vista Block A	Residential	264
35	Garden Vista Block B	Residential	264
36	Garden Vista Block C	Residential	264
37	Garden Vista Block D	Residential	624
38	Garden Vista Block E	Residential	624
39	Garden Vista Block F	Residential	480
40	Pictorial Garden Abbey Court	Residential	696
41	Pictorial Garden Believe Court	Residential	696
42	Pictorial Garden Capilano Court	Residential	696
43	Pictorial Garden Delite Court	Residential	312
44	Pictorial Garden Elegant Court	Residential	312
45	Pictorial Garden Forum Court	Residential	624
46	Pictorial Garden Galaxy Court	Residential	624
47	Pictorial Garden Hillview Court	Residential	414
48	Pictorial Garden Iris Court	Residential	414
49	Pictorial Garden Juniper Court	Residential	414
50	HKCDBA Training Centre	Recreation	10
51	STSA Water Sport Centre	Recreation	10
52	Sha Tin Hospital	Hospital	1050
53	STTL626	Residential	0
54	STTL627	Residential	0
55	ClubONE	Commercial	1180

No	Description	Occupancy Type	Population (2025)
56	Car Park	Car Park	1
57	Bowling Green	Recreation	50
58	Siu Lek Yuen Playground Building	Recreation	10
59	Tennis Court	Recreation	20
60	Jockey Club Kitchee Centre Football Field	Recreation	100

Road Population

5.3.7 Traffic data in terms of Annual Average Daily Traffic (AADT) was acquired from the latest Annual Traffic Census (ATC 2024) [2]. For some roads, the traffic data is not available on the ATC. The number of vehicles on these roads was estimated based on the site survey conducted in December 2024.

Diagram 5-8 Traffic Road within the Study Zones



5.3.8 Road population can be estimated using the following equation:

$$Road\ Population = \frac{No.\ of\ Vehicles\ per\ hour * No.\ of\ Persons\ per\ Vehicle * Length\ of\ Road\ within\ Study\ Zone}{Speed}$$

5.3.9 The road population data considered in the assessment is given in Table 5-3 below:

Table 5-3 Road Population

No.	Name	Speed (km/hr)	Daily Vehicle Count (based on AADT 2024)
R1	Tate's Cairn Highway Expressway	70	83,770
R2	A Kung Kok St Local Distributor	50	10,980
R3	Tai Chung Kiu Road Primary Distributor	70	28,400
R4	Tate's Cairn Highway Expressway	70	74,540
S1	On King Street	50	9,072(1)
S2	On Muk Stret	50	2,448(1)
S3	On Lai Street	50	10,656(1)
S4	On Yiu Street	50	9,216(1)
S5	On Sum Street	50	18,288(1)
S6	On Ping Street	50	7,632(1)

(1) AADT Data not available hence road survey has been conducted. It was carried out during afternoon peak hour (5:00pm).

5.3.10 The detailed tabulation of projected road population data, including the distribution of road population between day and night time is provided in Table A2 (Annexure A). Noted that the growth rate estimated for the entire Sha Tin area is negative for the next 10 years (refer to discussion in Section 5.3.1), the traffic data based on AADT 2024 is also applied to Year 2032 case conservatively.

Pedestrian Population

5.3.11 In the estimation of building/land population, an indoor factor of 0.95 was considered for the occupants [1]. The remaining 0.05 of the building/land population is assumed to be outdoors which are essentially the pedestrian population. A detailed tabulation of the projected pedestrian population data is presented in Table A3 (Annexure A). The assumption of indoor factor have already considered that some residents of proposed development will be staying within the proposed retail facilities at a particular timepoint concerned with the assessment.

Transient Population of Tuen Ma Line

5.3.12 As per information from the government document [11], the population of Tuen Ma Line utilizing the Tuen Ma Line during peak hours is 35,700 in each direction. Assuming the peak population for both directions is evenly distributed by all Tuen Ma line stations (28) and the population for an average hour is half of the population during peak hour, the average transient

population for each station would be 1,275 per hour. It is noteworthy that, according to the statistics, the segment exhibiting the highest congestion is between Mei Foo Station and Tsuen Wan West Station, characterized by an 86% loading at 4 passengers per square meter (ppsm). For other stations, it is reasonable to postulate that those serving as interchange hubs, as well as the segments connecting two interchange stations, will experience heightened congestion, particularly the stretch between Tai Wai Station and Mei Foo Station. Consequently, the segment of interest for this project, extending from Wu Kai Sha Station to Shek Mun Station, comprises standard stations catering to local communities. Therefore, utilizing the average population of 1,275 per station per hour is deemed appropriate. With a total of five stations spanning from Wu Kai Sha Station to Shek Mun Station, the maximum transient population for Shek Mun Station is estimated to reach 6,375 per hour. The detailed tabulation of projected transient population data, including the distribution of the transient population between daytime and nighttime, is provided in Table A2 (Annexure A).

5.4 Meteorological Data

5.4.1 The wind speed, wind direction, and atmospheric stability class can affect the dispersion of gas releases as well as the various fire effects to a certain extent. The wind data (day and night) that was used for this QRA is presented in Table 5-4 and 5-5. Meteorological data from Sha Tin Weather Station (2019 to 2023) Observatory has been adopted in this study.

5.4.2 For day-time, six weather conditions are used as representatives for consequence modelling. These are 3B, 1D, 4D, 6D, 1F and 3E. In terms of nomenclature, the number denotes the wind speed in m/s and the letter indicates the Pasquill-Gifford stability class as given below:

A – Turbulent atmosphere

B – Very unstable atmosphere

C – Unstable atmosphere

D – Neutral

E – Stable

F – Very Stable

5.4.3 For night-time, five weather conditions are used as representatives for consequence modelling. These are 1D, 4D, 6D, 1F and 3E.

Table 5-4 Meteorological Data (Day)

Wind Direction	Weather Category - Percentage of Occurrence					
	3B	1D	4D	6D	1F	3E
0 - 30	5.56%	2.64%	1.54%	0.01%	2.62%	0.48%
30 - 60	11.23%	3.10%	3.14%	0.03%	2.51%	0.50%
60 - 90	5.51%	2.06%	1.83%	0.00%	2.94%	0.34%
90 - 120	6.52%	2.05%	2.07%	0.00%	2.58%	0.49%
120 - 150	4.20%	1.16%	1.49%	0.01%	1.27%	0.38%
150 - 180	1.44%	0.66%	0.40%	0.03%	0.94%	0.07%
180 - 210	2.02%	0.70%	0.41%	0.00%	1.16%	0.04%
210 - 240	6.10%	1.05%	5.91%	0.55%	1.25%	0.59%
240 - 270	1.67%	0.33%	1.26%	0.06%	0.53%	0.14%
270 - 300	0.29%	0.17%	0.02%	0.00%	0.45%	0.00%
300 - 330	0.17%	0.15%	0.01%	0.00%	0.53%	0.00%
330 - 360	0.75%	0.55%	0.22%	0.00%	1.06%	0.07%
Total	**45.46%**	**14.62%**	**18.28%**	**0.71%**	**17.83%**	**3.09%**

Table 5-5 Meteorological Data (Night)

Wind Direction [1]	Weather Category - Percentage of Occurrence				
	1D	4D	6D	1F	3E
0 - 30	1.02%	1.03%	0.01%	10.28%	1.38%
30 - 60	0.50%	2.55%	0.12%	9.66%	1.78%
60 - 90	0.37%	1.34%	0.04%	12.08%	1.17%
90 - 120	0.22%	1.21%	0.00%	10.59%	1.29%
120 - 150	0.08%	0.58%	0.01%	5.77%	0.60%
150 - 180	0.04%	0.31%	0.02%	5.07%	0.20%
180 - 210	0.07%	0.25%	0.00%	4.42%	0.22%
210 - 240	0.07%	4.08%	0.03%	5.11%	2.18%
240 - 270	0.10%	1.17%	0.00%	2.75%	0.65%
270 - 300	0.05%	0.01%	0.00%	2.05%	0.01%
300 - 330	0.07%	0.01%	0.00%	2.12%	0.01%
330 - 360	0.21%	0.15%	0.00%	4.66%	0.27%
Total	**2.78%**	**12.68%**	**0.22%**	**74.56%**	**9.76%**

[1] Since there is an extremely low occurrence frequency (~0%) for unstable wind condition (i.e Class A, B and C) in the area, only Class D, E and F at different representative speeds were used for night time.

6 HAZARD IDENTIFICATION

6.1 Properties of Towngas

6.1.1 Towngas is produced from naphtha and natural gas. It is composed mainly of hydrogen, methane, carbon dioxide and carbon monoxide. Towngas is both flammable and toxic. It is also colorless and odorless, making gas leaks difficult to detect. For this reason, a special odorant is added to Towngas. In terms of density, Towngas is lighter than air. Any leak is expected to rise and dissipate into the atmosphere.

6.1.2 The composition and physical properties of Towngas is given in Table 6-1 and Table 6-2 below:

Table 6-1 Chemical Composition of Towngas

Chemical Composition	% by volume
Hydrogen	49%
Methane	28.5%
Carbon Dioxide	19.5%
Carbon Monoxide	3%

Table 6-2 Physical Properties of Towngas

Physical Properties	Value
Calorific Value	17.27 MJ/m^3
Specific Gravity	0.52
Wobbe Index	24
Weaver Flame Speed	35

6.1.3 For HP Towngas pipeline, the design pressure is 35 barg. However, the actual operating pressure in the pipeline fluctuates during the day depending on the demand. As per information from Towngas, the typical operating pressure is presented in

6.1.4 Table 6-3. Note that to be conservative, the modelling has considered the maximum pressure of 35 barg.

Table 6-3 Operating Pressure Towngas HP Pipeline

	08:00-20:00	20:00-08:00
Weekdays	25barg – 34barg	15barg – 25barg

	08:00-20:00	20:00-08:00
Weekends	25barg – 34barg	15barg – 25barg

6.2 Hazards from Towngas

6.2.1 The main hazard from a pressurized gas system is loss of containment leading to unintended release of flammable and explosive materials. This may result in subsequent jet fire, flash fire, fire ball and explosion. However, due to Towngas being buoyant and that the area surrounding the HP pipeline is unobstructed, vapor cloud explosion scenarios are not considered credible in this QRA. This is consistent with previous pipeline QRA in Hong Kong [1].

6.2.2 Towngas is also toxic due to the presence of carbon monoxide and carbon dioxide, both of which are asphyxiants. At high concentrations, carbon dioxide may displace oxygen in the atmosphere which will induce breathing difficulties. A few minutes of exposure to CO2 at concentrations of 70,000 to 100,000 ppm (7-10%) can result in unconsciousness. The Immediately Dangerous to Life or Health (IDLH) concentration for carbon dioxide is 40,000 ppm (4%)[3]. Similarly, carbon monoxide also displaces oxygen, but in the blood. Compared to oxygen, carbon monoxide has a higher affinity for hemoglobin in the blood which makes it easier to bind with the hemoglobin and starve the body of oxygen. A 30-minute exposure to CO at IDLH concentration will cause headaches. In severe cases, CO toxicity may cause impairment of fine motor skills, mental confusion, incoordination, etc. The IDLH for carbon monoxide is 1,200 ppm (0.12%) [4].

7 FREQUENCY ASSESSMENT

7.1 Initiating Event Frequencies

7.1.1 As per the requirement in the Guidance on QRA for HP Towngas Installations in HK [10], the failure frequency to be applied for various equipment in the QRA is summarized below.

Table 7-1 Failure Frequency Database

Equipment	Failure Frequency
Underground piping/ pipeline	1×10^{-5}/km/yr
Aboveground piping/ pipeline	2.67×10^{-7}/m/yr
Valve	1.1×10^{-3}/yr
Flange	1×10^{-3}/yr
Connection	5.7×10^{-4}/yr

7.2 Hole Size Distribution

7.2.1 The hole size distribution adopted in this study is provided below. The distribution is based on the recommendation in Guidance on QRA for HP Towngas Installations in HK [10].

Table 7-2 Overall Distribution by Hole Size

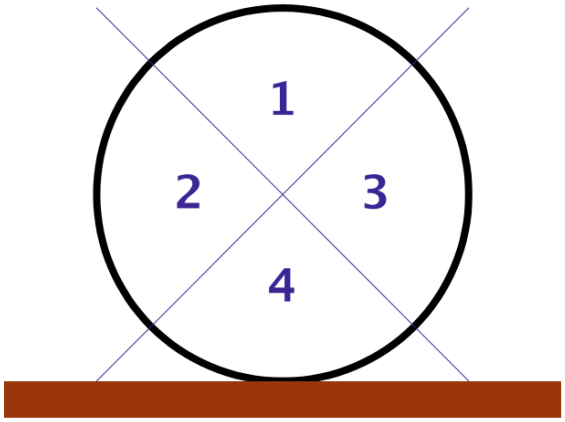
Category	Hole Size (mm)	Distribution (%)
Underground piping/ pipeline	10 mm	20
	25 mm	30
	50 mm	30
	100 mm	19
	Full bore	1
Aboveground piping/ pipeline	10 mm	30
	25 mm	30
	50 mm	25
	100 mm	12
	Full bore	2
Valve	10 mm	100
Flange	10 mm	90
	25 mm	9
	50 mm	1

Category	Hole Size (mm)	Distribution (%)
Connection	10 mm	88.5
	25 mm	11.5

7.3 Orientation of Release

7.3.1 The shape and magnitude of any hazardous events is affected by the release rate and orientation of release. Failures may occur on top, on the sides, or at the bottom of the buried pipeline, as recommended for QRA by OGP[5]. These failures are depicted in Diagram 7-1.

Diagram 7-1 Quadrants of Release Directions



7.3.2 Failures that occur on top of the pipeline (quadrant 1) will result in vertical releases and are governed by momentum jet dispersion / momentum jet fires. Failures that occur on the sides of the pipeline (quadrants 2 and 3) are assumed to be impinged inclined releases, modelled 45° upwards. Failures that occur at the bottom of the pipeline (quadrant 4) lose momentum on impact with the ground. The probability of release orientation considered in this assessment is summarized below. This is in line with the Guidance on QRA for HP Towngas Installations in HK [10].

Table 7-3 Probability of Release Orientation

Category	Vertical	Horizontal	Inclined (45º)
Aboveground piping/ pipeline/ valves/ flanges/ connections	0.5	0.25	0.25
Underground piping/ pipeline	0.5	0	0.5

7.4 Event Tree Analysis

7.4.1 Various hazardous events may arise depending on the release conditions (e.g. instantaneous or continuous release, rainout and vaporisation of the released material) as well as the type of ignition (e.g. immediate or delayed ignition). The frequencies of these undesired outcome events such as flash fire, pool fire, jet fire, etc. were derived using Event Tree Analysis (ETA).

7.4.2 ETA is an analysis technique which identifies different possible outcomes following an initiating event and estimates the probabilities for each of these outcomes. An Event Tree (ET) starts with an initiating event and proceeds by examining each contributing factor in chronological order to identify all possible outcomes. The frequency of event outcome is estimated by multiplying the initiating event frequency and probabilities of all contributing factors leading to the specific hazardous event.

7.4.3 The event tree used in this study is provided in the diagrams below:

Diagram 7-2 Event Trees for Underground HPTGP [10]

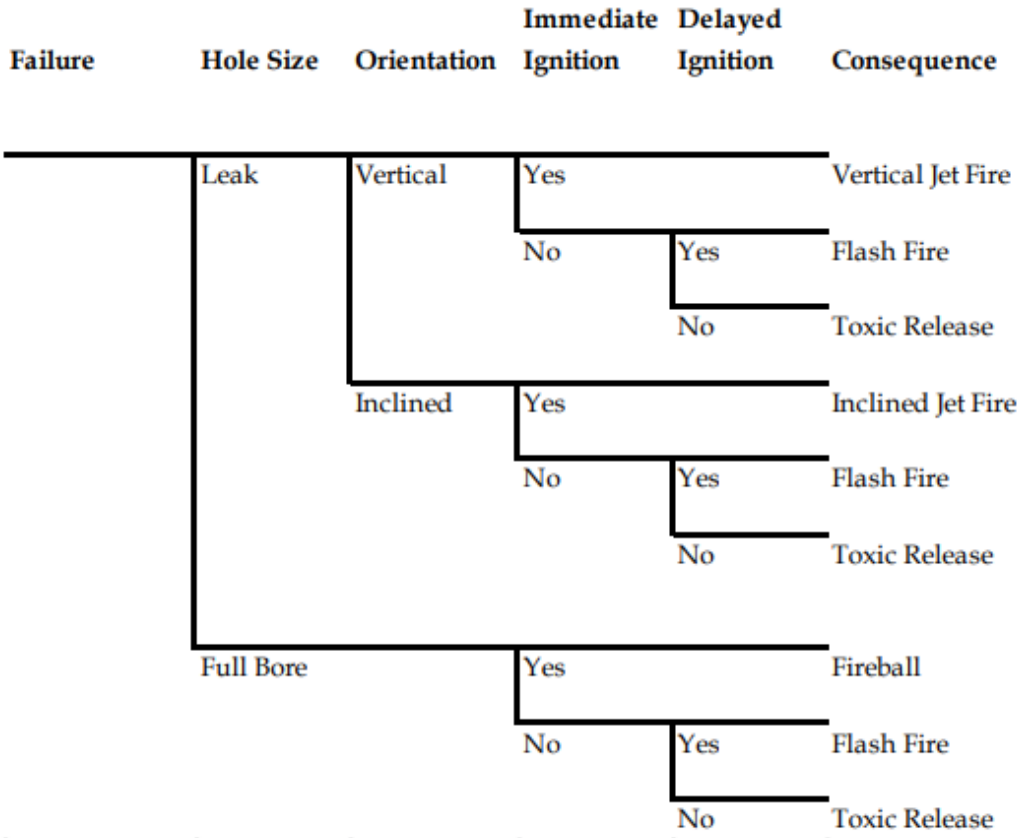
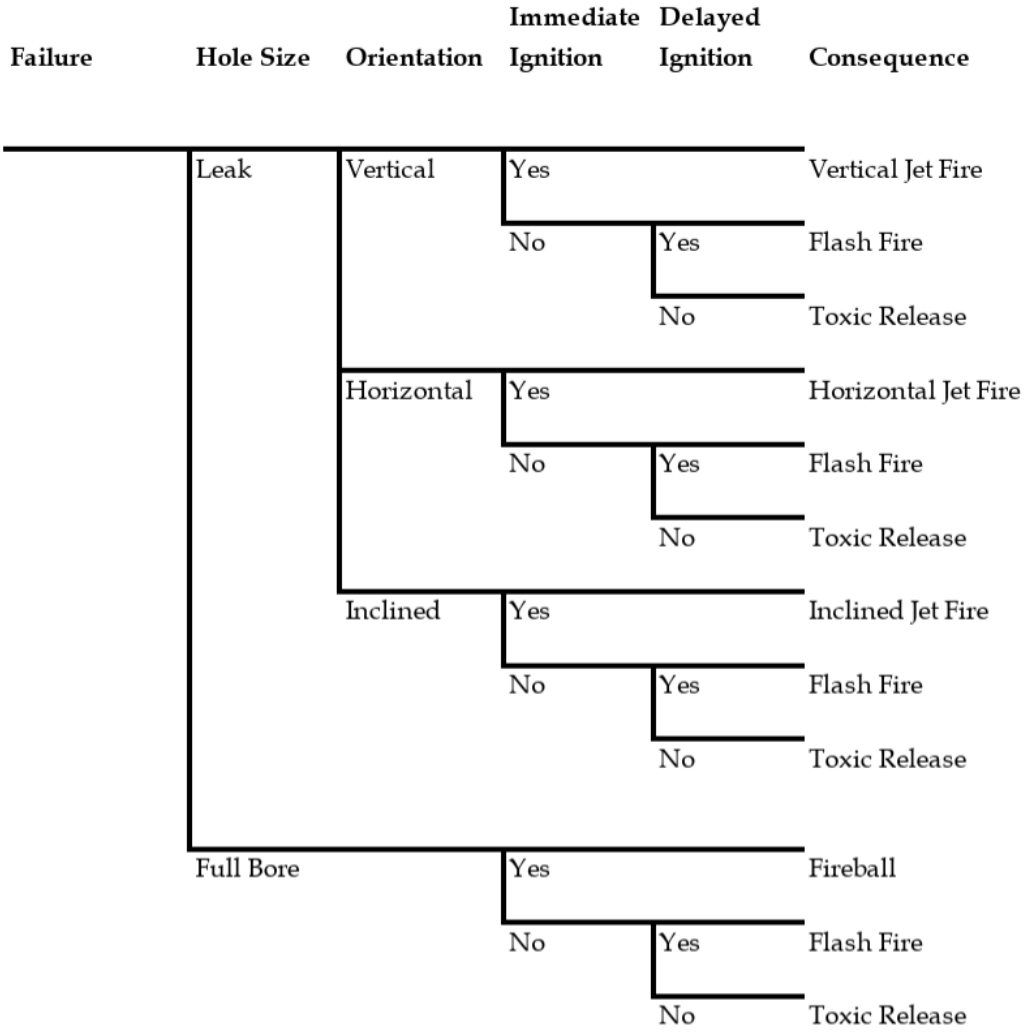


Diagram 7-3 Event Trees for Aboveground HPTGP [10]



7.4.4 The event frequency of each hazardous outcome is provided in Annexure B.

7.5 Ignition Probability

7.5.1 Ignition can be categorized as immediate or delayed ignition. Immediate ignition occurs near the release point before the gas cloud disperses due to presence of ignition sources such as sparks/static while delayed ignition considers drifting of a gas cloud to an ignition source. In the ETA, it is considered that an immediate ignition of the released gas can result in jet fire. For delayed ignition, this can result in a flash fire. In case of no ignition, toxic gas dispersion can occur.

7.5.2 The ignition probability was determined using the Cox, Lees, and Ang Model [6] and are provided in Table 7-4 below.

Table 7-4 Cox, Lees, and Ang Ignition Probability

Leak Size	Total Ignition Probability	
	Gas	Liquid
Minor (1 kg/s)	0.01	0.01
Major (1-50 kg/s)	0.07	0.03
Massive (>50 kg/s)	0.3	0.08

7.5.3 However, the ignition probabilities from the Cox, Lees, and Ang Model are derived from plant releases and gas well blowouts. For areas with open residential areas and high density traffic, the ignition probability will be higher. Therefore, the ignition probabilities given above are taken as the immediate ignition probability. The delayed ignition probability is taken as 0.4 of non-immediate ignition probability. The ignition probabilities (gas) adopted in this study is presented below:

Table 7-5 Adopted Ignition Probability

Leak Size	Probability of Ignition	
	Immediate	Delayed
Minor (1 kg/s)	0.01	0.40
Major (1-50 kg/s)	0.07	0.37
Massive (>50 kg/s)	0.3	0.28

8 CONSEQUENCE ASSESSMENT

Consequence modelling was used to predict the size, shape, and orientation of hazard zones resulting from releases of hazardous materials. Safeti V9.0 was used to perform the consequence modelling.

8.1 Source Term Modelling

8.1.1 Source term or discharge modelling involves the determination of maximum discharge rate, release duration and other physical properties of the released material, such as temperature and pressure. These estimated parameters were then set as the initial conditions for the subsequent dispersion or fire effects modelling.

8.1.2 Note that flammable dispersion and fire effects were modelled assuming methane gas. However, toxic dispersion of Towngas was modelled separately to account for the toxicity of CO.

8.2 Dispersion Modelling

8.2.1 Dispersion modelling involves mathematical simulation of how the released materials disperse in the ambient atmosphere. Downwind and crosswind concentrations were determined to find the gas cloud hazard footprint. Vapor dispersion modelling was conducted using PHAST’s Unified Dispersion Model (UDM). The model considers the following aspects of vapor cloud behavior in dispersion modelling:

- Continuous, instantaneous or time-varying releases;
- Jet, heavy-gas and passive dispersion;
- Elevated, touchdown and ground level dispersion;
- Droplet dispersion, rainout and droplet vaporization; and,
- Dispersion over land or water surfaces.

8.3 Physical Effects Modelling

8.3.1 Physical effect modelling determines the magnitude of damage caused by exposure to fire, heat radiation, toxic, or overpressure. The following possible hazardous outcomes were considered in the QRA:

- Fireball;

- Jet Fire;
- Flash Fire; and,
- Unignited Toxic Release.

Fireball

8.3.2 A fireball can result from an immediate ignition of sudden release of pressurized gas due to rupture of the pipeline. Ignition of the rapidly released materials will form a ball of flame rising rapidly into the air and burning out in a short time. The area of possible direct flame contact effects was determined by the fireball radius.

8.3.3 Due to the transient nature of a release for high pressure condition, the mass of fuel entering the fireball from a high pressure pipeline can be difficult to estimate. One method is to calculate the cumulative quantity of fuel that is consumed in a fireball at each time step based on transient release rate. Numerical modelling was used to calculate the mass released for different burning durations. The size and duration of the fireball can then be estimated by equating the total burning time to the fireball duration.

8.3.4 This process is handled internally within PHAST and the modelled selected is TNO (Yellow Book) method.

Jet Fire

8.3.5 A jet fire results from immediate ignition of the flammable material from a pressurized release. In this study, jet fires were modelled for all pressurized hydrocarbon releases from pipe leaks. The main hazards from a jet fire are direct flame contact and thermal radiation, both of which were modelled using default parameters in Safeti V9.0.

Flash Fire

8.3.6 A flash fire results from delayed ignition of a flammable vapor cloud, generated either through vaporization directly from the release, or from vaporizing pools. The main hazard of a flash fire is direct flame contact.

8.3.7 The area of possible direct flame contact effects is determined as the distance to the lower flammability limit (LFL) of the vapor cloud. All persons outdoor within the flash fire envelope (LFL contour) are assumed to be fatally injured i.e. fatality rate of 100%.

8.3.8 It is important to note that for indoor population, the protection offered by the building structures was accounted for in evaluating the risk to the occupants inside. In line with

previous HK QRA[7], a protection factor of 0.9 was considered for persons indoor for flash fire risk assessment.

Toxic Dispersion

8.3.9 In the event of an unignited release, the dispersed gas may cause toxic effect to people due to the presence of CO in Towngas. Following a loss of containment scenario involving toxic substances (i.e. CO), the resulting toxic gas cloud will disperse with the wind over long distances from the source and cause fatalities to populations at downwind locations.

8.4 End Point Criteria

8.4.1 Probit functions were used to estimate the probability of fatality due to a physical effect, e.g. thermal radiation, etc.

Flash Fires

8.4.2 All persons outdoor within the flash fire envelope (LFL contour) were assumed to be fatally injured i.e. fatality rate of 100%.

Thermal Radiation

8.4.3 The main hazard for jet fire and fireball is personnel being exposed to the thermal radiation. The probability of fatality due to the exposure to thermal radiation can be calculated with the probit equation in the following form:

$$\mathrm{Pr} = -36.38 + 2.56 \times \ln(Q^{4/3} \times t)$$

Where,

Pr is the probit;

$\boldsymbol{Q}$ is the heat radiation (Wm^{-2}); and

$\boldsymbol{t}$ is the exposure time (s).

8.4.4 While both pool fire and jet fire scenarios in this study are expected to last for some duration, the exposure time, t, is limited to a maximum of 20s. This is considered a reasonable time for an able person to seek shelter from the fire. For the thermal radiation effects, an indoor protection factor of 0.9 was additionally considered [1][7].

Toxic Effects

8.4.5 The probability of fatality due to exposure to toxic CO can be calculated with the following probit equation, as shown in Safeti V9.0's built-in toxic probit for CO:

$$Pr = -7.21 + \ln(Ct)$$

Where:

Pr is the probit;

C is the gas concentration (ppm); and,

t is the exposure time (min).

8.5 Protection from Fireball Event

Height Protection Factor

8.5.1 Depending on the extent of the consequential impact distance, not all hazardous events can affect populations situated at higher elevations. The following equation [12] is used to calculate the lift-off height for fireball:

$$Lift\ off\ height\ for\ fireball\ (m) = 10 * Flame\ duration\ (s)$$

8.5.2 The fireball flame duration is calculated to be 7.6 seconds based on the output from Phast V9.0. As such, the estimated maximum elevation is about 76 meters. Consequently, populations residing above this elevation will be excluded from the modelling. In relation to the proposed development, the floor height is assumed to be 3.15 meters per floor.

Fireball Shielding Factor

8.5.3 For Fireball assessment, a shielding factor of 0.5 was considered for people inside buildings, which are assessed to be within the impact zone but have no direct line-of-sight to the fireball. In line with previous HK QRAs [1][7], However, no shielding factor was considered for outdoor population.

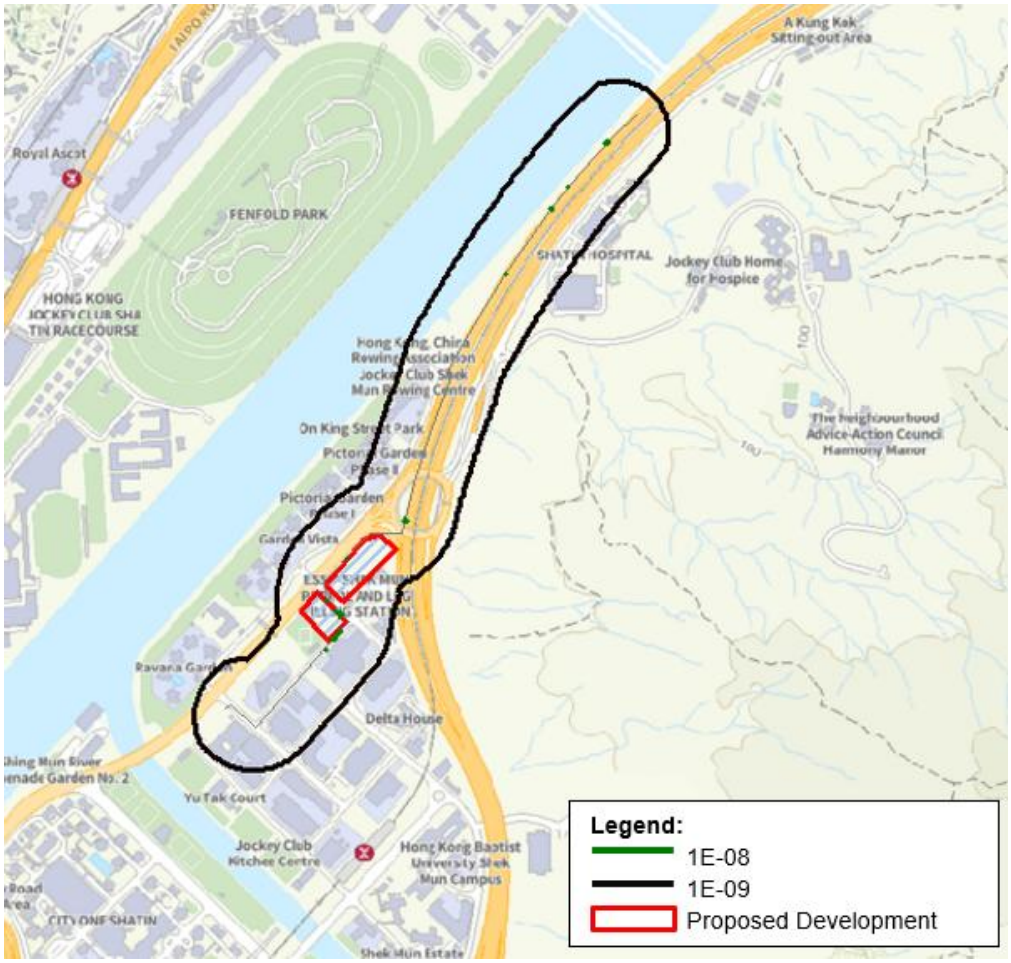
9 RISK SUMMATION

The calculation and summation of the risk associated with HP Towngas pipelines and Shatin North Offtake and Pigging Station to the nearby buildings and outdoor population were performed using the Safeti V9.0. The risk results have been expressed in terms of individual risk and societal risk, in the form of F-N curve, for comparison against the risk criteria as stated in Annex 4 of TM of EIAO[8].

9.1 Individual Risk (IR)

9.1.1 The individual risk contours for HP Towngas Pipeline are illustrated in Diagram 9-1, Shatin North Offtake and Pigging Station in Diagram 9-2 and the combined IR results in Diagram 9-3.

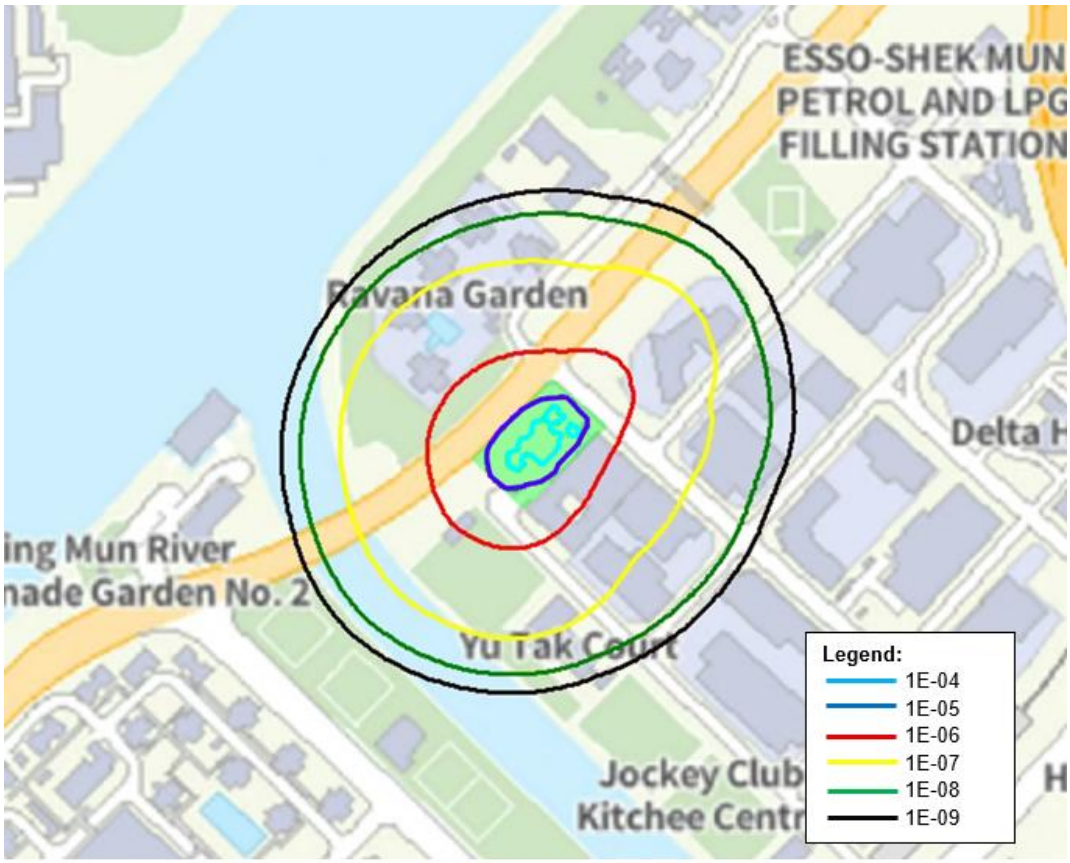
Diagram 9-1 Individual Risk Contour for HP Towngas Pipeline



9.1.2 As shown only for the underground pipeline, the 1 x 10^{-9} per year IR contour is roughly in line with the 200m study zone and the 1 x 10^{-8} per year IR contour is roughly spot on

the path of the pipeline. The maximum IR from the HP pipeline to the proposed development site is limited to the order of 10^{-8} per year only and the overall maximum IR is less than 1 x 10^{-7} per year, the IR criteria defined in Hong Kong risk guidelines can be considered to be met.

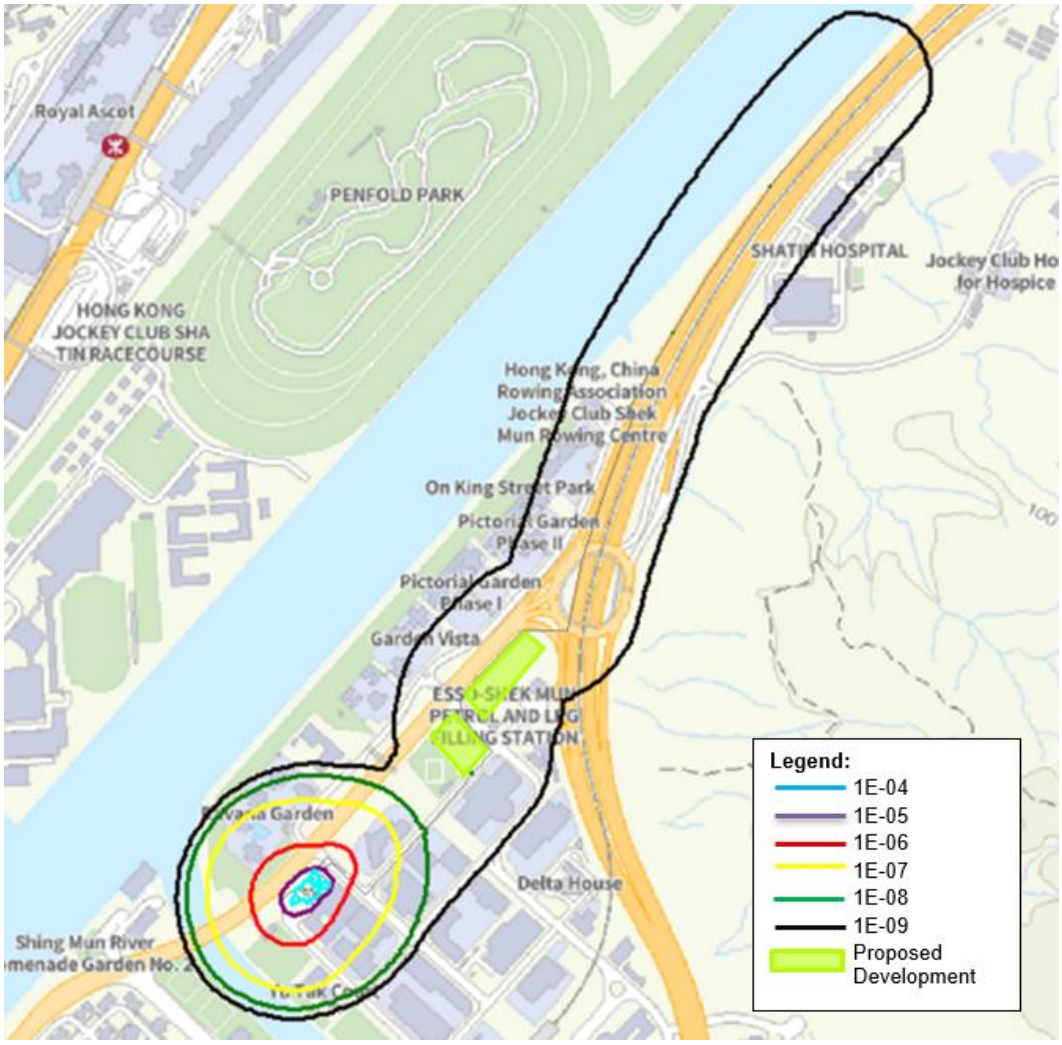
Diagram 9-2 Individual Risk Contour for Shatin North Offtake and Pigging Station



9.1.3 As such, the maximum IR from the station is observed to be in the range of 10-4 per year but is limited to the center of the station. The 1 x 10^{-5} per year IR is confined within the site boundary, hence meeting the Hong Kong risk guidelines. The extent of the 1 x 10^{-9} per year IR from the station is confirmed within 180m from the station boundary. As such, it can be concluded that there is no significant impact from the station to the proposed development site, which is more than 200m away.

9.1.4 Overall, from an Individual Risk (IR) point of view, there are no further mitigation measures required regarding the proposed development. Furthermore, the proposed development will not increase the IR results from the existing pipeline/ station.

Diagram 9-3 Combined Individual Risk Contour for Pipeline and Station



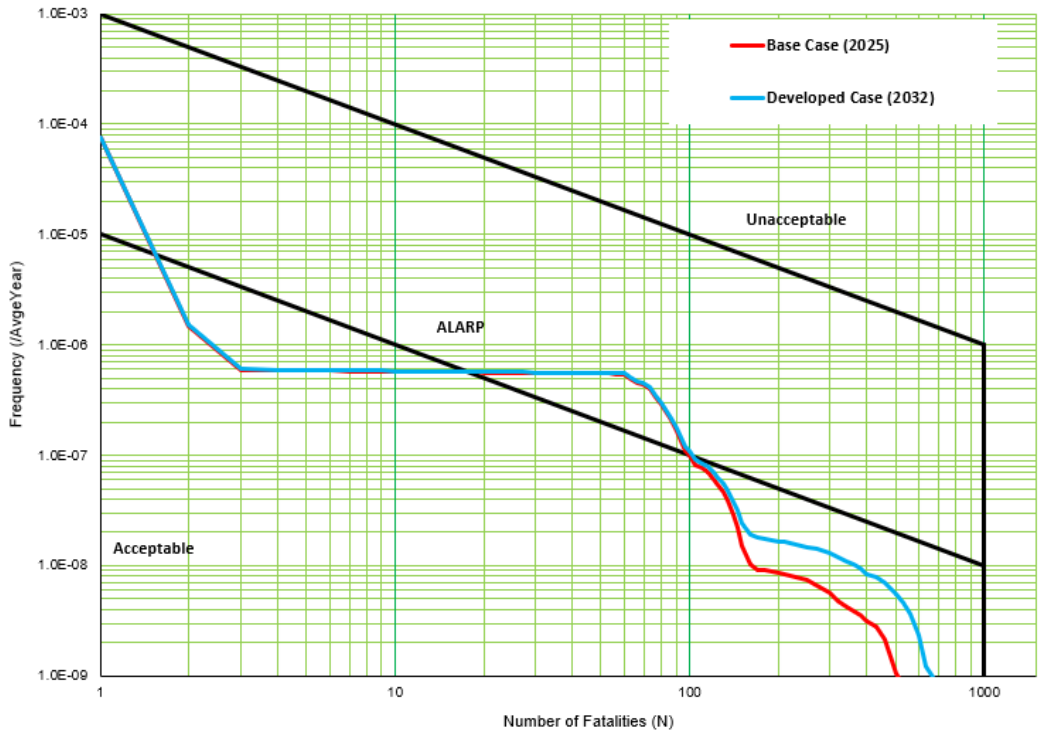
9.2 Societal Risk (SR)

9.2.1 The F-N results (combining both HP Pipeline and Shatin North Offtake and Pigging Station) for this project are shown in Diagram 9-4. As can be seen, the FN curve for both Base Case (2025) and Developed Case (2032) are mainly within the acceptable region of the criteria. For the region of fatality less than 2 as well as the region between 20 and 100, the FN curves for both cases are in the low to middle ALARP region. Note that for the region of fatality of up to 100, the FN curve for Developed Case (2032) is same as that for Base Case (2025). This means this part of the risk is due to the existing population around the pipeline and station and no further mitigation measure is required.

9.2.2 For region beyond fatality of 100, the FN curve of the Developed Case (2032) is higher than that of Base Case (2025). Note that this part of the FN curve is within the acceptable region of the criteria. Also, the maximum fatalities (at 1 x 10^{-9} per year) has increased from 500 to 650 and is less than 1,000 people criteria.

9.2.3 Overall, from a Societal Risk (SR) point of view, there are no further mitigation measures required regarding the proposed development.

Diagram 9-4 Combined FN Curve Result for Pipeline and Station



9.3 PLL Distribution

9.3.1 The top PLL distributions for this project are presented in the following table.

Table 9-1 Top PLL Distribution

Scenarios	Outcome	PLL	
		/year	%
50mm Leak from Aboveground Pipeline in offtake station	Toxic	6.01E-05	46.1
Rupture of Aboveground Pipeline in offtake station	Fireball	4.55E-05	34.8
25mm Leak from Aboveground Pipeline in offtake station	Toxic	1.59E-05	12.2
Rupture of HP Underground Pipeline	Fireball	8.47E-06	6.5
Others		5.10E-07	0.4
Total		1.30E-04	100

9.3.2 In the above table, the top 4 scenarios account for 99.6% of overall PLL. Of these, scenarios originating from the offtake station contribute up to 93.1%, while those from the underground pipeline contribute 6.5%. The predominant risk scenario at the offtake station is toxic release, representing 58.3% of the overall PLL. This is followed by fireball incidents, which contribute 34.8%. For the underground pipeline, the principal risk scenario is fireball. Other scenarios, such as fires from the underground system at the offtake station or fire/toxic releases from underground pipeline are negligible, collectively accounting for only 0.4% of the overall PLL.

10 CONCLUSIONS

10.1.1 A Quantitative Risk Assessment was conducted for the underground Towngas high pressure pipeline in Shek Mun, New Territories as well as Shatin North Offtake and Pigging Station to assess the risks associated with the proposed residential development which will be located in the vicinity of the pipelines. The assessment has considered the surrounding building population, traffic population, and future occupants of the residential development at appropriate stages of the project.

10.1.2 Although an existing Petrol-cum-LPG Filling Station is located adjacent to the development sites, according to correspondence with EEB, the LPG facilities of this station will be decommissioned and there will be no LPG supply at this station after 31 Jan 2029. Therefore, this QRA was conducted based on a no-LPG scenario.

10.1.3 Based on the results, the maximum individual risk within the offtake station is below 1 x 10^{-3} per year. At boundary of the offtake station, the maximum individual risk remains below 1 x 10^{-5} per year. Furthermore, the maximum individual risk associated with both high pressure pipeline and the proposed project site is below 1 x 10^{-7} per year. Therefore, in terms of individual risk, the project has met the requirements defined in Hong Kong risk guidelines and no mitigation measures are necessary.

10.1.4 The societal risk assessment for the Based Case and Developed Case are the same for the region of fatality less than 100, which implied that this part of the risk is due to the existing population around the pipeline and station. The societal risk assessment for the 2 assessment cases are within the acceptable region for the region beyond fatality of 100. Moreover, the maximum fatality for both cases are less than 1,000 people at 1 x 10^{-9} per year. Therefore, in terms of societal risk, the project has met the requirements defined in Hong Kong risk guidelines and no mitigation measures are necessary.

10.1.5 Nevertheless, caution shall be observed when excavating the area surrounding the pipeline to prevent causing damage, and the minimum pipeline clearance shall be maintained for future maintenance in accordance with the code of practice [9] and any recommendation by the gas pipeline operator.

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[9] Avoidance of Damage to Gas Pipes, Code of Practice, 2nd Edition, Gas Authority EMSD, 2018

[10] Guideline Note on Quantitative Risk Assessment Study for High Pressure Town Gas Installations in Hong Kong, EMSD, April 2021

[11] Review of the initial responses from budget control officers to the preliminary questions of expenditure budget from Legislative Council members for the 2024-25 fiscal years, report no. TLB-2-cl.docx, 2024

[12] D A Lihou and J K Maund, Thermal Radiation Hazard from Fireballs, I. Chem. E. Symposium Series No. 71

Appendix

ANNEXURE A

Population Data

Table A1: Building/Land Population Data

ID	Description	Population		Indoor Ratio	%Occupancy				Population in 2025			
		2025	2032		Weekday Day	Weekday Night	Weekend Day	Weekend Night	Weekday Day	Weekday Night	Weekend Day	Weekend night
1	Yu Tak Court	1629	1629	0.95	0.5	1	0.7	1	815	1629	1140	1629
2	On Muk Street Garden	18	18	0	1	0.1	0.4	0.05	18	2	7	1
3	Towngas Shatin Openyard	0	0	0.5	1	0	1	0	0	0	0	0
4	Towngas Pigging Station	0	0	0.95	1	0	1	0	0	0	0	0
5	Heung Yee Kuk Building	50	50	0.95	1	0.1	1	0.1	50	5	50	5
6	Ever Gain Building	680	680	0.95	1	0.1	1	0.1	680	68	680	68
7	CLP Building	400	400	0.95	1	0.1	1	0.1	400	40	400	40
8	Ever Gain Centre	760	760	0.95	1	0.1	1	0.1	760	76	760	76
9	New Commerce Centre	630	630	0.95	1	0.1	1	0.1	630	63	630	63
10	Technology Park	640	640	0.95	1	0.1	1	0.1	640	64	640	64
11	On Lai Street Car Park	1	1	0.5	0.7	0.1	0.7	0.1	1	0	1	0
12	Courtyard by Marriott Hong Kong Sha Tin	2096	2096	0.95	0.5	0.9	0.8	0.9	1048	1886	1677	1886
13	Li Fung Centre	600	600	0.95	1	0.1	1	0.1	600	60	600	60
14	New Trade Plaza Block A	504	504	0.95	1	0.1	1	0.1	504	50	504	50
15	New Trade Plaza Block B	528	528	0.95	1	0.1	1	0.1	528	53	528	53
16	Corporation Park	1500	1500	0.95	1	0.1	1	0.1	1500	150	1500	150
17	Metropole Square	988	988	0.95	1	0.1	1	0.1	988	99	988	99
18	HSBC Shek Mun Building	720	720	0.95	1	0.1	1	0.1	720	72	720	72
19	Shek Mun Playground	20	20	0.5	1	0.1	1	0.1	20	2	20	2
20	Grandtech Centre	966	966	0.95	1	0.1	1	0.1	966	97	966	97

ID	Description	Population		Indoor Ratio	%Occupancy				Population in 2025			
		2025	2032		Weekday Day	Weekday Night	Weekend Day	Weekend Night	Weekday Day	Weekday Night	Weekend Day	Weekend night
21	Topsail Plaza	840	840	0.95	1	0.1	1	0.1	840	84	840	84
22	W luxe	960	960	0.95	1	0.1	1	0.1	960	96	960	96
23	ESSO Shek Mun	2	2	0.5	0.5	0.01	0.5	0.01	1	0	1	0
24	Water Supplies Department Shek mun Fresh Water Booster Pumping Station	0	0	0.95	1	0	1	0	0	0	0	0
25	Green @ Sha Tin	2	2	0.95	1	0	1	0	0	0	0	0
26	CLP Power Hong Kong Limited On Sum Street Substation	0	0	0.95	1	0	1	0	0	0	0	0
27	Shing Mun River walking path	40	40	0.5	1	0.2	1	0.2	40	8	40	8
28	Ravana Garden Block 1	720	720	0.95	0.5	1	0.7	1	360	720	504	720
29	Ravana Garden Block 2	720	720	0.95	0.5	1	0.7	1	360	720	504	720
30	Ravana Garden Block 3	717	717	0.95	0.5	1	0.7	1	359	717	502	717
31	Ravana Garden Block 4	642	642	0.95	0.5	1	0.7	1	321	642	449	642
32	Ravana Garden Block 5	642	642	0.95	0.5	1	0.7	1	321	642	449	642
33	Leung Kui Kau Lutheran Primary School	956	956	0.95	1	0.1	0.3	0.1	956	96	287	96
34	Garden Vista Block A	264	264	0.95	0.5	1	0.7	1	132	264	185	264
35	Garden Vista Block B	264	264	0.95	0.5	1	0.7	1	132	264	185	264
36	Garden Vista Block C	264	264	0.95	0.5	1	0.7	1	132	264	185	264
37	Garden Vista Block D	624	624	0.95	0.5	1	0.7	1	312	624	437	624
38	Garden Vista Block E	624	624	0.95	0.5	1	0.7	1	312	624	437	624
39	Garden Vista Block F	480	480	0.95	0.5	1	0.7	1	240	480	336	480

ID	Description	Population		Indoor Ratio	%Occupancy				Population in 2025			
		2025	2032		Weekday Day	Weekday Night	Weekend Day	Weekend Night	Weekday Day	Weekday Night	Weekend Day	Weekend night
40	Pictorial Garden Abbey Court	696	696	0.95	0.5	1	0.7	1	348	696	487	696
41	Pictorial Garden Believe Court	696	696	0.95	0.5	1	0.7	1	348	696	487	696
42	Pictorial Garden Capilano Court	696	696	0.95	0.5	1	0.7	1	348	696	487	696
43	Pictorial Garden Delite Court	312	312	0.95	0.5	1	0.7	1	156	312	218	312
44	Pictorial Garden Elegant Court	312	312	0.95	0.5	1	0.7	1	156	312	218	312
45	Pictorial Garden Forum Court	624	624	0.95	0.5	1	0.7	1	312	624	437	624
46	Pictorial Garden Galaxy Court	624	624	0.95	0.5	1	0.7	1	312	624	437	624
47	Pictorial Garden Hillview Court	414	414	0.95	0.5	1	0.7	1	207	414	290	414
48	Pictorial Garden Iris Court	414	414	0.95	0.5	1	0.7	1	207	414	290	414
49	Pictorial Garden Juniper Court	414	414	0.95	0.5	1	0.7	1	207	414	290	414
50	HKCDBA Training Centre	20	20	0.95	0.7	0.25	1	0.25	14	5	20	5
51	STSA Water Sports Centre	20	20	0.95	0.7	0.25	1	0.25	14	5	20	5
52	Sha Tin Hospital	1050	1050	0.95	1	0.5	1	0.5	1050	525	1050	525
53	ClubONE	1180	1180	0.95	0.083	0.083	0.133	0.133	98	98	157	157
54	Car Park	1	1	0	0.7	0.1	0.7	0.1	1	1	1	1
55	Bowling Green	50	50	0	0.5	0.1	0.7	0.1	25	5	35	5
56	Siu Lek Yuen Playground washrom	10	10	0.95	1	0.1	1	0.1	10	1	10	1
57	Tennis Court	20	20	0	1	0.1	1	0.1	20	2	20	2
58	Jockey Club Kitchee Centre Football Field	100	100	0	0.25	0.25	1	0.25	25	25	100	25
New Development												
59	STTL626											

ID	Description	Population		Indoor Ratio	%Occupancy				Population in 2025			
		2025	2032		Weekday Day	Weekday Night	Weekend Day	Weekend Night	Weekday Day	Weekday Night	Weekend Day	Weekend night
A	STTL626 Residential	0	2670	0.95	0.5	1	0.7	1	0	0	0	0
B	Integrated Children and Youth Service Centre (ICYSC)	0	65	0.95	0.62	0	0.62	0	0	0	0	0
C1	Residential Care Home For the Elderly (RCHE)	0	155	0.95	1	0.74	1	0.74	0	0	0	0
C2	Day Care Unit for the Elderly (DCU)	0	37	0.95	1	0	1	0	0	0	0	0
D	Care and Attention Home for Severely Disabled Persons (C&A/SD)	0	88	0.95	1	0.68	1	0.68	0	0	0	0
E	Retail	0	25	0.95	0.5	0.1	1	0.1	0	0	0	0
Total population of STTL626		0	3040	0.95	-	-	-	-	0	0	0	0
60	STTL627											
A	STTL627 Residential	0	1290	0.95	0.5	1	0.7	1	0	0	0	0
B	Neighbourhood Elderly Centre (NEC)	0	65	0.95	0.62	0	0.62	0	0	0	0	0
C	Hostel for Severely Mentally Handicapped Persons (HSMH)	0	84	0.95	1	0.7	1	0.7	0	0	0	0
D	Day Activity Centre (DAC)	0	67	0.95	0.63	0	0.63	0	0	0	0	0
E	Retail	0	25	0.95	0.5	0.1	1	0.1	0	0	0	0
Total population of STTL627		0	1531	0.95	-	-	-	-	0	0	0	0

Table A1: Building/Land Population Data (cont’d)

ID	Description	Population in 2032			
		Weekday Day	Weekday Night	Weekend Day	Weekend Night
1	Yu Tak Court	815	1629	1140	1629
2	On Muk Street Garden	18	2	7	1
3	Towngas Shatin Openyard	0	0	0	0
4	Towngas Pigging Station	0	0	0	0
5	Heung Yee Kuk Building	50	5	50	5
6	Ever Gain Building	680	68	680	68
7	CLP Building	400	40	400	40
8	Ever Gain Centre	760	76	760	76
9	New Commerce Centre	630	63	630	63
10	Technology Park	640	64	640	64
11	On Lai Street Car Park	1	0	1	0
12	Courtyard by Marriott Hong Kong Sha Tin	1048	1886	1677	1886
13	Li Fung Centre	600	60	600	60
14	New Trade Plaza Block A	504	50	504	50
15	New Trade Plaza Block B	528	53	528	53
16	Corporation Park	1500	150	1500	150
17	Metropole Square	988	99	988	99
18	HSBC Shek Mun Building	720	72	720	72
19	Shek Mun Playground	20	2	20	2

ID	Description	Population in 2032			
		Weekday Day	Weekday Night	Weekend Day	Weekend Night
20	Grandtech Centre	966	97	966	97
21	Topsail Plaza	840	84	840	84
22	W luxe	960	96	960	96
23	ESSO Shek Mun	1	0	1	0
24	Water Supplies Department Shek mun Fresh Water Booster Pumping Station	0	0	0	0
25	Green @ Sha Tin	0	0	0	0
26	CLP Power Hong Kong Limited On Sum Street Substation	0	0	0	0
27	Shing Mun River walking path	40	8	40	8
28	Ravana Garden Block 1	360	720	504	720
29	Ravana Garden Block 2	360	720	504	720
30	Ravana Garden Block 3	359	717	502	717
31	Ravana Garden Block 4	321	642	449	642
32	Ravana Garden Block 5	321	642	449	642
33	Leung Kui Kau Lutheran Primary School	956	96	287	96
34	Garden Vista Block A	132	264	185	264
35	Garden Vista Block B	132	264	185	264
36	Garden Vista Block C	132	264	185	264
37	Garden Vista Block D	312	624	437	624
38	Garden Vista Block E	312	624	437	624

ID	Description	Population in 2032			
		Weekday Day	Weekday Night	Weekend Day	Weekend Night
39	Garden Vista Block F	240	480	336	480
40	Pictorial Garden Abbey Court	348	696	487	696
41	Pictorial Garden Believe Court	348	696	487	696
42	Pictorial Garden Capilano Court	348	696	487	696
43	Pictorial Garden Delite Court	156	312	218	312
44	Pictorial Garden Elegant Court	156	312	218	312
45	Pictorial Garden Forum Court	312	624	437	624
46	Pictorial Garden Galaxy Court	312	624	437	624
47	Pictorial Garden Hillview Court	207	414	290	414
48	Pictorial Garden Iris Court	207	414	290	414
49	Pictorial Garden Juniper Court	207	414	290	414
50	HKCDBA Training Centre	14	5	20	5
51	STSA Water Sports Centre	14	5	20	5
52	Sha Tin Hospital	1050	525	1050	525
55	ClubONE	98	98	157	157
56	Car Park	1	1	1	1
57	Bowling Green	25	5	35	5
58	Siu Lek Yuen Playground washrom	10	1	10	1
59	Tennis Court	20	2	20	2
60	Jockey Club Kitchee Centre Football Field	25	25	100	25
New Development					

ID	Description	Population in 2032			
		Weekday Day	Weekday Night	Weekend Day	Weekend Night
53	STTL626				
A	STTL626 Residential	1335	2670	1335	2670
B	Integrated Children and Youth Service Centre (ICYSC)	40	0	40	0
C1	Residential Care Home For the Elderly (RCHE)	155	114	155	114
C2	Day Care Unit for the Elderly (DCU)	37	0	37	0
D	Care and Attention Home for Severely Disabled Persons (C&A/SD)	88	60	88	60
E	Retail	13	3	25	3
Total population of STTL626		1668	2846	2214	2846
54	STTL627				
A	STTL627 Residential	645	1290	903	1290
B	Neighbourhood Elderly Centre (NEC)	40	0	40	0
C	Hostel for Severely Mentally Handicapped Persons (HSMH)	84	59	84	59
D	Day Activity Centre (DAC)	42	0	42	0
E	Retail	13	3	25	3
Total population of STTL627		824	1351	1094	1351

Table A2: Road Population Data

No	Name	Length (km)	Speed (km/hr)	2025		2032	
				Day	Night	Day	Night
R1	Tate’s Cairn Highway Expressway	1.05	70	81	36	81	36
R2	A Kung Kok St, Local Distributor	1.05	50	15	7	15	7
R3	Tai Chung Kiu Rd, Primary Distributor	1.09	70	29	13	29	13
R4	Tate’s Cairn Highway Expressway	0.44	70	30	14	30	14
S1	On King Street	0.82	70	175	22	175	22
S2	On Muk Street	0.20	50	13	1	13	1
S3	On Lai Street	0.29	50	56	7	56	7
S4	On Yiu Street	0.12	50	18	2	18	2
S5	On Sum Street	0.51	50	61	10	61	10
S6	On Ping Street	0.36	50	49	6	49	6
-	MTR line	1.52	60	167	98	167	98

Table A3: Pedestrian Population Data

ID	Description	Population	
		2025	2032
1	Yu Tak Court	81	81
2	On Muk Street Garden	1	1
3	Towngas Shatin Openyard	0	0
4	Towngas Pigging Station	0	0
5	Heung Yee Kuk Building	3	3
6	Ever Gain Building	34	34
7	CLP Building	20	20
8	Ever Gain Centre	38	38
9	New Conmerce Centre	32	32
10	Technology Park	32	32
11	On Lai Street Car Park	0	0
12	Courtyard by Marriott Hong Kong Sha Tin	105	105
13	Li Fung Centre	30	30
14	New Trade Plaza Block A	25	25
15	New Trade Plaza Block B	26	26
16	Corporation Park	75	75
17	Metropole Square	49	49
18	HSBC Shek Mun Building	36	36
19	Shek Mun Playground	1	1
20	Grandtech Centre	48	48
21	Topsail Plaza	42	42

ID	Description	Population	
		2025	2032
22	W luxe	48	48
23	ESSO Shek Mun	0	0
24	Water Supplies Department Shek mun Fresh Water Booster Pumping Station	0	0
25	Green @ Sha Tin	0	0
26	CLP Power Hong Kong Limited On Sum Street Substation	0	0
27	Shing Mun River walking path	2	2
28	Ravana Garden Block 1	36	36
29	Ravana Garden Block 2	36	36
30	Ravana Garden Block 3	36	36
31	Ravana Garden Block 4	32	32
32	Ravana Garden Block 5	32	32
33	Leung Kui Kau Lutheran Primary School	48	48
34	Garden Vista Block A	13	13
35	Garden Vista Block B	13	13
36	Garden Vista Block C	13	13
37	Garden Vista Block D	31	31
38	Garden Vista Block E	31	31
39	Garden Vista Block F	24	24
40	Pictorial Garden Abbey Court	35	35
41	Pictorial Garden Believe Court	35	35
42	Pictorial Garden Capilano Court	35	35

ID	Description	Population	
		2025	2032
43	Pictorial Garden Delite Court	16	16
44	Pictorial Garden Elegant Court	16	16
45	Pictorial Garden Forum Court	31	31
46	Pictorial Garden Galaxy Court	31	31
47	Pictorial Garden Hillview Court	21	21
48	Pictorial Garden Iris Court	21	21
49	Pictorial Garden Juniper Court	21	21
50	HKCDBA Training Centre	0	0
51	STSA Water Sports Centre	0	0
52	Sha Tin Hospital	53	53
53	STTL626	0	134
54	STTL627	0	65
55	ClubONE	59	59
56	Car Park	0	0
57	Bowling Green	3	3
58	Siu Lek Yuen Playground washrom	1	1
59	Tennis Court	1	1
60	Jockey Club Kitchee Centre Football Field	5	5

ANNEXURE B

Event Frequency

Table B1: Event Frequency

Scenario Tag	Failure Frequency (per year)	Event Frequency (per year)			
		JF	FF	FB	Toxic
AG_ST_010_H	1.12E-01	1.12E-03	4.45E-02	-	6.68E-02
AG_ST_025_H	8.56E-03	5.99E-04	3.18E-03	-	4.78E-03
AG_ST_050_H	9.56E-04	6.69E-05	3.56E-04	-	5.34E-04
AG_ST_100_H	2.63E-06	1.84E-07	9.77E-07	-	1.47E-06
AG_ST_010_A	1.12E-01	1.12E-03	4.45E-02	-	6.68E-02
AG_ST_025_A	8.56E-03	5.99E-04	3.18E-03	-	4.78E-03
AG_ST_050_A	9.56E-04	6.69E-05	3.56E-04	-	5.34E-04
AG_ST_100_A	2.63E-06	1.84E-07	9.77E-07	-	1.47E-06
AG_ST_010_V	2.25E-01	2.25E-03	8.91E-02	-	1.34E-01
AG_ST_025_V	1.71E-02	1.20E-03	6.37E-03	-	9.55E-03
AG_ST_050_V	1.91E-03	1.34E-04	7.11E-04	-	1.07E-03
AG_ST_100_V	5.25E-06	3.68E-07	1.95E-06	-	2.93E-06
AG_ST_RUP_R	1.75E-06	-	4.90E-07	5.25E-07	7.36E-07
UG_ST_010_A	3.05E-07	3.05E-09	1.21E-07	-	1.81E-07
UG_ST_025_A	4.58E-07	3.20E-08	1.70E-07	-	2.55E-07
UG_ST_050_A	4.58E-07	3.20E-08	1.70E-07	-	2.55E-07
UG_ST_100_A	2.90E-07	2.03E-08	1.08E-07	-	1.62E-07
UG_ST_010_V	3.05E-07	3.05E-09	1.21E-07	-	1.81E-07
UG_ST_025_V	4.58E-07	3.20E-08	1.70E-07	-	2.55E-07
UG_ST_050_V	4.58E-07	3.20E-08	1.70E-07	-	2.55E-07
UG_ST_100_V	2.90E-07	2.03E-08	1.08E-07	-	1.62E-07
UG_ST_RUP_R	3.05E-08	-	8.54E-09	9.15E-09	1.28E-08
UG_PL_010_A	1.60E-06	1.60E-08	6.34E-07	-	9.50E-07
UG_PL_025_A	2.40E-06	1.68E-07	8.93E-07	-	1.34E-06
UG_PL_050_A	2.40E-06	1.68E-07	8.93E-07	-	1.34E-06
UG_PL_100_A	1.52E-06	1.06E-07	5.65E-07	-	8.48E-07
UG_PL_010_V	1.60E-06	1.60E-08	6.34E-07	-	9.50E-07
UG_PL_025_V	2.40E-06	1.68E-07	8.93E-07	-	1.34E-06
UG_PL_050_V	2.40E-06	1.68E-07	8.93E-07	-	1.34E-06
UG_PL_100_V	1.52E-06	1.06E-07	5.65E-07	-	8.48E-07
UG_PL_RUP_R	1.60E-07	-	4.48E-08	4.80E-08	6.72E-08

Scenario Tag is presented in the format of AA_BB_CCC_D, where:
- AA is release location. UG is Underground and AG is Aboveground
- BB is system location. PL is HP Pipeline and ST is Shatin North Offtake Station
- CCC is hole size. 010 is 10mm, 025 is 25mm, 050 is 50mm, 100 is 100mm and RUP is Full bore rupture
- D is release direction. H is Horizontal, V is Vertical, A is Inclined and R is Rupture (i.e. non-directional)

ANNEXURE C

Additional Information from Towngas

Andrew Tsang

From:	Hui Jacqueline T.Y. [redacted]
Sent:	Monday, 9 February 2026 7:52 pm
To:	Vincent Fong
Cc:	Dicky Ngai; Andrew Tsang; Terry Chui; LEO TL CHAN/CEDD; CHUN YAT LEE/CEDD; Chan Remus Y.C.; Leung Fu Lok; Cheng Jack W.; Lam Wendy Y.L.
Subject:	Re: Restricted: Agreement No. CE 19/2023 (CE) - Request for Information of Shatin North Offtake and Pigging Station
Attachments:	SM-a02-26-00042-jc 20260209.pdf; STN_Layout.pdf; Gas Main at Shatin North.pdf

Dear Mr. Fong

Please find attached the reply to your request for information of gas facilities near Shatin North Offtake and Pigging Station.

Thanks & regards
Jacqueline Hui

From: Vincent Fong [redacted]
Sent: Monday, February 2, 2026 3:57 PM
To: Hui Jacqueline T.Y. [redacted]
Cc: Wu Fanny W.Y. [redacted] Dicky Ngai [redacted] Andrew Tsang [redacted] Terry Chui [redacted] LEO TL CHAN/CEDD <leochan@cedd.gov.hk>; CHUN YAT LEE/CEDD <cylee@cedd.gov.hk>
Subject: Restricted: Agreement No. CE 19/2023 (CE) - Request for Information of Shatin North Offtake and Pigging Station

Dear Ms. Hui,

We have been appointed by CEDD to undertake various technical assessments for the project. To facilitate our project, we would be grateful if you could furnish us with the following information regarding the Shatin North Offtake and Pigging Station located at Shek Mun.

- the total piping length (including the associated diameter)
- the total number of valves (including the associated diameter)
- the total number of flanges (including the associated diameter)
- the number and dimension of the pig receivers (if any)
- any other equipment containing towngas

Due to the tight programme of this Study, we shall be much grateful if you could return to us by 5 February 2026. Should you find any enquiries, please feel free to contact the undersigned.

Thanks.

Regards,
Vincent Fong
[redacted]

MOTT MACDONALD

[redacted]

Website | **LinkedIn** | **Instagram** | **Facebook** | **YouTube**

[redacted]

Towngas 智慧燃展未來 Smart Energy for a Brighter Future

www.towngas.com

香港中華煤氣有限公司
The Hong Kong and China Gas Company Limited

09 February 2026

Your ref :
Our ref : SM-a02-26-00042-jc

Mr Vincent Fong
[redacted]

Dear Mr Fong

Agreement No. CE 19/2023 (CE)
RE: Request for Information of Shatin North Offtake and Pigging Station

Reference is made to your email dated 02 February 2026 in relation to the captioned subject.

A copy of technical information and drawings of the existing High Pressure 600mm pipe and Shatin North Offtake and Pigging Station in the concerned area are enclosed for your action.

You are advised to provide our Company a copy of the Quantitative Risk Assessment report for review and comment.

Should you have any further enquiry, please feel free to contact Mr Jack Cheng at [redacted] or me at [redacted]

Thank you for your kind attention.

Yours sincerely

Jacqueline Hui
Senior System Maintenance Manager

JH/jc/wl

Encl.

[redacted]

Technical Specification for the existing 600mm HPTGP

Parameter	Specification
Pipe Diameter (Nominal)	600mm
Pipe wall thickness	12.7mm
Design Pressure	35 barg
Maximum Operating Pressure	35 barg
Hydraulic Test Pressure	900 psi
Air Test Pressure	100 psi
Pipe Material	Steel
External Coating	400 micron of fusion bonded epoxy coating
Internal Coating	50 micron Two Pack Epoxy
Year of Construction	1987-1991
Backfilling Material	Surrounded by 150mm Thick Zone 2 fresh sand
Cathodic Protection	Sacrificial Anode at about 300 m Interval
Minimum Depth	1.1m
Material Grading (Pipe/ Fitting)	API 5L X42 / X52
Jointing Method	Butt Welding
Welding Specification	Welding complied with BGC/PS/P2
Non-Destructive Test of Jointing	100% X-Ray
Isolation Valves (Cameron Full Bore Ball Valve)	Upstream: Ball Valve near Ma On Shan Road Downstream: Valve in Shatin North Offtake and Pigging Station
Pipe Length between isolation valves	3.7km

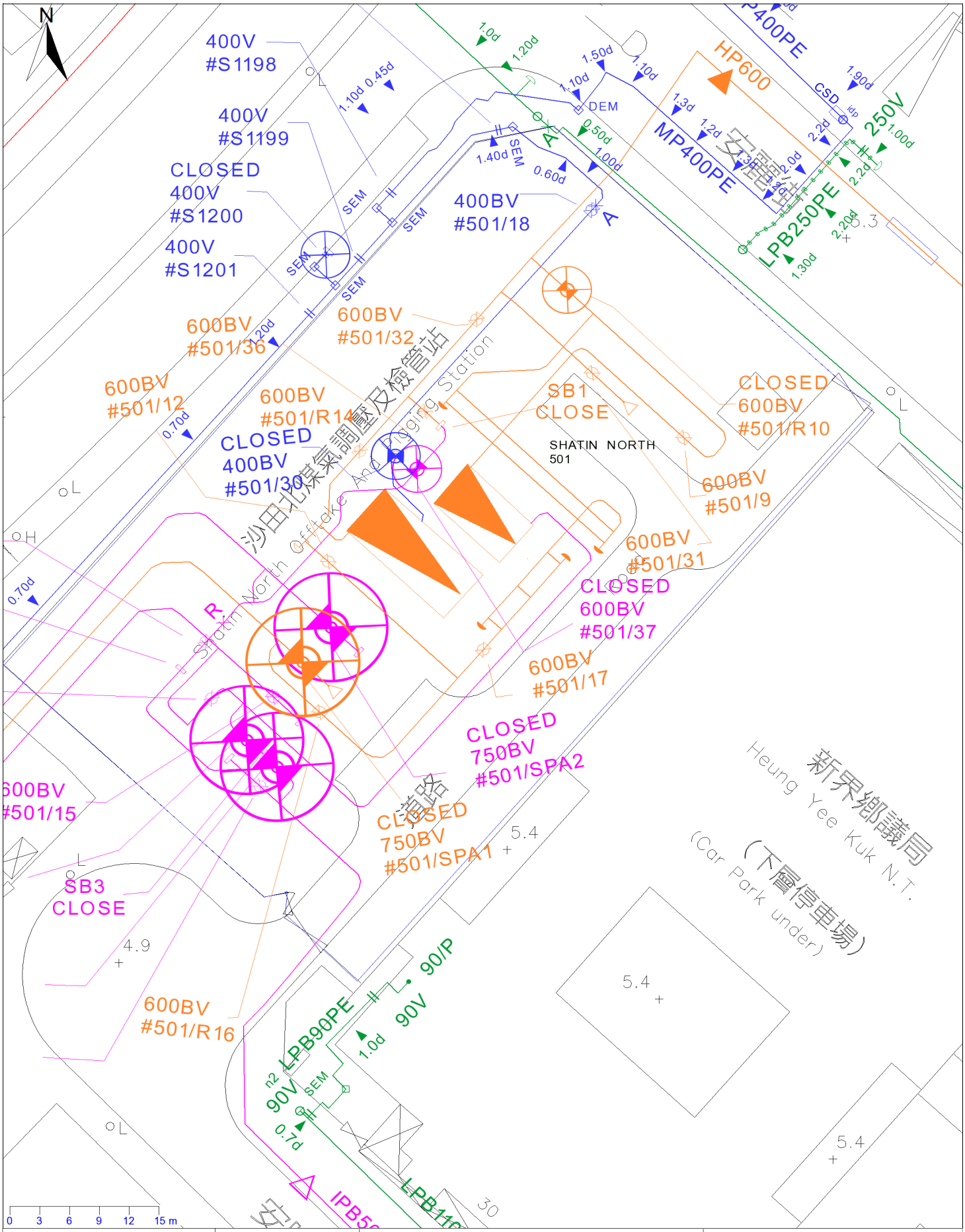
Technical Information – Shatin North Offtake and Pigging Station

Equipment/ Connection Details

Item	Size (mm)	Quantity	Pressure
Valve	50	3	MP
	400	2	MP
	50	13	IPB
	100	1	IPB
	200	2	IPB
	400	4	IPB
	500	3	IPB
	600	1	IPB
	50	43	HP
	75	1	HP
	100	3	HP
	150	6	HP
	200	4	HP
	250	9	HP
	300	12	HP
	400	3	HP
	500	4	HP
	600	11	HP
	750	2	HP
Flange	50	18	MP
	75	8	MP
	200	2	MP
	400	12	MP
	50	36	IPB
	100	6	IPB
	200	4	IPB
	300	19	IPB
	500	5	IPB
	600	1	IPB
	50	168	HP
	100	16	HP
	150	7	HP
	200	50	HP
	300	81	HP
	400	12	HP
	500	21	HP
	600	11	HP
	750	14	HP

Pipeline Distance within Station

Size (mm)	Above ground Length (m)	Underground Length (m)	Pressure
DN400	3	42	MP
DN50	11	N/A	IPB
DN150	21	N/A	IPB
DN500	28	40	IPB
DN600	28	97	IPB
DN50	40	N/A	
DN150	50	N/A	HP
DN200	50	N/A	HP
DN250	32	5	HP
DN400	5	12	HP
DN500	27	3	HP
DN600	140	212	HP
DN750	24	73	HP



煤氣 Towngas
香港中華煤氣有限公司
The Hong Kong and China Gas Company Limited

網絡發展部

時間：14:05:43

比例：1 : 500

圖例：

- LPA 現有低壓 A 管道 (2.0 千帕以下)
- LPB 現有低壓 B 管道 (2.0–7.5 千帕)
- MP 現有中壓管道 (7.5–240 千帕)
- IPA 現有次高壓 A 管道 (240–400 千帕)
- IPB 現有次高壓 B 管道 (400–700 千帕)
- HP 現有高壓管道 (700 千帕以上)
- PE 設有可探索警告帶的聚乙烯管道
- IPB* 現有次高壓 B 管道 (暫以較低壓力運作)
- HP* 現有高壓管道 (暫以較低壓力運作)
- PE* 沒有可探索警告帶的聚乙烯管道
- RP / IPit 備用管道 / 保留管道檢測井
- 擬建/在建管道

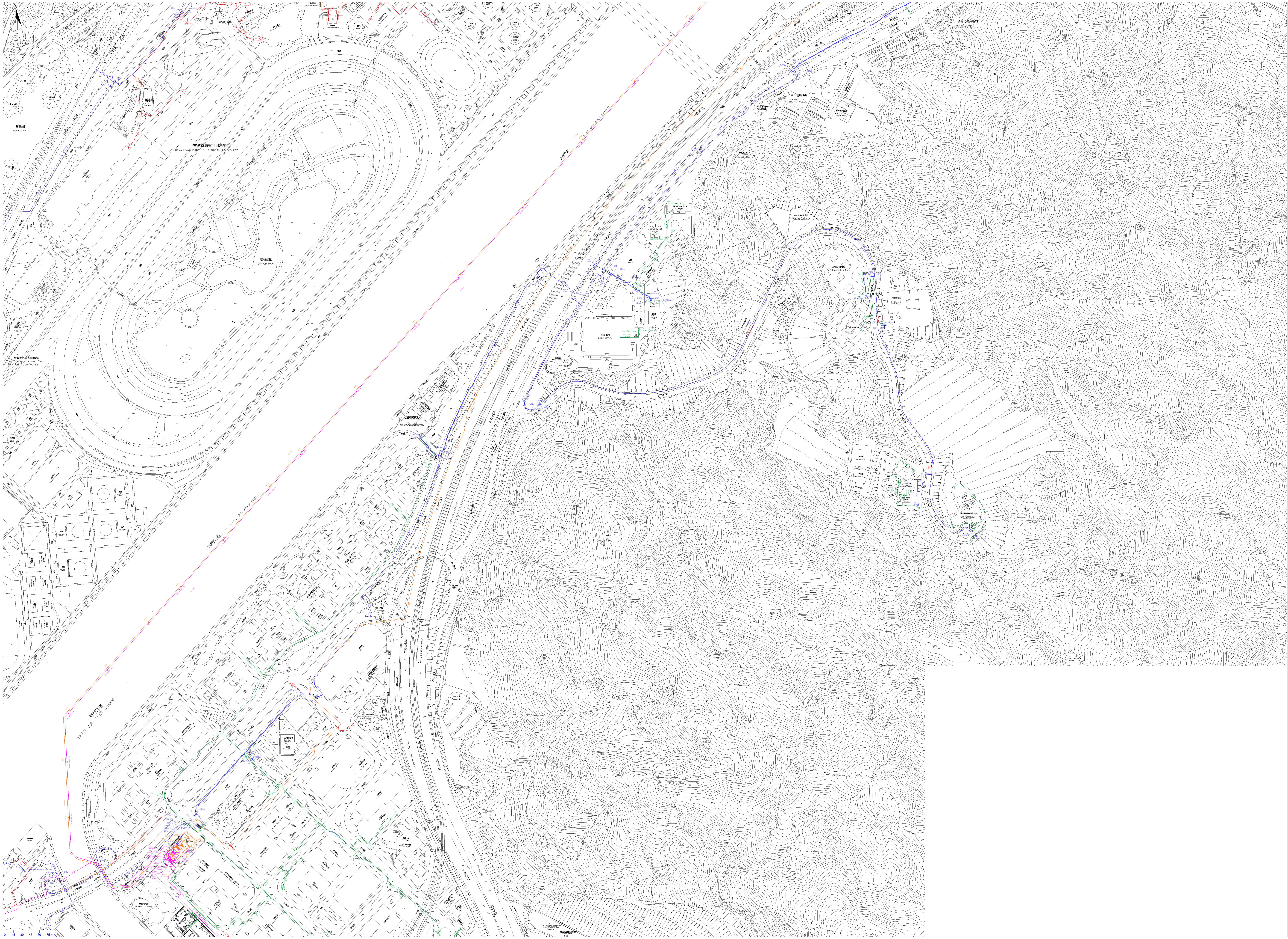
- 鋼蓋板
- 冷凝液罐
- 無警管的冷凝液罐 / 放散點
- 閥門
- 球閥井
- Idp 清管井
- RPIT 立管井
- CP 陰極保護裝置
- 大約埋深(米)
- 管網通訊導管
- TT:鞍型旁通 / BS:塞氣馬鞍
- RS:鞍型三通 / WT:華士三通

[注意：鞍型管件埋深，比管道淺約 5 0 毫米]

圖則顯示的管道位置只作參考之用。其實際位置和深度仍須以人手開挖探孔確定。在煤氣管道設施附近施工期間，必須要加倍小心。

檢查日期： Feb 9 2026

座標 xy (839229,827881)



煤氣 Towngas
香港中華煤氣有限公司
The Hong Kong and China Gas Company Limited

網絡發展部

時間：10:10:58

比例：1：2000

圖例：

LPA	現有低壓 A 管道 (2.0 千帕以下)
LPB	現有低壓 B 管道 (2.0–7.5 千帕)
MP	現有中壓管道 (7.5–240 千帕)
IPA	現有次高壓 A 管道 (240–400 千帕)
IPB	現有次高壓 B 管道 (400–700 千帕)
HP	現有高壓管道 (700 千帕以上)
PE	設有可探索警告帶的聚乙烯管道
IPB*	現有次高壓 B 管道 (暫以較低壓力運作)
HP*	現有高壓管道 (暫以較低壓力運作)
PE*	沒有可探索警告帶的聚乙烯管道
RP / iPit	備用管道 / 保留管道檢測井
	擬建/在建管道

	鋼蓋板
	冷凝液罐
	無豎管的冷凝液罐 / 放散點
	閥門
	球閥井
Idp	清管井
RPIT	立管井
CP	陰極保護裝置
	大約埋深(米)
	管網通訊導管
TT / BS	TT：鞍型旁通 / BS：塞氣馬鞍
RS / WT	RS：鞍型三通 / WT：蓽士三通

[注意：鞍型管件埋深，比管道淺約 5 0 毫米]

圖則顯示的管道位置只作參考之用。其實際位置和深度仍須以人手開挖探孔確定。在煤氣管道設施附近施工期間，必須要加倍小心。

檢查日期：Feb 9 2026

坐標 xy (840021,828536)

ANNEXURE D

Phast Input Parameter

Input Report

Workspace: Base Case & 2032 Case

Dispersion parameters

Dispersion parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Building wake	Model in use	Model in use	Best estimate	
	Calculation control	Lee length	Calculate	
		Lee half-width	Calculate	
		Lee height	Calculate	
		K-factor	Calculate	
		Switch distance	Calculate	
		Specified lee length		m
		Specified lee half-width		m
		Specified lee height		m
		Specified k-factor		
		Specified switch distance		m
	Output granularity	Maximum initial step size	10	m
		Maximum number of output steps	1000	
Near field	Momentum jet – continuous	Jet model	Morton (crosswind modified)	

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		Coefficients	Use recommended	
		Drag coefficient between plume and air	0.39	
		Jet entrainment coefficient alpha1	0.17	
		Jet entrainment coefficient alpha2	0.35	
	Initial energetic expansion – instantaneous	Modelling of instantaneous expansion	New standard method	
		Kinetic-energy fraction of discharge expansion energy	0.04	fraction
		Rainout coefficient	1	
		Air drag coefficient to radial expansion	0	
		Ratio droplet/ expansion velocity for inst. release	0.8	
		Expansion energy cutoff for droplet angle	0.69	kJ/kg
	Dense cloud	Dense cloud parameter gamma - continuous	0	
		Dense cloud parameter gamma - instantaneous	0.3	
		Dense cloud parameter K - continuous	1.15	
		Dense cloud parameter K - instantaneous	1.15	
		Gravity spreading collapse	Allow gravity collapse	
	Atmospheric entrainment	Near field passive entrainment parameter	1	

§

Far field	Criteria for transition to passive dispersion	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	
	Modeling the transition	Distance multiple for full passive entrainment	2	
	Modeling passive dispersion	Ratio instantaneous/continuous sigma-y	1	
		Ratio instantaneous/continuous sigma-z	1	
		Core averaging time	18.75	s
	End of dispersion	Criterion for halting dispersion model	Mixed basis	
Liquid	Droplet modelling	Droplet evaporation thermodynamics model	Rainout, non-equilibrium	
Ground	Modelling of heat and water transfer	Flag for heat/water vapour transfer	Heat and water	
	Modelling of impingement	Impingement option	Use velocity modification factor	
		Impinged velocity limit	500	m/s
		Impinged velocity factor	0.25	fraction
	Cloud impact and lift-off	Richardson number criterion for cloud lift-off	-20	
	Gas blanket	Gas blanket modelling	Gas blanket	

§

	modelling for buried pipeline rupture		modelling (CO2 ruptures only)	
		Maximum ground impact angle for gas blanket modelling	-45	deg
Time-varying and finite duration	Observer release control	Suggested number of pool observers	10	
	Modelling of finite duration or time-varying dispersion	Method for non-instantaneous dispersion	Along wind diffusion (AWD)	
		Quasi-instantaneous transition parameter	0.8	
		Time averaging for concentrations	Do not average concentrations over time	
		Observer mass correction	Apply observer mass correction	
		Minimum release duration for time-varying dispersion	3	s
		Method to handle mass conservation failure	Recommended	
		Fraction of mass lost to trigger equivalent pool	0.25	fraction
	Gravity spreading	Gravity spreading correction	Correct for gravity spreading for large gravity-spread rate only	
Accuracy and speed	Integration in calculations	Relative tolerance for dispersion calculations	0.001	
	Step sizes for	Maximum integration step	1000	s

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	cloud integration			
		Fixed step size	0.01	s
		Number of fixed size output steps	20	
		Multiplier for output step sizes	1.2	
	Concentration grid definition	Critical separation ratio	0.2	fraction
		Spacing parameter for the grid in the x dimension	0.1	
		Number of grid points in time dimension	100	
		Number of grid points in Y and Z direction	50	
		Use grid	Use grid	
Limits	Minimum limits	Minimum temperature allowed	-262.1	degC
		Minimum release velocity for cont. release	0.1	m/s
		Minimum continuous release height	0	m
	Maximum limits	Maximum temperature allowed	926.9	degC
		Maximum distance for dispersion	5E+04	m
		Maximum height for dispersion	1000	m
	Treatment of mixing layer	Treatment of top mixing layer	Constrained	

§

Discharge parameters

Discharge parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Discharge constants	Capping options	Velocity capping method	Fixed velocity	
		Maximum release velocity	1E+08	m/s
	Short pipe modelling	Minimum RV diameter ratio	1	
		Relief valve safety factor	1.2	
		Critical pressure greater than flow phase	0.3447	bar
		Capping of pipe flow rates	Use leak scenario cap, disallow flashing	
	Equation constants	Continuous critical Weber number	12.5	
		Instantaneous critical Weber number	12.5	
		Venting equation constant	24.82	
Reference	Droplet handling	Droplet method - continuous only	Modified CCPS	
	Phase data	Minimum drop diameter allowed	0.01	um
		Maximum drop diameter allowed	1E+04	um

§

		Default liquid fraction	1	fraction
		Use Bernoulli for forced -phase liq-liq discharge	Use compressible flow eqn	
	Short pipe modelling	Tolerance	0.0001	
Scenario	Release location	Elevation	1	m
Short pipe	Pipe characteristics	Pipe roughness	0.045	mm
	Frequencies	Frequency of bends in pipe	0	/m
		Frequency of couplings in pipe	0	/m
		Frequency of junctions in pipe	0	/m
	Frequencies of valves	Frequency of excess flow valves	0	/m
		Frequency of non-return valves	0	/m
		Frequency of shut-off valves	0	/m
	Velocity head losses	Excess flow valve velocity head losses	0	
		Non-return valve velocity head losses	0	
		Shut-off valve velocity head losses	0	
Long pipe	Long pipe	Model heat transfer	No modelling of heat transfer	
		Thermodynamic option for gas pipelines	Non-ideal gas	

§

		Number of time steps	100	
		Maximum number of data points	1000	
	Pipe characteristics	Friction factor method	Fannelop's (GSPP)	
	Crater modelling for buried pipeline rupture	Crater model type	Defined area model (CO2 ruptures only)	
		Fracture length	12	m
	Small holes method (Long pipelines only)	Small hole size discharge method	Steady state orifice model	
		Relative size for "small" breach - liquid	0.2	
		Relative size for "small" breach - vapour	0.04	
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating	
		Vacuum relief valve set point	0	bar
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No	
Safety systems	Isolation for time-varying releases	Time to isolation	0	s
	Blowdown for time-varying releases	Time to blowdown actuation	0	s
Discharge	Model settings	Atmospheric	DNV	

§

parameters		expansion method	recommended	
		Phase change upstream of orifice?	Disallow liquid phase change only (metastable liquid)	
	Droplet break-up mechanism	Droplet break-up mechanism - instantaneous	Use flashing correlation	
		Droplet break-up mechanism - continuous	Do not force correlation	

§

Jet fire parameters

Jet fire parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Jet fire reference data	Constant for jet fire calculation	Jet fire averaging time	20	s
	Constants for radiation calculation	Maximum SEP for a jet fire	350	kW/m2
	Flammable-probit inner-ellipse risk calculations	Measure to use for critical radiation	Intensity	
	Miller model parameters	Radiative fraction method	Miller	
		Lift off option	DNV	
		Radiation intensity capping method	Use Boltzmann's law	
Jet fire	Jet fire method	Selection for jet fire method	Automatic selection / DNV recommended	
	Result types to calculate	Calculate probit	No	
		Calculate dose	No	
		Calculate lethality	Yes	
	Radiation levels	Number of input radiation levels	3	
		Intensity levels	9.8, 19.4, 38.5	kW/m2
		Probit levels	16	
		Dose levels	16	

§

		Lethality levels	0.01, 0.5, 0.99	fraction
	Parameters	Rate modification factor	3	
		Jet fire maximum exposure duration	20	s
		Time for delayed ignition jet fires	60	s
	Cone model data	Horizontal options	Use standard method	
		Correlation	Recommended	
		Flame-shape adjustment if grounded	Yes	
	Surface emissive power	Calculation method for surface emissive power	Calculate SEP	
		Flame emissive power		kW/m2
		Emissivity fraction		fraction
	Stoichiometric mass fraction calculation method	Use material property system	No	

§

Pool fire parameters

Pool fire parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Pool fire reference data	Minimum pool duration for pool fire risk	Instantaneous releases	10	s
		Continuous releases	10	s
	Options for pool fire sizing	Apply maximum duration?	No	
		Cut-off duration	300	s
		Apply maximum diameter?	No	
		Cut-off diameter	100	m
	Flammable-probit inner-ellipse risk calculations	Measure to use for critical radiation	Intensity	
	Constants for radiation calculation	Maximum surface emissive power for pool fires	350	kW/m2
Pool fire	Result types to calculate	Calculate probit	No	
		Calculate dose	No	
		Calculate lethality	Yes	
	Radiation levels	Number of input radiation levels	3	
		Intensity levels	7.3, 14.4, 35.5	kW/m2
		Probit levels	16	
		Dose levels	16	

§

		Lethality levels	0.01, 0.5, 0.9	fraction
	Parameters	Radiative fraction for general fires	0.4	fraction
		Pool fire maximum exposure duration	20	s
		Two-zone pool fire model	No	

§

Fireball and BLEVE blast parameters

Fireball and BLEVE blast parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Constants	Constants for radiation calculation	Maximum surface emissive power	400	kW/m2
	Flammable-probit inner-ellipse risk calculations	Measure to use for critical radiation	Dose	
Fireball	Result types to calculate	Calculate probit	No	
		Calculate dose	No	
		Calculate lethality	Yes	
	Radiation levels	Number of input radiation levels	3	
		Intensity levels	9.8, 19.4, 38.5	kW/m2
		Probit levels	16	
		Dose levels	16	
		Lethality levels	0.01, 0.5, 0.99	fraction
	Parameters	Mass modification factor	3	
		Fireball maximum exposure duration	20	s
	Calculation method	Fireball model	TNO (yellow book) model	

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		TNO model flame temperature	1727	degC
BLEVE blast parameters	BLEVE blast parameters	Air or ground burst	Ground burst	
		Ideal gas modeling	Model as real gas	
		Model option	CCPS second edition (2010)	
		Minimum distance	0	m
		Number of distance points	100	

§

Flammable parameters

Flammable parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Flammables	Modelling of immediate flash fire	UFL multiple for immediate ignition	1	
		Cut off fraction for cloud volume	0.001	fraction
	Short duration effects	For time-varying releases	Do not model short duration effects	
		Match fireball duration and mass released	No	
		Cut off time for short continuous releases	20	s
	Results grid steps	Flammable result grid step in X-direction	10	m
	Flammable concentrations in cloud	Flammable mass calculation method	Mass between LFL and UFL	
		Flammable averaging time	18.75	s
		LFL fraction to finish	1	fraction
	Wind sector modelling for flammable hazards	Number of wind subdivisions per sector	1	
Radiation	Observer properties	Observer type radiation modelling flag	Planar	
		Observer direction	Variable	

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		Angle of inclination	0	deg
		Angle of orientation	0	deg
	Radiation probit values (units of dose in probit equation is (W/m2)^Probit N value).s)	Probit N value	1.333	
		Probit A value	-36.38	
		Probit B value	2.56	
	Tolerances in radiation calculations	Absolute tolerance for linked radiation calcs	1E-10	
		Relative tolerance for radiation calculations	0.01	fraction
	Radiation versus distance	Number of radiation/distance points in linked radiation calculations	50	
	Solar radiation	Solar radiation	Exclude from calculations	
Flammable risk	Risk for fireball, jet fire and pool fire	Number of lethality ellipses	3	
		Critical radiation intensity	35.5	kW/m2
		Critical radiation dose (W/m2)4/3.s	2.29E+07	
		Minimum probability of death	0.01	fraction
		Ellipse linear spacing variable	Probit	
	Flash Fires	Method for fitting ellipse to flash fire	ChiSq method	

§

		shape		
	Plant boundary modelling of delayed ignition	Plant boundary method	None	
		Late pool fire	Exclude effects	
	Flammable risk	Basis for calculations	Centreline height	
		Population omega factor	0.000168	
		Indoor population omega factor	0	
		Inter-ellipse interpolation method	Weighted	
		Include jet fire effects with delayed ignition outcomes	Exclude effects	
	Immediate ignition method	Immediate ignition method	0	
Ignition	Behaviour on first exposure (elevated sources only)	Method	None	
	Cox-Lees-Ang and UKOOA ignition modelling	Fraction of ignition probability for immediate ignition	0.3	
Flammable parameters		Distance to site boundary	0	m

§

Explosion parameters

Explosion parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Overpressures	Explosion overpressures for reporting (gauge)	Overpressure levels	0.02068, 0.1379, 0.2068	bar
	Explosion centre location criterion and minimum flammable mass parameters	Explosion location criterion	Cloud front (LFL fraction)	
		Minimum explosive mass	0	kg
Explosion parameters	Vapour liquid method	Use explosion mass modification factor	Yes	
		Explosion mass modification factor	3	
	Explosions	Minimum probability of death for explosions	0.001	
Multi-Energy	Multi-Energy: Uniform confined	Uniform confined explosion strength	10	
		Uniform confined method explosion efficiency	12.5	%
	Multi-Energy: User-defined	Unconfined explosion	2	

§

		strength		
		Unconfined explosion efficiency	100	%
BST and ME	BST and ME	Cloud shape of area integration	Elliptical	
		Explosion efficiency method	100% efficiency	
		Maximum number of effect points along transect	2	
		Minimum explosion energy	0	kJ
	Curve fitting method	Explosion type calculation method	Polynomial curve-fit equations	
		Number of blast curve discretisation Points	30000	
	Calculation method	Flammable mass calculation type	Area weighted mass integral	
	Cloud view timesteps	Between cloud views	Minimise gaps	
		Maximum number of time steps	100	
		Number of time steps - continuous clouds	5	
		Number of timesteps - time varying clouds	10	

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	Cloud view control	Number of X steps per view	21	
		Minimum X step	0.1	m
TNT	TNT parameters	Air or ground burst	Air burst	
ME (3D options)	3D Cloud ME / Purple Book explosions	Unconfined explosion strength	2	
		Explosion efficiency	100	%
	3D Obstructed region	Unconfined explosion strength	2	
		Explosion efficiency	100	%
BST and ME (3D options)	Critical separation specification	Separation specification	Use ratio	
		Critical separation distance	0	m
		Critical separation ratio	0.5	
	Cloud view methods	Method option	Normal dispersion	
		Cylinder height over radius ratio	3	
		Concentration method for filling	Stoichiometric	
		Elevation of floor or ceiling	0	m
	Pressure exceedance results	Pressure exceedance curves	Calculate	

§

		Minimum pressure filter	0.01	bar
	Buildings	Reflection method	Calculated angle	
		Building damage method	Worst point	
	Detonation of VCE in obstructed regions	Model option	Normal explosion	
		Critical VBR for detonation	0.15	fraction
		Flame speed for detonation (Mach number)	0.8	fraction
BST (3D options)	BST volume blockage criteria for congestion	Low to medium criterion	0.006	
		Medium to high criterion	0.08	
	Method for correcting the ground effect	Method option	Ground reflection	
		Reflection factor	1	
	Method for combining obstructed regions	Options available	Volume averaged	

§

General parameters

General parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
General reference data	Discharge and dispersion	Maximum release duration	3600	s
	Reporting of concentrations and effects	Height of interest	1	m
Long pipe	Overall pipeline parameters	Maximum number of event locations (automatic event spacing logic)	1000	
	Section / sub-section parameters	Tolerance (distance) for section boundary checking	0.1	m
		Maximum fraction of pipe length for sub-sectioning	0.2	fraction
		Minimum ideal sub-section piping length	500	m
		Maximum fractional pressure drop across a sub-section	0.8	fraction

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Pool vaporisation parameters

Pool vaporisation parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Pool vaporisation	Cut-offs for pool evaporation rates	Toxics cut-off rate for pool evaporation	0.001	kg/s
		Flammable cut-off rate for pool evaporation	0.1	kg/s
	Pool vaporisation modelling	Evaporation on land correlation	MacKay and Matsugu	
		Solver tolerance	0.001	

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Toxic parameters

Toxic parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Toxics	Calculation options	Multi-comp. toxic calc. method	Most toxic material probit	
		Probit calculation method	Use probit	
		Toxics: minimum probability of death	0.001	
		Tolerance on minimum probability of death	0.01	
		Toxic averaging time	600	s
	Toxic grid parameters	Use toxics grid?	Use grid	
		Number of grid points in X direction	99	
		Number of grid points in Y direction	50	
Toxic parameters	Exposure time data	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

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		Cut-off concentration for exposure time calculations	0	fraction
	Toxic contours	Number of toxic levels	4	
		Dose levels [ppm^n.min]	1.3E+05, 1.3E+06, 1.3E+07, 1.3E+08	
		Probit levels	2, 3, 4, 10	
		Lethality levels	0.001, 0.01, 0.1, 0.99	fraction
Concentration based risk	Concentration based risk	ERPG 3 factor	2.54	
		Concentration type	ERPG 3	
		Use outdoor or indoor concentration	Use outdoor	
Threshold concentration	Threshold concentration (N.B. Concentrations based on mixture rather than toxic component(s))	Threshold concentration	1E+06	ppm
		Minimum fatality if threshold concentration reached	0	fraction

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Weather parameters

Weather parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Atmospheric constants	Constants	Atmospheric pressure	1.013	bar
		Atmospheric molecular weight	28.97	kg/kmol
		Atmospheric specific heat at constant pressure	1.004	kJ/kg.degK
	Temperature and pressure data	Atmospheric T and P profile	Temp. logarithmic; Pres. linear	
		Temperature reference height	0	m
	Wind speed data	Wind speed profile	Power law	
		Wind speed reference height	10	m
		Cut-off height for wind speed profile	1	m
Atmospheric parameters	General atmospheric parameters	Atmospheric temperature	25	degC
		Relative humidity	0.7	fraction
		Solar radiation flux	1	kW/m2
	Mixing layer	Mixing layer	1300	m

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	height vs. Pasquill stability	height for Pasquill stability A		
		Mixing layer height for Pasquill stability A/B	1080	m
		Mixing layer height for Pasquill stability B	920	m
		Mixing layer height for Pasquill stability B/C	880	m
		Mixing layer height for Pasquill stability C	840	m
		Mixing layer height for Pasquill stability C/D	820	m
		Mixing layer height for Pasquill stability D	800	m
		Mixing layer height for Pasquill stability E	400	m
		Mixing layer height for Pasquill stability F	100	m
		Mixing layer height for	100	m

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		Pasquill stability G		
	Building data	Building exchange rate	4	/hr
		Tail time	1800	s
Substrate data	Surface temperature	Surface temperature for dispersion calculations	25	degC
		Surface temperature for pool calculations	25	degC

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Building parameters

Building parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
In-building release	Ventilation	Ventilation type	Natural ventilation	
		Air changes	3	/hr
		Vent location		
		Exhaust diameter		m
		Vent flowrate		m3/hr
	Indoor explosion model	Indoor explosion model	NFPA 68 (2007)	
		Internal obstacle to building area ratio		
		Vent panel height		m
		Vent panel location		
Indoor toxic modelling	Building data	Building exchange rate	4	/hr
		Tail time	1800	s
		Wind speed dependent	From Building	
Building wake	Chimney	Chimney diameter	2.5	m
		Chimney height	60	m

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Event tree parameters

Event tree parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Standalones	Standalones	Probability of a fireball	1	fraction
		Probability of a jet fire - see "Cont. - no rainout"		
		Probability of a pool fire	1	fraction
		Toxic probability	1	fraction
Explosion probability	Volume based	Volume based explosion probabilities	No	
		Low - medium boundary	0.45	m/s
		Medium - high boundary	0.75	m/s
		Number of volume definitions	3	
		Obstructed cloud volume	200, 3000, 6000	m3
		Low flame speed probability	0, 0.3, 0.6	fraction
		Medium flame speed probability	0.3, 0.6, 0.9	fraction
		High flame speed probability	0.6, 0.9, 1	fraction

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	Detonation probability [used only when detonation model is selected under Explosion parameters/BST and ME (3D options)]	Probability of detonation for delayed ignitions	1	fraction
Continuous - no rainout	Immediate ignition	Immediate ignition	0.3	fraction
	Immediate ignition short duration effects	Fraction for effects	1	fraction
		Fireball	1	fraction
		Flash fire	0	fraction
		Explosion with flash fire	0	fraction
	Immediate ignition long duration effects	Horizontal fraction	0.6	fraction
	Immediate ignition long duration effects and standalone jet fires	Horizontal jet fire effects	1	fraction
		Vertical jet fire effects	1	fraction
	Delayed ignition	Flash fire	1	fraction
		Explosion with flash fire	0	fraction
Continuous - rainout	Immediate ignition	Immediate ignition	0.3	fraction
	Immediate ignition short duration effects	Fraction for effects	1	fraction
		Fireball with pool fire	1	fraction
		Fireball alone	0	fraction

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		Flash fire with pool fire	0	fraction
		Flash fire alone	0	fraction
		Explosion with flash fire and pool fire	0	fraction
		Explosion with flash fire	0	fraction
		Pool fire alone	0	fraction
	Immediate ignition long duration effects	Horizontal fraction	0.6	fraction
		Horizontal jet fire alone	0	fraction
		Horizontal release pool fire effects	0	fraction
		Horizontal jet fire with pool fire	1	fraction
		Vertical release pool fire effects	0	fraction
		Vertical jet fire alone	0	fraction
		Vertical jet fire with pool fire	1	fraction
	Delayed ignition of cloud	Residual pool fire	0.15	fraction
		Flash fire with/without pool fire	0.6	fraction
		Explosion with flash fire and with/without pool fire	0.4	fraction
Instantaneous - no §	Immediate ignition	Immediate	0.3	fraction

rainout		ignition		
	Immediate ignition short duration effects	Fireball alone	1	fraction
		Flash fire	0	fraction
		Explosion with flash fire	0	fraction
	Delayed ignition	Flash fire	1	fraction
		Explosion with flash fire	0	fraction
Instantaneous - rainout	Immediate ignition	Immediate ignition	0.3	fraction
	Immediate ignition short duration effects	Fireball with pool fire	1	fraction
		Fireball alone	0	fraction
		Flash fire with pool fire	0	fraction
		Flash fire alone	0	fraction
		Explosion with flash fire and pool fire	0	fraction
		Explosion with flash fire	0	fraction
		Pool fire alone	0	fraction
	Delayed ignition of cloud	Residual pool fire	0.15	fraction
		Flash fire with/without pool fire	0.6	fraction
		Explosion with flash fire and with/without pool fire	0.4	fraction

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Grid parameters

Grid parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Effects grid	Grid	Grid calculation method	Number of cells	
		Grid cell size	10	m
		Maximum number of cells	160000	
		Grid sizing	Calculated	
	Grid bounds	Grid bounds minimum x	388.7	m
		Grid bounds maximum x	1361	m
		Grid bounds minimum y	-168.6	m
		Grid bounds maximum y	1213	m

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General risk parameters

General risk parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
General risk	General risk	Maximum number of subdivisions per square	5	
		Maximum number of subsquares across ellipse	10	
		Aversion index	1.2	
		Method for handling indoor / outdoor risk	Indoor and outdoor risk calculations	
	Risk Level Lower Limit	Minimum case frequency	1E-12	/AvgeYear
		Minimum event probability	1E-12	
	Toxic risk	Factor for toxic F-N spread	2	
	Explosions	Optimise explosions	No optimisation	
		Number of explosion steps	100	
		Tolerance for distance to overpressure thresholds	1E-06	
	Outdoor risk	Fraction of population indoors for societal risk	0.9	fraction
		Fraction of	0	fraction

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		population indoors for individual risk		
IRISK	Run control	IRISK run mode	Use IRISK	
	Parallelization control	CPU / GPU Parallelization mode	Asynchronous (multi-threaded)	
		Asynchronous parallelization mode	MT-Single-Precision (GPU-CUDA)	
	Effect zone modelling control	Specify number of radiation X steps?	No	
		Specify number of flash fire X steps?	No	
		Specify number of explosion X steps?	No	
		Number of X steps per radiation ellipse	21	
		Number of X steps per explosion source	21	
		Number of X steps per flash fire envelope	21	
	Multi-grids	Use multi-grid?	Partial multi-grid	
		Number of zoom levels	12	
		Constant zoom level multiplier	2	
		Target number of grid cells spanning effect zone	300	
		Multi-grid parallelization	Optimized structured grid	

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		options		
Ignition	Ignition source shut down	Active shut down	No shut down	
		Shut down time		s
		Cooling time		s
MISOF Ignition	Intensities	Rotating equip. cont. intensity	3.7E-06	m3
		Rotating equip. disc. intensity	1E-09	m3/s
		Electrical equip. cont. intensity	1.8E-06	m3
		Electrical equip. disc. intensity	1.5E-09	m3/s
		Other cont. intensity	6E-07	m3
		Other disc. intensity	1.2E-08	m3/s
		Per unit rotating equip. cont. intensity	0.0037	
		Per unit rotating equip. disc. intensity	1.5E-06	s
		Per unit hot surface cont. intensity	1	s
	Hot work	Probability of ignition - Open flame and welding without habitat	1	fraction
		Probability of ignition - Grinding	0.1	fraction
		Probability of ignition - Class B	0.1	fraction

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		Hot work time to 50%	20	s
		Hot work fraction alive	0.25	fraction
	In habitat hot work	Probability of doors open	0.3	fraction
		Instantaneous number of habitat ingress levels	4	
		Mass threshold	10, 100, 1000, 3000	kg
		Instantaneous probability of ingress and ignition	0.17, 0.33, 0.67, 1	fraction
		Continuous number habitat ingress levels	4	
		Mass flow rate threshold	0.1, 1, 10, 30	kg/s
		Continuous probability of ingress and ignition	0.17, 0.33, 0.67, 1	fraction

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Outdoor vulnerability

Outdoor vulnerability

all model with TNO for FB with result\Parameters\General risk parameters

Tab	Group	Field	Value
Enable	Enable	Info	Can be made editable on the Workspace dialog 'Editing' tab

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Indoor vulnerability

Indoor vulnerability

all model with TNO for FB with result\Parameters\General risk parameters

Tab	Group	Field	Value
Enable	Enable	Info	Can be made editable on the Workspace dialog 'Editing' tab

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Surface parameters

Surface parameters

all model with TNO for FB with result\Parameters

Tab	Group	Field	Value	Units
Dispersing surface	Properties	Surface over which the dispersion occurs	Land	
		Surface roughness length	User-defined	
		User-defined length	183.2	mm
Surface for pools	Type of surface for pools	Type of surface for pools	Concrete	
	User defined surface properties	Pool minimum thickness	5	mm
		Surface thermal diffusivity	9.48E-07	m2/s
		Surface roughness factor	2.634	
		Surface thermal conductivity	0.00221	kJ/m.s.degK
Bund properties	Dimensions	Bund height	0	m
		Bund area (internal)	0	m2
		Bund diameter (internal)	0	m
	Whether the bund can overflow	Bund area multiplier for catastrophic rupture	1.5	

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