THE GOVERNMENT OF THE
HONG KONG SPECIAL ADMINISTRATIVE REGION

GUIDANCE NOTE ON QUANTITATIVE RISK ASSESSMENT STUDY FOR HYDROGEN INSTALLATIONS IN HONG KONG

Version 2.0

EMSD

January 2024

Preface

This Guidance Note aims to provide technical guidelines and general requirements for conducting Quantitative Risk Assessment (QRA) of hydrogen installations in Hong Kong. A standard approach is recommended with a view to ensuring the consistency of the QRAs conducted by different consultants. Whenever alternative methodologies and/or assumptions are adopted, relevant justification(s) should be provided as appropriate.

The current version is an interim guideline and update/review will be required as experience is gained when moving forward.

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Definition

ALARP	– As Low As Reasonably Practicable
CBA	– Cost Benefit Analysis
CCPHI	– Coordinating Committee on Land-use Planning and Control relating to Potentially Hazardous Installations
CFD	– Computational Fluid Dynamics
DFS	– Dedicated Filling Station
EMSD	– Electrical and Mechanical Services Department
F	– Frequency
FB	– Full-Bore
FN	– Frequency-Number
HCRD	– Hydrocarbon Release Database
HFCV	– Hydrogen Fuel Cell Vehicle
HFS	– Hydrogen Filling Station
HKRG	– Hong Kong Government's Risk Guidelines
HPTGI	– High Pressure Town Gas Installations
HyRAM	– Hydrogen Risk Analysis Model
IOGP	– International Association of Oil & Gas Producers
IR	– Individual Risk
LFL	– Lower Flammability Limit
LPG	– Liquefied Petroleum Gas
PHIs	– Potentially Hazardous Installations
PLL	– Potential Loss of Life
QRA	– Quantitative Risk Assessment
RG	– Risk Guidelines
SR	– Societal Risk
UK	– United Kingdom
USA	– United States of America
VCE	– Vapour Cloud Explosions

1. Foreword and Scope

1.1 Objectives

1.1.1 This Guidance Note aims to provide technical guidelines and general requirements for conducting Quantitative Risk Assessment (QRA) of hydrogen installations in Hong Kong. Its purpose is to achieve a consistent approach for the QRAs conducted by different consultants.

1.2 Scope

1.2.1 This Guidance Note covers as far as possible all aspects of modelling approaches and assumptions for QRAs of hydrogen installations. It includes scope definition, study zone, hazard identification, failure cases, leak frequencies, event development, ignition probabilities, consequence models, impact models, risk summation and risk criteria.

1.2.2 The Guidance Note only addresses gaseous hydrogen, stored under pressure at ambient temperature.

1.2.3 The Guidance Note addresses the following types of hydrogen installations:

- Hydrogen production and storage installations; and
- Hydrogen filling stations (HFSs), which may be installed at bus depots, retrofitted/ new energy filling stations[1] or converted[2]/new dedicated filling stations (DFSs).

1.2.4 The Guidance Note does not cover the mobile hydrogen sources such as hydrogen fuel cell vehicles (HFCV), or bulk hydrogen transport in tube trailers or tankers, except where these contribute to the risks at installations.

1.3 Application

1.3.1 QRA should be performed for any hydrogen installation that includes electrolysers, pressure swing adsorption units, tube trailers, compressors, buffer storage or dispensers. This includes HFS and hydrogen production and storage installations of any size and pressure.

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1 Energy filling stations offer multiple types of fuel, say petrol, electric charging and hydrogen filling.

2 Say converted from dedicated LPG filling stations to hydrogen filling stations.

2. QRA Methodology

2.1 Scope of Assessment

2.1.1 The scope of the QRA should be defined clearly at the outset and documented in the QRA report. For example, it should define:

- Sub-systems to be included (e.g. whether it includes leaks from HFCVs while at the HFS, and leaks during hydrogen deliveries and vehicle refuelling).
- Other hazardous materials to be included (e.g. petrol, diesel or LPG fuels at the HFS), and escalation from hydrogen to other fuels and vice-versa.
- Other hazardous activities (e.g. bus maintenance) to be included, either as sources of hydrogen leaks, ignition of hydrogen leaks or escalation to hydrogen fires.

2.1.2 The hydrogen supply may either be sourced from local suppliers and other regions via tube trailers or piped supply from extraction of town gas. If piped supply from the high pressure town gas network is adopted as the hydrogen source, assessment for the associated extraction facility should follow the approach as stipulated in the "Guidance Note on Quantitative Risk Assessment Study for High Pressure Town Gas Installations in Hong Kong" (EMSD HPTGI Guidance Note) [3.4].

2.1.3 The hydrogen facilities should be broken down into isolatable sections for analysis. Each sub-system should be clearly identified as whether it is isolatable and the quantity of hydrogen in the isolatable section should be estimated. The process of triggering the isolation and depressurisation of the sections should be described, as well as an estimate of the time to complete isolation and blowdown. Key assumptions should be recorded and included as recommendations for installation design.

2.1.4 The QRA methodology assumes that the installation complies with established design standards for hydrogen facilities, and the adopted design standards should be stated in the QRA report. As the hydrogen industry is under development, the QRA should also identify safety measures and barriers.

2.2 Study Zone

2.2.1 A Study Zone (SZ) should be considered, covering the maximum distance for fatal effects from catastrophic release of the largest section inventory using the consequence models (see below), and a minimum of 200 metres from the installation boundary. There should be a check at the end of the study that the individual risk contour of 1×10^{-9} per year lies within the study area.

2.3 Hazard Identification

2.3.1 The potential hazardous events and failure scenarios should be identified based on the best available information in order to determine a set of relevant scenarios to be included in a QRA.

2.3.2 All aspects of the QRA should be informed by previous accidents and incidents in similar installations world-wide. The previous accidents and incidents relevant to the study installation should be reviewed.

2.3.3 Sufficient failure cases should be modelled to represent the risks. Between 3 and 6 leak sizes should be used, depending on the equipment size, as recommended in Table 1. For storage cylinders, instantaneous releases of the entire content should also be considered.

2.3.4 Hazardous events should include:

- Jet Fire;
- Fireball;
- Flash Fire;
- Vapour Cloud Explosion (deflagration) with overpressure typically 1 bar; and
- Detonation with overpressure much greater than 1 bar.

2.3.5 If piped supply from the high pressure town gas network is adopted as the hydrogen source, the potential hazardous events due to loss of containment from the extraction facility, are described in Section 3.3 of the EMSD HPTGI Guidance Note [3.4].

2.3.6 Both isolated and unisolated cases should be modelled, involving success and failure of the planned isolation and/or blowdown.

2.4 Failure Cases Based on Hole Size

2.4.1 Where failure cases are based on equipment size, the nominal equipment diameter should be used. If the pipe schedule is known, the inside diameter can be used for the consequence calculations.

2.4.2 Recommended release categories are given in Table 1, expressed in terms of ranges of hole diameter (for consistency with the frequency data) for different equipment diameters. The representative hole size in each category is taken as the average of the ends of the range or the full-bore (FB) equipment size. If the consequence results are within the site boundary, the smaller cases may be neglected and the corresponding frequencies being discarded.

Case	4-8mm equipment diameter		8-16mm equipment diameter		16-32mm equipment diameter		>32mm equipment diameter	
	Range (mm)	Represented by (mm)	Range (mm)	Represented by (mm)	Range (mm)	Represented by (mm)	Range (mm)	Represented by (mm)
Very small	1-2	1.5	1-2	1.5	1-2	1.5	1-2	1.5
Small	2-4	3	2-4	3	2-4	3	2-4	3
Medium			4-8	6	4-8	6	4-8	6
Large					8-16	12	8-16	12
Very large							16-32	24
Full-bore	>4	FB	>8	FB	>16	FB	>32	FB

Table 1: Recommended Hole Size Categories

2.5 Failure Frequency

2.5.1 Failure frequencies of gas installations considered in the QRA study should be determined with reference to internationally recognised historical failure databases, taking account of spontaneous failures of hydrogen equipment, operational failures of hoses, impact-induced leaks from vehicle collisions and fire-induced failures. The recommended leak frequencies for hydrogen equipment are given Table 2, which are derived based on hydrogen leak experience provided by the Compressed Gas Association to Sandia [3.1], combined with analysis of the Hydrocarbon Release Database (HCRD) from 2006-15 published by the International Association of Oil & Gas Producers (IOGP) [3.2] and earlier estimates from HyRAM [3.3]. Other failure frequencies should be justified with reference to more recent and relevant data. The tabulated values include external events, but impact-induced leaks from vehicle collisions and fire-induced failures may be considered and added to the equipment leak frequencies if appropriate. For hoses, the tabulated values cover connection and drive-off failures. For cylinders, full-bore refers to the size of the connecting pipe, and instantaneous refers to larger failures of the cylinder itself.

Equipment Type	Leak Frequency (per year) within Hole Diameter Range Note 1					
	Very small	Small	Medium	Large	Full-bore	Instantaneous
Compressors (centrifugal)	7.91E-03	4.54E-03	2.61E-03	1.50E-03	2.02E-03	
Compressors (reciprocating)	1.59E-02	9.27E-03	5.40E-03	3.14E-03	4.38E-03	
Cylinders	2.42E-07	1.84E-07	1.39E-07	1.05E-07	2.82E-08	3.02E-07
Filters	1.84E-03	9.30E-04	4.69E-04	2.36E-04	2.40E-04	
Heat exchangers (shell & tube)	5.43E-04	3.76E-04	2.60E-04	1.80E-04	4.06E-04	
Hoses	1.39E-04	8.85E-05	5.65E-05	3.61E-05	6.38E-05	
Instruments	1.80E-04	9.86E-05	1.19E-04			
Joints	5.84E-06	3.41E-06	1.99E-06	1.16E-06	1.63E-06	
Pipes (1 metre)	2.36E-06	1.35E-06	7.70E-07	4.40E-07	5.85E-07	
TPRD				3.50E-03		
Valves (actuated)	2.76E-04	1.45E-04	7.68E-05	4.05E-05	4.53E-05	
Valves (manual)	2.30E-05	1.53E-05	1.02E-05	6.77E-06	1.34E-05	

Note:

They are based on an equipment diameter of 20 mm, but they can be applied to any diameter in the range 16-32 mm. For equipment of 8-16 mm diameter, in the full-bore case, the tabulated frequencies of large and full-bore leaks should be added together. For equipment of 4-8 mm diameter, in the full-bore case, the tabulated frequencies of medium, large and full-bore leaks should be added together. For equipment of >32 mm diameter, the tabulated full-bore frequency should be split equally into very large and full-bore leaks.

Table 2: Summary of Hydrogen Equipment Leak Frequencies (Best Estimates)

2.5.2 For dispensers, electrolysers and pressure swing adsorption units, frequencies should be estimated by combining the frequencies above with the numbers of pipes, cylinders, joints and valves in the unit.

2.5.3 If piped supply from the high pressure town gas network is adopted as the hydrogen source, the equipment leak frequencies associated with the extraction facility, are as described in Section 3.4 of the EMSD HPTGI Guidance Note [3.4]. Where equipment leak frequencies are unavailable (e.g. compressor), internationally recognised historical failure databases should be referred.

2.6 Event Tree Analysis

2.6.1 An event tree analysis should be performed to model the development of each hazardous event from the initial release to final outcomes. The analysis should take into consideration of hole sizes of release, orientations of release, presence of ignition sources and types of ignition. A typical event tree is presented in Figure 1.

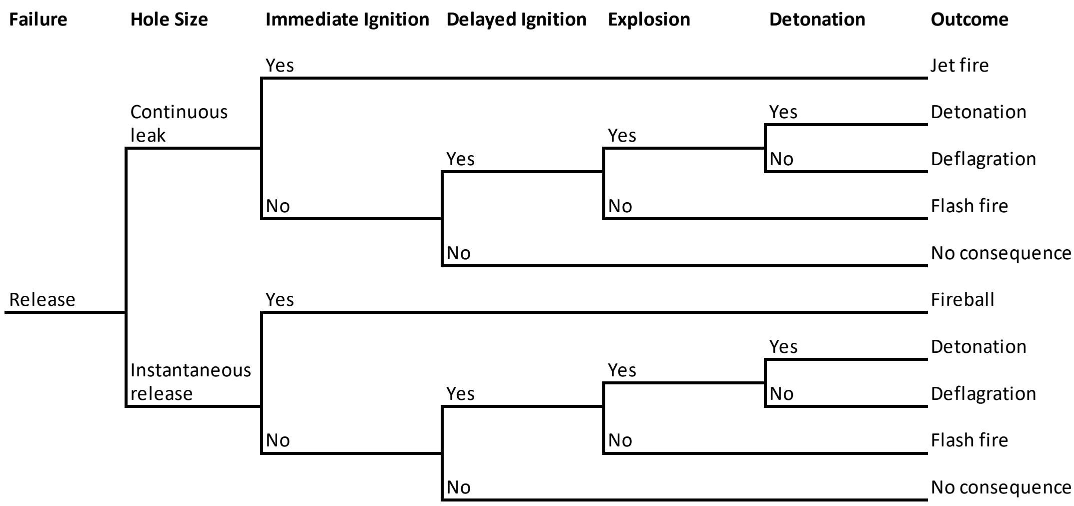

Figure 1: Event Tree Example for Hydrogen Equipment

2.6.2 If piped supply from the high pressure town gas network is adopted as the hydrogen source, the event tree associated with the extraction facility, as stipulated in Section 3.5 of the EMSD HPTGI Guidance Note [3.4] should be followed.

2.7 Release Orientation and Impingement

2.7.1 The consequence modelling should take account of the orientation of the leak and whether or not it impinges on nearby obstacles, which reduces the momentum of the release.

Possible orientation and impingement options include:

- Upwards (unimpinged) – the scenario where the release of hydrogen from equipment, such as a cylinder, is in an upward direction without encountering any form of obstruction.
- Horizontal (unimpinged) – the scenario where the release of hydrogen from equipment, such as a cylinder, is in a horizontal direction and free from any interfering objects or barriers.
- Horizontal (impinged) – the scenario where the release of hydrogen from equipment, such as a cylinder, is in a horizontal direction and obstructed by an obstacle, for example, a fire wall.
- Downwards (impinged) – the scenario where the release of hydrogen from equipment, such as a cylinder, is in a downward direction and obstructed by an obstacle, for example, the ground.

2.7.2 The orientation probabilities should be based on site-specific layouts. For spherical / cubic arrangement of equipment (e.g. cylinder leaks on a tube trailer), the probabilities of 0.17 upwards, 0.17 downwards and 0.66 horizontally can be considered. If the equipment in a segment has a long thin arrangement (e.g. an above ground pipe between two parts of a system) the random orientation of 0.25 upwards, 0.25 downwards and 0.5 horizontally can be considered. Where equipment are located within low fences, fire walls or site boundary walls, if the release is partially blocked, the horizontal hydrogen release can be modelled as evenly split between "unimpinged" and "impinged" conditions, thus 50% of unobstructed flow and 50% of obstructed flow; and if the release is completely blocked, the horizontal hydrogen release should be considered as "impinged only", thus 100% of obstructed flow.

2.7.3 For complex and critical cases, such as releases obstructed by walls, 3D calculations should be used. To take into account the effect of wall in 2D model risk calculations, the orientation and impingement should be chosen that best matches the dispersion in the 3D results.

2.7.4 If piped supply from the high pressure town gas network is adopted as the hydrogen source, the orientation probabilities for aboveground HPTGIs (e.g. aboveground HPTGP, valves, flanges, instrument connections), as stipulated in Section 3.5 of the EMSD HPTGI Guidance Note [3.4] should be followed.

2.8 Ignition Probability

Total Ignition Probability

2.8.1 The recommended ignition probability (PT) as a function of the release rate Q (kg/s) is as follows, based on analysis of leak experience at HFS in the USA, UK and Norway during 2005-19:

$P_T = 0.4Q^{0.2}$ to a maximum of 1

Delayed Ignition Probability

2.8.2 The recommended ignition probability mentioned above includes both immediate and delayed ignition. QRAs typically distinguish immediate and delayed ignition because immediate ignition is assumed to produce a jet fire while only delayed ignition has the potential for an explosion. For hydrogen release, "immediate" ignition refers to ignition occurring near the leak source within the first few seconds of the release, while "delayed" ignition refers to ignitions occurring further away or later. This includes all explosions under the "delayed" category.

2.8.3 Based on judgement, 50% of ignitions should be assumed to be immediate and 50% delayed.

2.8.4 Some variation with release rate is expected, since larger releases are more likely to reach distant ignition sources. This should be estimated by an ignition source model.

2.9 Ignition Modelling

2.9.1 If an ignition source model is used to calculate additional delayed ignition probabilities P_{model}, the conditional ignition probabilities on the event tree above are then:

$$P_{(immediate\ ignition)} = 0.5\ P_T$$

$$P_{(delayed\ ignition\ given\ no\ immediate\ ignition)} = \frac{(0.5\ P_T +\ P_{model})}{(1 - 0.5\ P_T)}$$

2.9.2 Delayed ignition sources should have minimum ignition probabilities of 0.4 per vehicle and 0.01 per person (for consistency with the EMSD HPTGI Guidance Note [3.4]).

2.10 Explosion Probability

2.10.1 The probability of explosion in a delayed ignition depends on the degree of confinement. If there is no confinement then no explosions are expected. For leaks inside a container, any delayed ignition should be assumed to explode. For leaks in open areas with normal confinement between equipment, vehicles or buildings, an explosion probability of 0.4 should be assumed [3.6].

2.10.2 Based on experiments, detonation is expected in flammable stoichiometric hydrogen-air clouds over 20 m^3 within a congested or semi-confined area. For leaks in open areas with normal confinement between equipment, vehicles or buildings, a detonation probability of 0.5 should be assumed.

2.11 Meteorological Conditions

2.11.1 Consequence calculations that are sensitive to weather conditions (i.e. all except fireballs) should be performed for at least 6 representative weather classes. These should cover low, medium and high wind speeds and stability conditions of stable, neutral and unstable. Probabilities of each weather class should be estimated from stability and wind speed data using the grouping scheme shown in Table 3.

<table>
<tr><th>Wind speed (m/s)</th><th>A</th><th>B</th><th>B/C</th><th>C</th><th>C/D</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td>< 2.5</td><td colspan="3" rowspan="3">B medium</td><td colspan="3">D low</td><td colspan="2">F low</td></tr>
<tr><td>2.5 – 6</td><td colspan="3">D medium</td><td colspan="2" rowspan="2">E medium</td></tr>
<tr><td>> 6</td><td colspan="3">D high</td></tr>
</table>

Note:
Low wind speed corresponding to < 2.5 m/s
Medium wind speed corresponding to 2.5 – 6 m/s
High wind speed corresponding to > 6 m/s

Table 3: Weather Class Definitions **[3.4]**

2.11.2 Wind speeds are in units of metres per second (m/s) while the atmospheric stability classes are referred to the following definition:-

A – Turbulent

B – Very Unstable

C – Unstable

D – Neutral

E – Stable

F – Very Stable

2.11.3 Risk calculations should be performed for at least 8 wind directions. The stability, wind speed and wind direction data should be taken from the nearest available weather station.

2.12 Population

<u>Off-Site Population</u>

2.12.1 The following major types of population within the study zone should be considered.

- Building population
  - o Building population includes residential (i.e. apartments), commercial, government, institutional and community (e.g. shops, workshops, offices, etc.), industrial, outdoor areas (e.g., on pavements, in bus queues, around hawker stalls, in sitting-out areas, in MTR entrances, in lift lobbies and outside shops) etc.; and

- Transient population
  - o Transient population includes road traffic population (e.g. Vehicles on roads or in parking areas) and pedestrian population.

2.12.2 The typical indoor factor as 0.95 should be considered for typical building such as residential building, while the indoor factor for other types of buildings should be case by case to considered in the QRA Study.

2.12.3 For multi-storey buildings and elevated expressways, the population on all levels should be included. This is appropriate for broadly spherical effects from fireballs and explosions on distant buildings, but pessimistic for flash fires and jet fires or buildings very close to the release location. If the results are critical, 3D calculations should be used to identify the building levels affected by dominant events, and the population should represent only these levels.

<u>On-Site Population</u>

2.12.4 For consistency with previous practice in Hong Kong, on-site populations (e.g. workers based at hydrogen installations, vehicle occupants etc.) are excluded.

2.13 Consequence Modelling

2.13.1 Consequence modelling (including source term and physical effect modelling) should be conducted by industrially recognised and validated software that is appropriate for hydrogen modelling. With the consequence modelling, hazardous impact distance and the associated impacts for all identified hazardous events can be evaluated.

- Source term modelling
  - For every failure scenario, gas release rates under various sizes of leak should be evaluated by the gas dispersion modelling, and from this determine the associated probabilities of ignition.

- Physical effects modelling
  - All possible final outcomes of every hazardous event should be modelled. Final outcomes for ignited hydrogen gas can be fireball, jet fire, flash fire, deflagration and detonation.

2.13.2 Current integrated QRA models are all based on a flat-earth (2D) approach, which is acceptable as the base QRA. Where congested release locations, obstructions such as fire/blast walls, and terrain effects are important, 3D computational fluid dynamics (CFD) models should be used to calibrate or justify the 2D model. CFD should also be used to analyse the benefits of fire/blast walls and to establish design requirements such as fire and explosion resistance, wall heights and layouts.

2.14 Impacts on People

2.14.1 The impact of the modelled consequences on people nearby should be calculated using impact criteria defining the average probability of death within the threshold hazard intensities given in Table 4.

<table>
<tr><th rowspan="3">Risk Type</th><th rowspan="3">Location</th><th colspan="6">% Fatalities in Impact Zone</th></tr>
<tr><th colspan="2">Fireball/ Jet fire</th><th>Flash fire</th><th colspan="2">VCE</th></tr>
<tr><th>>37.5 kW/m^2 or fire envelope</th><th><37.5 kW/m^2</th><th>(>LFL)</th><th>>0.3 bar</th><th>0.1 – 0.3 bar</th></tr>
<tr><td>Individual risk</td><td>Outdoors</td><td>100</td><td>Probit</td><td>100</td><td>100</td><td>0</td></tr>
<tr><td rowspan="3">Societal risk</td><td>Outdoors</td><td>100</td><td>Day: Probit × 0.28
Night: Probit × 0.14</td><td>100</td><td>100</td><td>0</td></tr>
<tr><td>In vehicles</td><td>Fireball: 25
Jet fire: 100</td><td>0</td><td>100</td><td>100</td><td>0</td></tr>
<tr><td>In buildings</td><td>5</td><td>0</td><td>5</td><td>100</td><td>2.5</td></tr>
</table>

Note:
Eisenberg probit is referred [3.6].

Table 4: Impact Criteria for Hydrogen

2.14.2 The protection of people at height in multi-storey buildings should be modelled by selecting the population on appropriate levels, as described in Section 0 above.

2.15 Risk Summation

2.15.1 Risk summation should be conducted by industrially recognised and validated risk summation software, as agreed/approved by the authority to generate the risk levels associated with the hydrogen installations in terms of Individual Risk (IR) and Societal Risk (SR), taking account of the following parameters:

- Release cases of all identified hazardous events with the associated likelihood;
- Release locations of all identified hazardous events;
- Meteorological data including the wind direction and the associated wind speed and stability; and
- Population data (building population, road traffic population and pedestrian population) with the location as well as the indoor fraction.

2.15.2 Apart from the IR (in terms of iso-contours) and SR (in terms of FN curves), a summary of Potential Loss of Life (PLL) with breakdown of major risk contributors (such as PLL ranking by failure case) should be presented.

2.16 Risk Criteria

2.16.1 The acceptability of the risks from hydrogen installations should be assessed using the HKRG for PHIs, developed by the Coordinating Committee on Land-use Planning and Control relating to Potentially Hazardous Installations (CCPHI) and published as part of the Planning Department's Miscellaneous Planning Standards and Guidelines [3.4].

2.16.2 The key criteria in the risk guideline are:

- Individual risk criterion: The individual risk is defined in the RG as the predicted increase in the chance of death for an individual living or working near the PHI. When using risk contours, the estimated duration of exposure of a person to the PHI should also be taken into account. The maximum level of off-site individual risk associated with PHIs should not exceed 1×10^{-5} per year; and
- Societal risk criterion: The societal risk expresses the risks to the whole population living near the PHI. It is expressed as an FN curve, plotting the frequency (F) per year of N or more deaths in the population from incidents at the PHI (Figure 2). The societal RG divide risks into unacceptable, ALARP or acceptable. In the "ALARP region" risks should be made "as low as reasonably practicable".

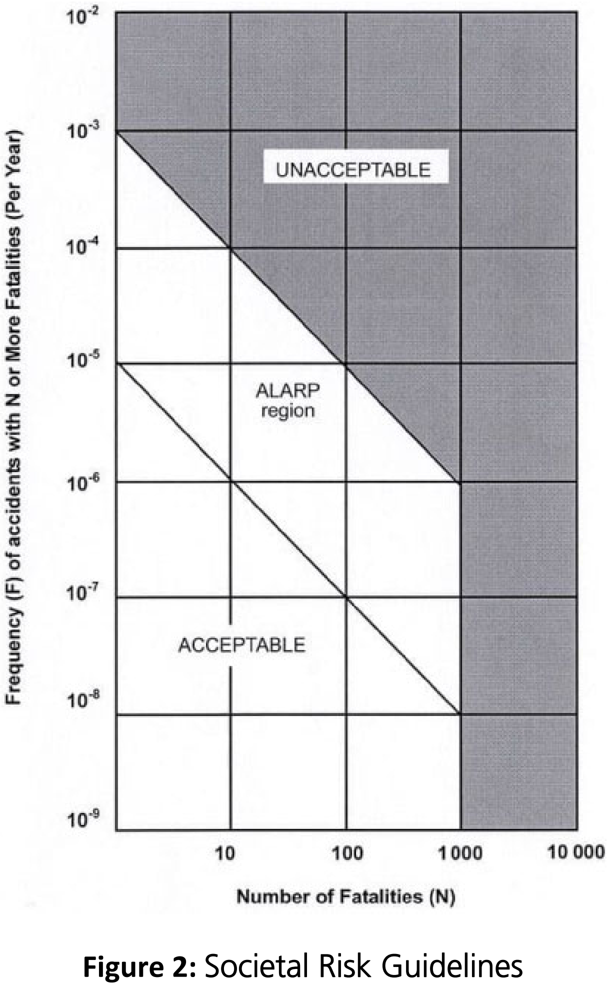

Figure 2: Societal Risk Guidelines

2.17 Study Findings

2.17.1 The QRA Study should summarise the gas risks in terms of both IR and SR with precise and concise descriptions of the overall QRA study. Apart from IR and SR, PLL should also be incorporated to present the top risk contributors in order to propose practical and cost-effective mitigation measures, where necessary.

2.18 Mitigation Measures

2.18.1 If SR result falls into ALARP region, all practicable and cost-effective mitigation measures should be considered. The feasibility of the proposed mitigation measures should be evaluated and justified by Cost Benefit Analysis (CBA).

2.18.2 If IR/SR result falls into Unacceptable region, all practicable mitigation measures should be implemented regardless of cost of construction or fulfilment.

2.18.3 The SR results for new installations in Hong Kong should be within the acceptable region. This assumes that new installations are of less constraints and measures to lower the SR to acceptable region are normally more cost-effective for new installations. It also avoids any need for ALARP demonstration.

2.19 Conclusion and Recommendations

2.19.1 Conclusion should summarise the background of the QRA study, key study findings and QRA results to indicate whether the associated risks posed from hydrogen installations within the study zone are in compliance with HKRGs in terms of IR and SR.

2.19.2 The QRA study should provide recommendations in the interest of gas safety where applicable. Recommendations include but are not limited to the proposed mitigation measures.

3. Reference

3.1 Sandia National Laboratories (2009), "Analyses to Support Development of Risk-Informed Separation Distances for Hydrogen Codes and Standards", SAND 2008-0874, March 2009.

3.2 International Association of Oil & Gas Producers (2019), "Risk Assessment Data Directory: Process Release Frequencies", Report 434-01, September 2019.

3.3 Sandia National Laboratories (2020), "Final Report on Hydrogen Plant Hazards and Risk Analysis Supporting Hydrogen Plant Siting near Nuclear Power Plants", SAND 2020-10828, Oct 2020.

3.4 EMSD (2021), "Guidance Note on Quantitative Risk Assessment Study for High Pressure Town Gas Installations in Hong Kong".

3.5 Planning Department (2022), "Hong Kong Planning Standards and Guidelines, Chapter 12: Miscellaneous"

3.6 VROM (2005), "Guidelines for quantitative risk assessment", Ministry of Housing Spatial Planning and the Environment, the Netherlands.