RISK ASSESSMENT

Presentation

For the

Gas to Power Facility

In

Saldanha Bay

By:

MHR Consultants

Major Hazard Risk Consultants

GOVERNMENT
APPROVED
INSPECTION
AUTHORITY

sanas Inspection Body

MHI 0017

PUBLIC REVIEW FOR THE RISK ASSESSMENT AS A SPECIALIST REPORT FOR THE GAS TO POWER FACILITY IN SALDANHA BAY

Introduction

Assegai Energy, in conjunction with their international technology partners, are proposing a gas to power facility on Portion 69 of Farm 127.

The project area is located adjacent to the Saldanha Industrial Development Zone (IDZ), in Saldanha Bay, Western Cape, where the applicant is proposing the development of a gas-to-power facility for direct transmission into the ESKOM electricity grid. The proposal forms part of a bid submission to be included under the Risk Mitigation of the IPP Procurement Programme for new generation capacity (as advertised by the DMRE).

The site is partially developed as an LPG import and distribution terminal. The terminal is located on the southern part of the property. The terminal consists of the following:

1. 8x 500m3 semi-mounded vessels;
2. LPG Pumping manifold;
3. Road Gantry;
4. Cylinder Filling Area;
5. Cylinder Storage Area.

The area immediately surrounding the facility is undeveloped with the following MHI companies in close proximity to the site:

1. Sunrise Energy LPG Depot – Registered MHI 650m located South East from Avedia;
2. ArcelorMittal – Registered MHI 1700m located North East from Avedia;
3. SFF – Registered MHI 3600m located East from Avedia.

The area is designated as Medium – High Industrial with 40 persons/ hectare in the daytime and 8 persons/hectare at nighttime (Thackwray, 2017).

The terminal will be used as the baseline for the study. All the proposed developments and upgrades will be measured against the baseline to see the impacts of the proposed installations and upgrades.

The project aims to have LPG supplied from a VLGC (Very Large Gas Carrier) at the Port of Saldanha which would be offloaded via a pipeline to the existing Avedia Energy onshore terminal (previously authorised). The vessel will serve as primary storage, whilst the facility will serve as secondary storage.

The power plant, to be established on the existing Avedia Energy site, will consist of 12 gas fired turbines fuelled with the piped LPG. The LPG will be supplied to the power plant from the existing on-site LPG tanks via an on-site pipeline. The process entails the direct fire vaporisation of propane to produce propane vapour which will be used to fuel the gas turbines. With a maximum output of 32 MW per turbine, and considering transmission loss, it is anticipated that a maximum of 320 MW of power generation can be achieved. The activity will emit NOx, SOx and Particulate Matter. Refer to Figure 1 below for a flow diagram of the power generation process.

The space requirement for the power plant is approximately 0.5 ha which is available in the northern corner of the site (refer to Figure 2). Some minor clearing of the area and stabilisation would be required to prepare the surface for the location of the plant. The construction of concrete slabs/pads on which the plant could be anchored remains a possibility.

A new substation will be constructed on site from where the generated electricity will be transmitted via a new 132 kV line, either into an existing power line near the site, or into the Blouwater substation. Five power line route alternatives will be considered during the Scoping Phase (see Option 1 - 5 described below).

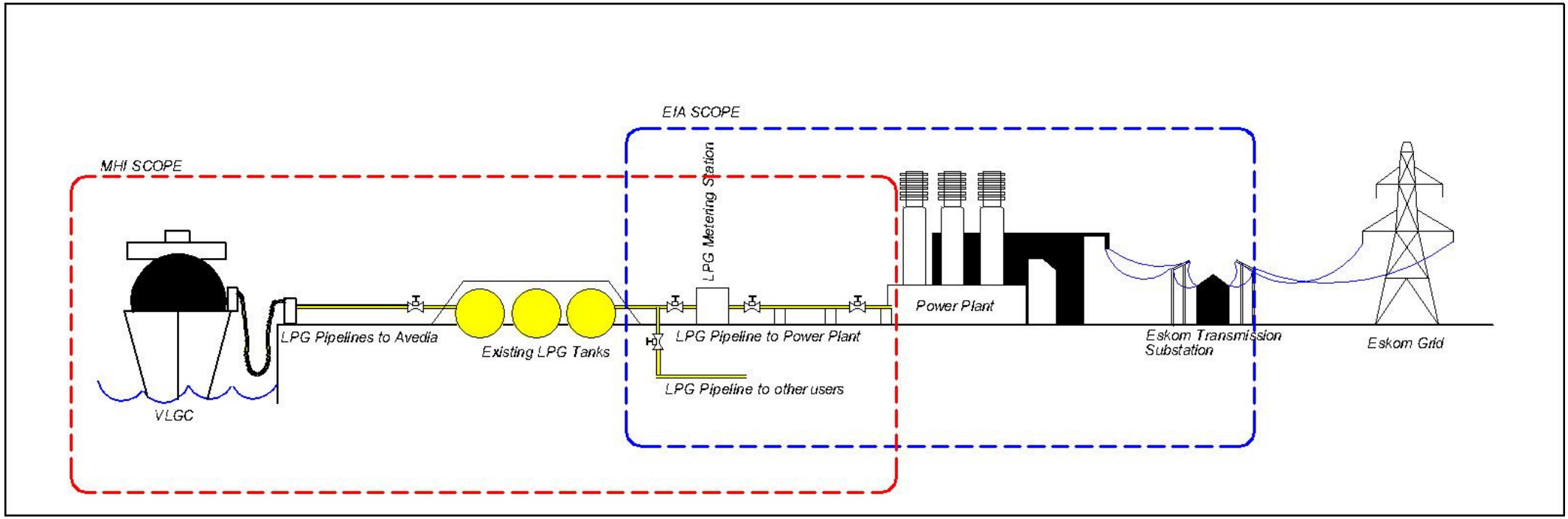
The power generation facility will make use of the existing service infrastructure at the Avedia Energy LPG Terminal.

The feasibility of making use of water injection technology for cleaner emissions will be investigated. The water supply requirement would be approximately 10L/hour per gas turbine. There is an existing high yielding borehole on site from which groundwater may be abstracted and demineralised for this purpose. An additional borehole may be drilled to meet the water demand once the design of the plant is finalised and the required volumes known.

The pipeline route for the “inbound” LPG would extend south along the Avedia Energy site, until turning east to connect to the SFF (Strategic Fuel Fund) pipeline route which runs in the SFF servitude to the SFF berth. The SFF infrastructure has already been authorised and does not form part of this application. The new pipeline would be ±2km in length. The total throughput capacity would be 500 tons per day.

It is further proposed that a second pipeline be constructed which will channel LPG from the Avedia Energy site to the Arcelor Mittal pipeline route intersection for the supply of LPG to potential projects in the area. The pipeline would extend for ±2.8km along Camp Street, Saldanha, with a maximum throughput capacity of 500 tons per day.

It is anticipated that the excavations required for the installations of the pipelines would be a maximum depth of 1.2m and a width of 1m.



GAS TO POWER PROCESS

Declaration of Independence

(from Assegai)

Legislative Context

The Occupational Health and Safety Act (OHS Act) defines an Approved Inspection Authority (AIA) in Section 1(1)(i) as *"An inspection authority approved by the Chief Inspector: Provided that an inspection authority approved by the Chief Inspector with respect to any particular service shall be an approved inspection authority with respect to that service only."*

The Major Hazard Installation Regulations (MHI Regulations), which were promulgated under the OHS Act provides more specifically for an AIA in terms of MHI Regulation 5 (5)(a) as *"An employer, self-employed person and a user shall ensure that the assessment contemplated in Sub-regulation (1), shall be carried out by an Approved Inspection Authority which is competent to express an opinion as to the risks associated with the Major Hazard Installation."*

The Risk Assessment must be conducted as per SANS 1461:2018 Codes of Practice.

The report will also include the Regulations according to the local by-laws.

Baseline Information

The area immediately surrounding the facility is undeveloped with the following MHI companies in close proximity to the site:

4. Sunrise Energy LPG Depot – Registered MHI 650m located South East from Avedia;
5. ArcelorMittal – Registered MHI 1700m located North East from Avedia;
6. SFF – Registered MHI 3600m located East from Avedia.

The area is designated as Medium – High Industrial with 40 persons/ hectare in the daytime and 8 persons/hectare at nighttime (Thackwray, 2017).

The terminal will be used as the baseline for the study. All the proposed developments and upgrades will be measured against the baseline to see the impacts of the proposed installations and upgrades.

MHR Consultants will complete a Quantitative Risk Assessment (QRA) to support the Assegai Energy project which will supply electrical power to Eskom. The project involves the direct fire vaporisation of propane to produce propane vapour to be used to fuel the gas turbines.

The Risk Assessment will include the following processes:

- Ship to shore LPG transfers;
- Pipeline from the jetty to the Avedia facility;
- Pipeline from the Avedia facility to the generating plant;
- Pipeline to new users.

Issues for Assessment

With the loss of containment of LPG, different types of fire hazard may arise, depending on whether a liquid or gas is being released. These fire hazards include jet fires, flash fires and pool fires. In certain circumstances, vapour cloud explosions (VCEs) may also occur.

Jet Fires

A jet fire is a strongly directional flame caused by burning of a continuous release of pressurised flammable gas (in this case natural gas) close to the point of release. Ignition may occur soon after the release begins; or may be delayed, with the flame burning back through the cloud (i.e. as a flash fire, see below) to the source. Jet fires may result from ignited leaks from process equipment (vessels, pipes, gaskets, etc.) and pipelines.

A jet fire may be directed horizontally or vertically (or at some angle in between). A jet fire may impinge on structures or other process equipment, potentially escalating the incident. The intensity of thermal radiation emitted by jet fires can be sufficient to cause harm to exposed persons.

Flash Fires

Flash fires result from ignition of a cloud of flammable gas or vapour when the concentration of gas within the cloud is within the flammable limits.

Typically, a flash fire occurs as the result of delayed ignition once the flammable cloud has had time to grow and reach an ignition source. In the absence of confinement or congestion, burning within the cloud takes place relatively slowly, without significant overpressure. It is assumed that thermal effects are generally limited to within the flame envelope where there is a high probability of death.

Pool Fires

A loss of containment of LPG does not normally result in the formation of a flammable pool. Pool fires will not be modelled.

Vapour Cloud Explosions

When a cloud of flammable gas occupies a region which is confined or congested, and is ignited, a vapour cloud explosion is the result. The presence of confinement (in the form of walls, floors and/ or a roof) or congestion (such as the pipes, vessels and other items associated with process plant) in and around the flammable cloud results in acceleration of the flame upon ignition. This flame acceleration generates blast overpressure. The strength of the blast depends on several factors, including:

- The reactivity of the fuel;
- The degree of confinement or congestion;
- The size of the congested / confined region occupied by the flammable cloud;
- The strength of the ignition source.

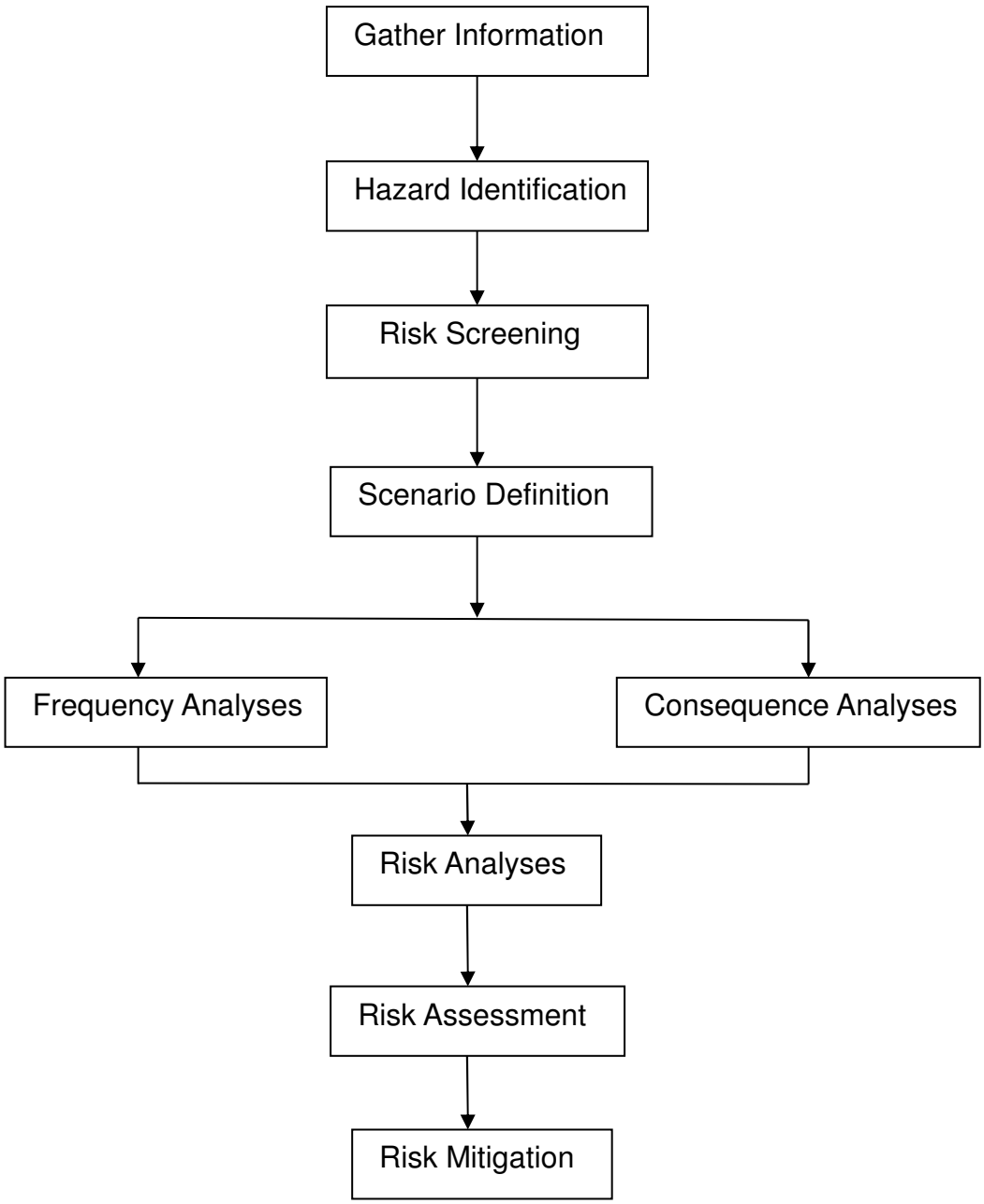
The Risk Assessment will address the following questions:

- What can go wrong?
- If things go wrong, what would the consequences be?
- What is the likelihood of things going wrong?

- Does action need to be taken?

A structured methodology is followed to obtain the answers to these, and other related questions. A Quantitative Risk Assessment (QRA) is used to calculate the likelihood, consequences, and risk results in numerical terms. The QRA process is shown below:

QRA PROCESS



Once the risk analysis results have been obtained, it is necessary to assess their significance. This often involves comparison of the results against pre-defined criteria. Risk criteria may be established by regulators or set internally by the company. Risk criteria usually define:

- The level of risk which is deemed unacceptable (except perhaps in extraordinary circumstances);
- The level of risk which is considered so low that further efforts to reduce the risk are unnecessary.

Between these two levels is a region in which the risk may be considered tolerable, on the condition that all appropriate measures have been taken to control the risk.

The risk analysis results may indicate a need to consider the implementation of further measures to reduce the risk. The analysis outputs may then be interrogated to determine whether there are any specific scenarios which dominate the risk profile. Where such key risk contributors can be identified, it is prudent to focus efforts to reduce the risk on these scenarios.

Once potential risk reduction measures have been postulated, their effectiveness may be evaluated by modifying the analysis inputs to include them and re-running the calculations. The final decision about whether, or not to implement a given risk reduction option depends on:

The magnitude of the initial risk

- if the risk is high relative to the relevant criteria, this will provide a stronger driver for taking action;
- The size of the risk reduction that would be achieved if the measure were to be introduced;
- The cost of implementing the measure.

It should be noted that consideration of the costs and benefits of implementing a risk reduction measure is usually weighted in favour of safety, such that the costs have to be much greater than the benefits before a measure can be ruled out.

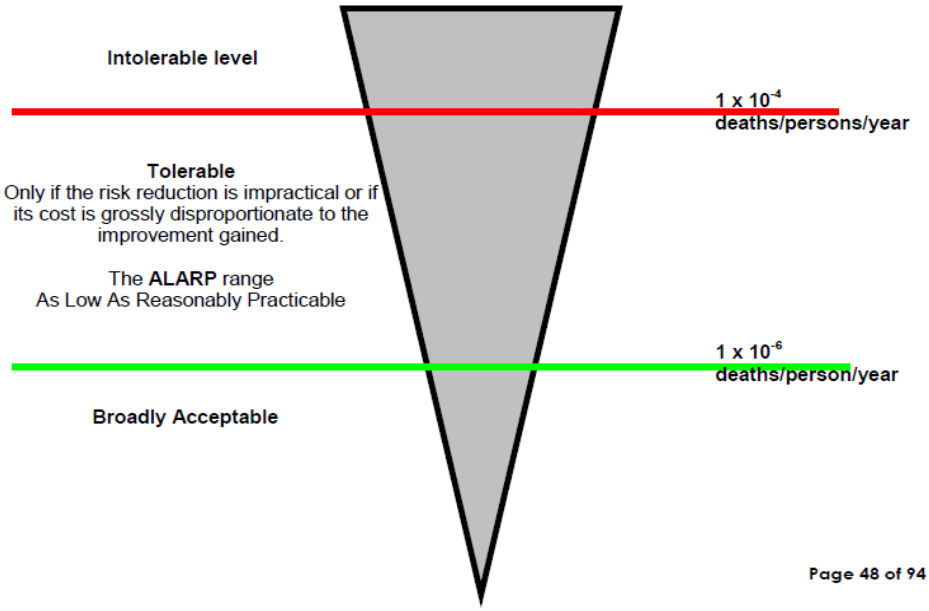
Results

The Individual Risk is the starting point for the development of the Risk Evaluation Criteria. However undesirable a fatality may be, there is a frequency of occurrence at which a single fatality could be considered “Broadly Acceptable”. Based on extensive analysis of accident data across a variety of industries (including land, sea and offshore) the UK HSE developed a criterion which defines the tolerability of a single fatality in terms of frequency of occurrence as shown in below.

Where an individual fatality is assessed to occur with a frequency of 1x10-3 for employees or 1x10-4 for the public, or greater, this is considered to be intolerable or unacceptable and risk reduction measures are required to reduce the risk to “Tolerable” or “As Low As Reasonably Practicable” (ALARP), or the project stopped.

Where an individual fatality is assessed to occur with a frequency of 1x10-6 or less, it is “Broadly Acceptable”, with no further consideration of risk reduction measures necessary.

Between the “Broadly Acceptable” and “Unacceptable Risk” sectors, there is a region in which the risk is considered tolerable if it is ‘as low as reasonably practicable’ (ALARP). The risk is ALARP when the cost of any further risk reduction measures would be grossly disproportionate (i.e. much greater than) to the benefits gained.

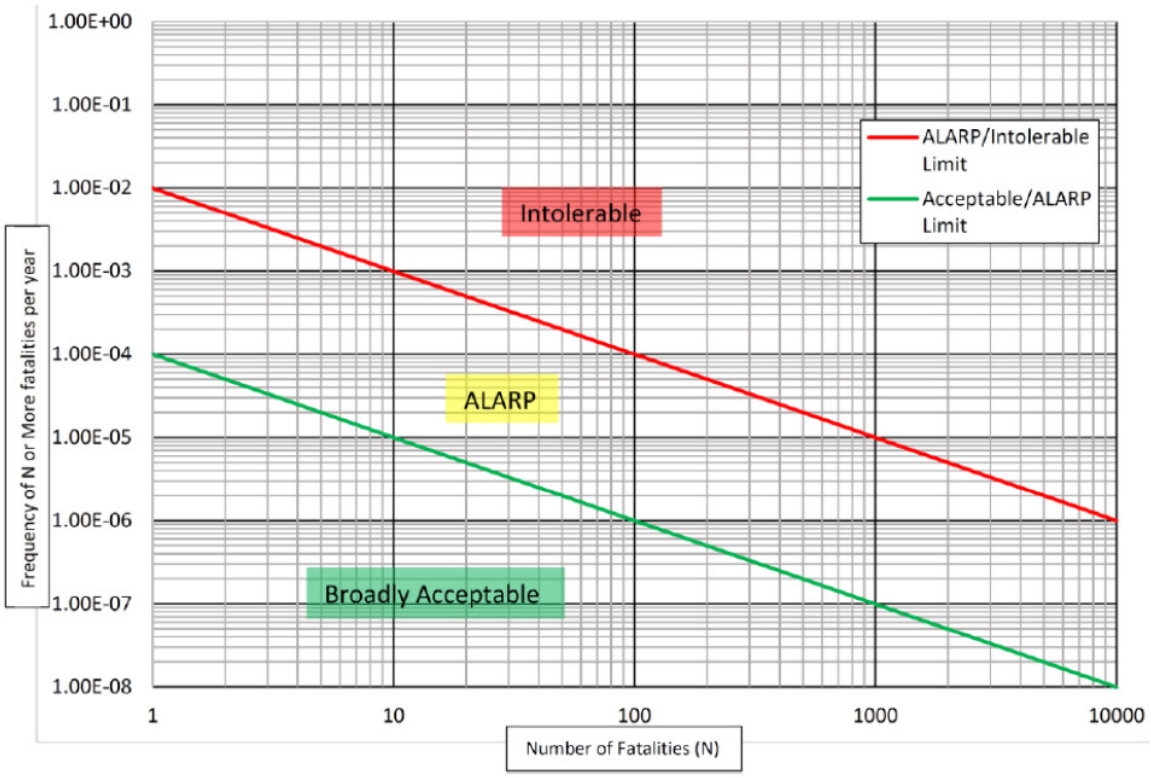


Societal risk is defined as the relationship between frequency and the number of people suffering from a specified level of harm in each population from the realisation of specified hazards *[Jones, 1985].* Societal risk evaluation is concerned with estimation of the chances of more than one individual being harmed simultaneously by an incident. The likelihood of the primary event (an accident at a major hazard installation) is still a factor, but the consequences are assessed in terms of level of harm and the numbers affected (severity), to provide an idea of the scale of an accident in terms of numbers killed or harmed.

Societal risk is dependent on the risks from the substances and processes located on a Major Hazard Installation. A key factor in estimating societal risk is the population around the site, its location and density. For example, the more (occupied) buildings in any area, the more people could be harmed by a flammable gas cloud passing through that area. For an installation with a population located in a specific compass direction, the chance of a flammable gas release would depend on the probability of drift in that direction.

Generally, scenarios to be included in a risk assessment can be characterised as having a frequency (F) and a consequence (N, number of casualties). *F* is used to denote the sum of the frequencies of all the individual events that could lead to *N* or more fatalities (hence the reference to *FN curves*).

Societal risk can be represented by FN curves, which are plots of the cumulative frequency (F) of various accident scenarios against the number (N) of casualties associated with the modelled incidents. The plot is cumulative in the sense that, for each frequency, N is the number of casualties that could be equalled or exceeded. Often 'casualties' are defined in a Risk Assessment as fatal injuries, in which case N is the number of people that could be killed by the incident.



Next Steps

During the EIA process the following needs to be compiled:

1. Preferred pipe routing from the LPG storage area to the power generation plant;
2. Pipeline specifications need to be designed and agreed on;
3. Possible mitigation that will be implemented with the pipeline design to minimise risk;
4. Additional safety systems that may be required on the site between the LPG storage area and power plant need to be investigated.

Once the above information is available, the MHI Risk Assessment can be compiled to determine the risks involved with the supply of LPG to the power plant.

The Risk Assessment will determine the effectiveness of the designs and the proposed mitigation in the designs. It will also establish if further mitigation should be implemented in the design of the pipelines.

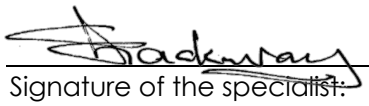
8.4 THE SPECIALIST

Note: Duplicate this section where there is more than one specialist.

I Claude Thackwray, as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
  - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
  - am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;
- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;
- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;
- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;
- have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;
- have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Note: The terms of reference of the review specialist must be attached.



Signature of the specialist:

Major Hazard Risk Consultants

Name of company:

13 October 2020

Date: