Quantitative Risk Assessment Explained

Elba Island regasification plant in Georgia, United States

Quantitative Risk Assessment explained

Introduction

This document explains how risks and hazards are assessed at industrial plants such as the one proposed by QGC for Curtis Island at Gladstone in Queensland.

The assessment of risk is necessarily technically demanding, and must be done with technical competence to be credible. Nonetheless, the acceptance of risk is an issue for the public, and for those who make decisions on behalf of the public.

This means that communication about risks and hazards needs to occur at various levels of complexity to cater for people with different levels of technical training. But all these levels of communication must have something in common: honesty and integrity.

The following is a communication for the public. We are happy to have your feedback about this document or to provide you with more detail.

Catherine Tanna
Managing Director, QGC Ltd

Managing risks and hazards

The liquefied natural gas industry involves hazards that must be managed.

This means the industry has a responsibility to take great care in the design and management of plant, equipment and operational processes so risks are minimised or, if possible, avoided.

Regulators and insurers have responsibilities too – they must be vigilant in monitoring and assessing developments to ensure that the industry is designed and managed safely.

The assessment and management of risk is a distinct and demanding profession.

Communication within that profession, among colleagues, is inevitably detailed and complex.

But the measurement of risk and questions about what represents an acceptable risk are of great relevance and interest to the public. It is important that people know in advance the risks associated with new developments.

This information sheet explains the key process companies use to determine the risk inherent in a particular activity, and what it means for the public.

QGC's Condamine power station in the Surat Basin.

The evolution of risk assessment – or how we got here

The general evolution in environmental awareness during the 1970s focused attention on hazardous industry, and particularly the potential impact of accidents on workers in the industry and on surrounding communities.

In 1972, a landmark study and subsequent report, led by Lord Robens in the United Kingdom, set the basis for what were to become regulations governing the control of industrial and major accident hazards.

The approaches and principles established then have been constantly refined in the years since, and remain the cornerstone of modern risk and hazard management.

In summary, these principles are:

- Industry is responsible for identifying and managing activities to protect workers and neighbours.
- Regulation should be strong, and aimed at performance rather than the prescription of methodology.
- A comprehensive safety assessment, done by an independent expert who will certify the competence of their assessment, is required for each hazardous industry.
- A specific low level of risk should apply to all new projects.
- Ongoing vigilance is required for operating projects, to ensure that standards do not slip.

These principles have been adapted to local conditions in most states of Australia.

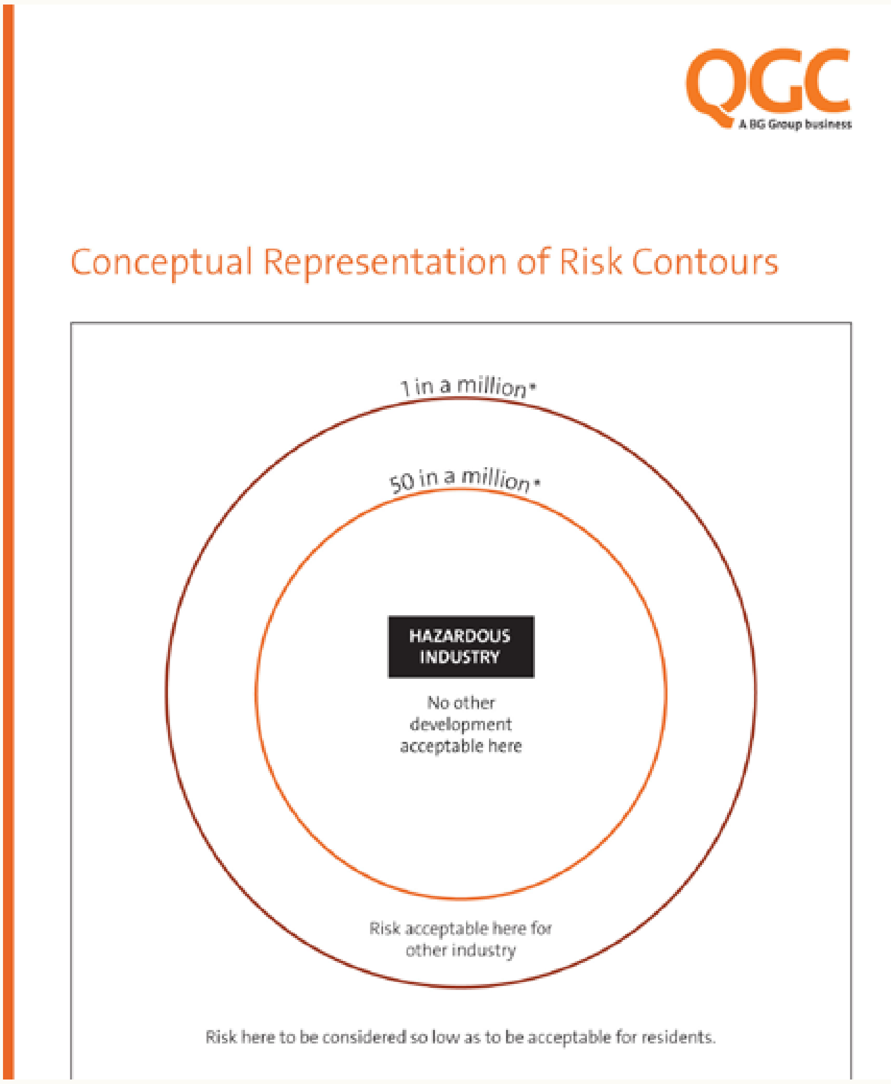
The global insurance industry uses quantitative risk assessment to help decide insurance for new developments.

Risk and quantitative risk assessment

The oil and gas industry, working with the insurance industry and government regulators, has led the development and application of a particular form of safety assessment that is part of the overall safety case for an industrial facility.

This is referred to as a quantitative risk assessment, or QRA.

Figure 1: Conceptual Representation of Risk Contours



Quantitative risk assessment helps answer the question:

How safe is safe enough?

Another way of looking at it is:

How low must an imposed risk be before communities decide that the risk is acceptable?

Quantitative risk assessment combines the known frequency, or probability, that something may go wrong with an assessment of the potential consequences for people if something goes wrong.

It then compares the results of these calculations against a benchmark of acceptable risk.

A one-in-a-million chance of an individual death occurring in a year at a particular location is the globally accepted benchmark for the additional risk that industry imposes on a residential population.

Comparing the outcome of the calculation of quantitative risk against the benchmark tells us whether the risk is low enough, for regulators and the public, to be considered acceptable.

You may have seen this result expressed as something like 1×10^{-6}, which really translates to a one-in-a-million chance of that activity causing an individual death in that particular location in a given year.

Results of quantitative risk assessments may be expressed as lines or "risk contours" on a map around an industrial development, describing the risk at a particular location. These risk contours are drawn on the very conservative assumption that an individual would remain exposed in that particular location for the entire year.

See Fig 1: Conceptual Representation of Risk Contours

For QGC's proposed Gladstone plant the individual risk of death at the nearest residence, about 4km away, is significantly lower than one in a million in a year.

Industries around the world engaged in potentially hazardous activities have used this approach for the past 25 years as the basis for calculating risks and consequences.


BG Group's liquefaction plant in Egypt

Imposed risk versus voluntary risk

Our tolerance to any risk is relative, and largely related to whether the particular risk is imposed on us, or whether we choose to impose it on ourselves.

We may be prepared to accept a new industrial development that carries a one-in-a-million risk of an individual death in a year. But, some people may choose to impose risks on themselves that are potentially a hundred-fold or thousand-fold higher.

Examples include travelling in cars or on motorbikes. In Australia, the annual risk of a work-related event causing a fatality is about 70 per million work-exposed individuals. This could be expressed as a risk of one in 14,300.

The table below presents the annual risk of fatality to an individual from certain activities or events:

Activity risk

Activity	Risk
The risk of being struck by lightning	One in 6 million
The risk of death in plane travel	One in 400,000
The risk of death in swimming	One in 88,000
The risk of death in crossing the street	One in 48,500
The risk of death in car travel	One in 6,500

As discussed, regulators require that industrial developments present a fatality risk to the residential public no greater than a one-in-a-million chance in a year. Compare this to the global risk for a person being struck by lightning of about one in 6 million a year.

Any development that poses a significantly greater risk to public safety than one in a million is not allowed to proceed and the proponent must find ways to make it safer.

At work, people will generally accept higher risk if they have been appropriately trained and the right precautions are in place. The normally accepted criterion for acceptable risk applied to industry is 50 in a million a year.

On the other hand, people expect greater protection for schools, hospitals, child-minding centres and mature-age people's homes. It is normally accepted that a risk of 0.5 in a million will apply in these places.

Calculating the risk

Quantitative risk assessment occurs in two stages. One stage assesses the likelihood that something may happen, and the other stage assesses the consequences if it does occur.

Assessing a risk involves looking at the whole of the industrial plant or process and all that goes with it, conceptually breaking it into its individual parts or pieces of equipment, and systematically assessing each of those components.

We know from established engineering knowledge the frequency or likelihood of a component malfunctioning or breaking.

Industry, insurers and regulators have kept meticulous records for decades, giving us a comprehensive history of a component's performance over time. Statistics and ratios are also kept on a range of other areas, including human error.

For example, in a liquefied natural gas plant we know the potential failure rate for pipes of different sizes and we know the total length of those pipes, so from that we can calculate the likelihood of failure for all pipes.

Similarly, we know the potential failure rate for pressure vessels, we know the scale of the vessels and the nature of the pressures they carry. This allows us to calculate the likelihood of potential failure for all pressure vessels. And so on.

By adding up the individual history of failure for each of the individual components we can calculate the overall risks of the operation.

Consequences

The next step in the risk assessment process is considering the consequences of something going wrong, and planning to mitigate, or avoid, any impacts.

In the case of the gas industry, for example, we assess what happens in a gas leak, or if gas vapour is ignited.

This analysis of consequence is an established science – we know about toxicities, we know about burning temperatures, we even know about explosive mixtures of vapours and their actual explosive force.

We can take all these possible occurrences and then determine their potential impact on people.

This helps industry put in place layers of protection to keep the public and workers safe in the event that something goes wrong.

So, by combining what we know about the failure rates of each item of equipment with the potential consequence of such a failure, we can arrive at the overall risk to safety.

Deliberate harm

Today, we would not build and operate a hazardous item of equipment without considering the potential for someone to deliberately cause problems.

An act of terrorism is an example of deliberate harm.

Quantitative risk assessment helps here, too, as the method for considering the consequences does not distinguish between whether an event or incident was caused on purpose or by accident.

How the incident occurs makes little difference to calculated outcomes, particularly for an industry as regulated as the gas industry.

Federal and state agencies in Australia are responsible for assessing threats on critical infrastructure. An assessment at Gladstone found that the introduction of the liquefied natural gas industry to the port would not change existing threat levels.

The quantitative risk assessment can guide the responsible government agencies in preparing appropriate management plans should an incident occur.

Keeping communities safe

Ultimately, this complicated-sounding process produces a simple and direct result: either a risk is acceptable, or it is not.

We know the acceptable standards of risk to which we have to design and manage equipment, and how to calculate whether we can meet those community and regulatory expectations.

But, it is just as important that we maintain that level of safety.

The gas industry typically ensures safety through designs which comply with international safety standards and by establishing buffer distances between populations and hazardous activities, just in case something goes wrong.

Even after construction of an industrial plant or facility, new residential populations must be kept outside of the safe line or risk contours.

In a liquefied natural gas plant, safety barriers apply to people, equipment, systems and processes.

These range from safety briefings for visitors and staff when they enter a facility to sophisticated sensors throughout the plant that are monitored by computer in the main control room.

On the water, other precautions, such as separation distances and safety zones, are established safety practice. One example pertinent to Gladstone is that recreational vessels and other potential sources of ignition are not allowed within 250 metres of a liquefied natural gas vessel that is berthed in port.

Beyond this, quantitative risk assessment provides industry with a tool for monitoring safety and using feedback to improve processes and operations.

This is part of the continuing vigilance required to manage a potentially hazardous operation.

About QGC

QGC is wholly owned by BG Group, a leading oil and gas company with headquarters in the United Kingdom and operations in 27 countries.

QGC is developing the Queensland Curtis LNG Project at Gladstone, in Queensland, Australia. This project involves extracting coal seam gas from the Surat Basin in southern Queensland and transporting it by a 340 km underground pipeline to Gladstone where it will be exported as liquefied natural gas.

BG Group is a world leader in natural gas and has liquefied natural gas interests in the United States, Trinidad and Tobago, Egypt and Wales.

In a liquefied natural gas plant, safety barriers apply to people, equipment, systems and processes.


A worker at a QGC gas plant in the Surat Basin

QGC Pty Limited
275 George Street
BRISBANE 4000
Queensland
Australia

GPO Box 3107
BRISBANE
Queensland 4001
Australia

Telephone: +61 7 3024 9000
Facsimile: +61 7 3024 8999
Email: community@qgc.com.au
Web: www.qgc.com.au

January 2010