

# LNG Shipping Safety



## LNG shipping – a strong safety record

Liquefied Natural Gas (LNG) has been safely produced and transported across the world since the 1960s - over 135,000 voyages have been completed covering over 100 million kilometres, without there ever being a significant spill, loss of cargo, or environmental incident.

There are hundreds of LNG carriers transporting LNG from production facilities to gas terminals and markets worldwide.

LNG carriers are built to very strict international design standards, and feature sophisticated equipment to enhance safe navigation.

LNG import terminals operate in many places around the world in close proximity to cities and urban populations. One example is Golden Pass LNG terminal in Texas, where houses are located around 200m from the facility and 100m from the shipping channel. Of the 28 existing LNG terminals in Japan, a seismically active country, most are near major cities such as Tokyo and Osaka.



## Ship Vetting

Strict vetting procedures would apply to the charter of LNG ships for use at the proposed terminal. This is to ensure that only high quality, modern ships with a good safety record can access the terminal.

All ships used by Viva Energy are inspected prior to being chartered to ensure they meet strict vetting criteria and all relevant laws, regulations and standards for ships entering Australian waters. This includes a requirement for a recent inspection under the international Ship Inspection Report Programme (SIRE) by an independent and experienced surveyor. The age, history, condition and certification of the ship are examined, and the ship's crew must meet minimum requirements regarding qualifications, experience and pay.

## LNG ships are specially designed for safety

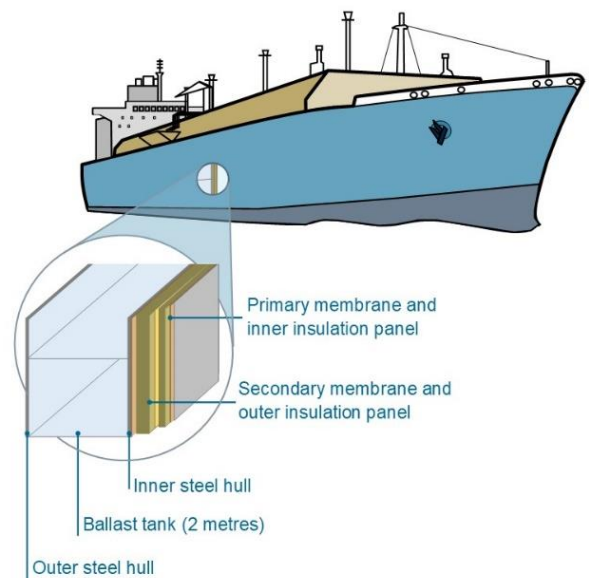
LNG carriers are modern ships specially designed and constructed to prevent leakage or rupture.

LNG is stored in a special containment system within the inner hull of the vessel, designed to protect the cargo in case of an accident. The double hull design means that in order for a leak of LNG to occur from a tank on board the ship, two steel hulls would need to be pierced, as well as the tank insulation and inner containment system.

Even if the outer hull was damaged during a major collision or during a serious grounding accident, there is more than 2 metres between the outer hull and the second inner steel hull.

LNG is stored in three or four separate tanks or compartments on board the ship. This means that even if one compartment was somehow breached, the cargo in the other tanks would not be at risk - limiting the volume of LNG which could potentially escape. The design of this system maintains the very low temperature of LNG, enabling LNG to stay cold ( $-161^{\circ}\text{C}$ ) without the need for pressurisation.

LNG is a liquid and is not carried under pressure. As such, it is not flammable or explosive on board the ship. Only when the vapours of LNG are mixed with oxygen (fresh air) does it become flammable – and the storage system is designed to prevent this occurring. The absence of pressurisation significantly reduces the chances of an incident, and further contributes to the safe transportation and storage of LNG.



LNG tanker construction requirements for safe LNG transport at sea

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## LNG Properties



LNG is not carried under pressure and as a liquid cannot be ignited.



In the unlikely event of an uncontrolled release, LNG will revert to a gas as it warms up in the open air.



Natural gas is lighter than air and quickly dissipates into the atmosphere.



Natural gas and LNG are non-toxic.

## Safe transit through Corio Bay

Ports Victoria is the regulatory body responsible for ensuring the safe transit of all ships in Port Phillip including Geelong and Corio Bay.

A navigational risk assessment has been carried out to ensure the safe navigation of the additional ships into the Port of Geelong. Simulations and modelling of LNG vessel movements have been undertaken in conjunction with Ports Victoria and pilotage providers. The transit route for the LNG carriers has been carefully surveyed to ensure there are no grounding risks such as shallow water or rocks along the proposed shipping route.

All LNG ships will have to comply with strict requirements imposed by Ports Victoria to mitigate risk, including of grounding or collision – for example, the LNG ships will require an escort by tugboats in the Geelong Channels, and will have to travel slowly, at around 8 knots. Maritime restrictions and port regulations apply, including rules aimed at preventing smaller vessels from coming too close.

LNG carriers will use dynamic under-keel clearance (DUKC) to monitor conditions in real time, including water depth and draft, to provide accurate under-keel clearance predictions for the channel transit.

Experienced and licenced marine pilots familiar with local conditions will navigate the ships inside Port Phillip and Corio Bay and guide them safely to and from the berth.

It is worth noting that large tankers carrying gas (such as LPG or Liquefied Petroleum Gas) have safely operated in Victorian ports for over 50 years –including previously in Geelong.

## Ports Victoria Restrictions and Regulations

- Vessels navigating within, into or out of port waters must be under the direction of a marine pilot.
- The main Geelong shipping channels are used for one-way traffic only unless prior agreement given.
- For the four main channels the maximum allowable draft is 11.9 metres
- The under-keel clearance for deep draft vessels navigating the channels to be verified through the use of dynamic under keel clearance (DUKC).
- Maximum speed restrictions are established for all commercial vessels at different points
- Wind speed limits for vessels entering the port channel are 30-35 knots (20-25 knots for LNGCs)
- Weather events continuously monitored on board, at the terminal and by Marine Control.
- A minimum of two tugs currently required for arrival and departure from Refinery Pier berths.
- Small vessels (< 50 metres in length) must keep clear of big vessels (> 50 metres in length) and a tug or launch assisting another vessel.



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## Floating Gas Terminal Operation

As part of the approvals process for the project, a comprehensive hazard and risk analysis is being undertaken covering the floating gas terminal operation as well as the visiting LNG carriers and jetty facilities. Modelling and quantitative risk assessment (QRA) will look at whether the proposed Floating Gas Terminal would create any additional risks to the refinery, and how these risks can be mitigated. Results of assessments carried out to date show that the proposed gas terminal can be operated safely.

Safety and risk studies will be summarised and incorporated into the Safety Case for the Gas Terminal. This forms an important part of the application to WorkSafe Victoria for an operating licence, which is required as the Floating Gas Terminal will be classified as a Major Hazard Facility (MHF). The terminal operation will be subject to strict operational parameters and conditions that are stipulated by the regulators and detailed in the operational license. Viva Energy is experienced in the safe operation of MHFs including the Geelong Refinery.

## Floating Gas Terminal Safety Features

A Floating Gas Terminal (also known as a Floating Storage and Regasification Unit or FSRU) is basically an LNG ship with extra facilities on board to re-gasify the LNG – that is, to warm up the cold liquid and turn it back into a gas.

It is a relatively simple operation. LNG is warmed up by circulating seawater through pipes – there are no boilers or electric heaters involved in this process.

It is worth noting that LNG is stored on board the floating terminal as a cold liquid. In this state it is not flammable. Natural gas is not stored on board (there are no gas storage tanks) - as the liquid LNG gets turned back into gas it would be exported from the terminal via pipeline. LNG is not stored under pressure.

Our floating gas terminal will be a modern ship supplied by Hoegh LNG, an experienced international shipowner and FSRU operator, with sophisticated technology supporting safe operations.

A number of safety features are built into the gas terminal design to avoid, mitigate and manage hazardous events. The primary and secondary containment system within the double-hull means it is very unlikely that a leak could occur. Fire and gas detection systems are installed on all FSRUs, and manual and automatic shutdown systems would quickly isolate and shutdown operations if any abnormalities were to be detected in operations.

## Prepared to respond to an emergency

As with existing refinery and jetty operations, we plan to be well prepared and well-practiced in case of an emergency. Evacuation and rescue systems and procedures would be in place, with all the appropriate protocols and training. Fire protection and fire-fighting systems will be installed, including on the floating terminal and the wharf, with additional support available from the port fire-fighting tugboats. Emergency response preparedness is closely regulated and required for our shipping licence.

Although moored in port, the Floating Gas Terminal remains a seaworthy vessel, with a marine crew living on board, so it could be sailed out of port if required.



## Safe Port operations

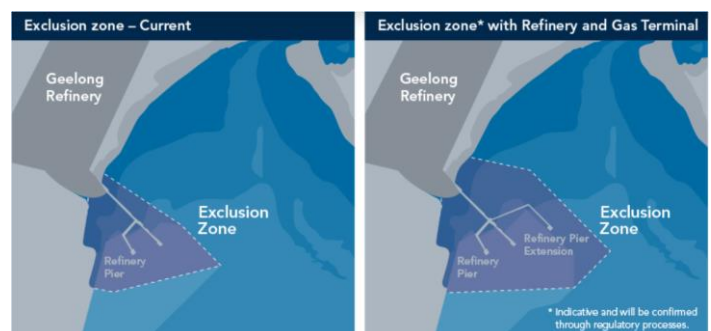
The existing operation at Refinery Pier in Geelong Port currently handles around 240 ships each year, as Viva Energy brings in crude oil for processing and exports fuel as part of our day-to-day operations. The Refinery works closely with a range of external parties such as Ports Victoria to ensure safe shipping operations, including appropriate mitigation and safety precautions for loading and unloading ships.

We expect around 40 LNG ships each year to visit the Gas Terminal – which is a small percentage increase in the 1000+ ships forecast to visit the Port of Geelong each year.

## Waterside Restricted Zone at Refinery Pier

There is a waterside restricted zone currently in place at Refinery Pier at all times. No unauthorised people or vessels are allowed inside the restricted zone. This restricts access by fishing boats and all other vessels as a safety precaution.

The waterside restricted zone has been re-assessed as part of the Project assessments, to take into account the pier extension and new Gas Terminal operations including LNG ships berthing. An expanded exclusion zone for unauthorised vessels would apply around Refinery Pier after completion of the new jetty.



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## A Focus on Security

While Australia is a very safe place to do business, as an experienced hazardous facility operator, Viva Energy is ever-vigilant and focused on ensuring that we take all possible practical measures to keep our facilities secure.

Viva Energy works closely with law enforcement agencies, security intelligence agencies, Federal and State Government departments and industry groups on an ongoing basis, in order to monitor and manage any potential threats to our business. We have safely and securely operated the Geelong Refinery, including shipping operations at Refinery Pier, for nearly 70 years.

### Security – protecting the gas terminal

Security measures currently deployed at the Geelong Refinery and Refinery Pier will be extended to the new gas terminal. Refinery Pier is surrounded by a regulated security zone. There are strict controls over who has access to the pier, and unauthorised personnel or craft are not permitted within this area. These controls would apply to the new facility. Federal Government Security background checks would be mandatory for all personnel including contractors requiring access.

In addition to specific requirements for the gas terminal operation, the Geelong Refinery Pier facility and the port are heavily regulated by the Commonwealth Government. The port also has its own strict security protocols and procedures in place to ensure the safe transit of over 1000 ships that are projected each year.

Regular security meetings are held to ensure a coordinated approach with key external authorities, such as the Police, Water Police, Australian Border Force, Parks Victoria, Ports Victoria, Department of Home Affairs - Aviation and Maritime Security Department and the City of Greater Geelong.

### Risk Assessment and the Maritime Security Plan

Viva Energy must prepare an updated Maritime Security Plan (MSP) covering both the current and new operations, and setting out security control measures and mitigations in detail. Prepared in consultation with a range of experts, the MSP must be approved by the Federal Government.

Once the proposed terminal is operational, the MSP would be regularly reviewed, actively managed and updated as required. It is subject to regular audits which are conducted by independent experts, the Government and other authorities such as Ports Victoria.

An independent security risk and vulnerability assessment has been carried out on the proposed gas terminal and the LNG import operation. This is an important input to the planning process for the proposed terminal, and the study will inform both the terminal design, operation and security plans.



The scope of the review included LNG ship transit and mooring, the proposed Floating Gas Terminal operation and the new pipeline. This comprehensive external study found existing security measures would be appropriate and adequate for the proposed Floating Gas Terminal and LNG import operations, and no major changes are required to existing security arrangements. It concluded that Viva Energy is well prepared to monitor the security environment and respond to any risks identified.

### Australia - a low risk security environment

Australia is overall a low-risk environment and a very safe place to do business. In relation to Maritime security, the official threat level has not changed since its inception.

Each Port is different, and requirements will be imposed on shipping operations here and around the world in line with local conditions and hazards, based on risk assessment specific to the location.

For example Australia has a very different security profile to the USA, which leads to different restrictions and requirements for shipping and port operations. One consideration is the availability and accessibility of dangerous firearms and explosives, which in Australia is highly regulated and restricted.

### Did You Know?

There are many global examples of LNG receiving terminals close to urban centres in Europe, North America and Asia. FSRUs operate in over 35 countries, safely meeting the energy needs of local markets.

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