AGL is currently undertaking a feasibility study to bring Australia’s first Floating Storage and Regassification Unit (FSRU) to Crib Point. But what is an FSRU and how does it work?

What is an FSRU?

In short, an FSRU is a Liquefied Natural Gas (LNG) storage ship that has an onboard regassification plant capable of returning LNG back into a gaseous state and then supplying it directly into the gas network.

The ships themselves are big, up to 290 meters long and 49 meters wide with a draft of 11-12m. A typical FSRU can travel at 19.5 knots and has a cargo capacity of between 125,000 m³ and 170,000 m³.

FSRUs and LNG ships have four to six separate cargo tanks inside their hull. As LNG is stored at very cold temperatures, the cargo tanks are segregated from the steel hull structure by thick insulation.

There are two cargo tank designs commonly in use. Membrane tanks are box shaped and LNG ships with membrane tanks look like any other liquid bulk tanker. The other design is known as ‘Moss tanks’ that are spherical. LNG ships equipped with Moss tanks have the recognizable dome shaped tanks visible above FSRUs and LNG tankers are powered by the LNG they carry, making them one of the most environmentally friendly ships in the world, emitting less CO₂, NOₓ, SOₓ and particulate matters than most other ship types that burn heavy petroleum fuels. As such, an LNG ship will only be carrying relatively small quantities of non-LNG fuels to power non-propulsion systems.

Unlike oil tankers, FSRUs are not involved in oil cargo transfer operations where there is the possibility of a spill or pollution. LNG cargo is a clear, colourless and odourless liquid; if a small quantity is accidentally spilled it will quickly and completely evaporate leaving no footprint behind.
How do they work?

FSRUs are usually permanently moored at a jetty, in this case it would be Crib Point, storing LNG at a temperature of -161°C in cryogenic storage tanks. The cold temperature keeps the LNG cargo in its liquid state until it is required for the gas network. LNG is generally stored and transported in bulk storage tanks at slightly above atmospheric pressure; usually less than 150 kPa (mbar) above.

When it is time to convert the liquid back into a gas, seawater is used to warm the LNG causing it to return to a gaseous state. The heater is usually a ‘tube and shell’ heat exchanger where water is pumped around the shell of the heat exchanger and LNG passes through tubes. The difference in temperature between the inlet seawater and outlet seawater is initially about -7°C, this then blends back to ambient temperature.

An FSRU typically discharges gas into the network at a pressure of around 60-80 Bar and at 5°C. Working at full capacity, a 170,000 m3 cargo could be regasified in about six days.

What are the advantages of using an FSRU?

The FSRU can sail in with the cryogenic tanks and regasification units onboard ready to go, avoiding the impact of building large infrastructure onshore. As the FSRU is an operating ship, when the project concludes the FSRU simply sails away and the community is not left with redundant infrastructure.

The FSRU also allows AGL to manage gas demand through high and low demand periods such as winter peak demand requirements. Gas can immediately be discharged into the network to cover network needs, be stored on board until it is required or sent to existing onshore storage facilities and more LNG imported to the FSRU. The timing and volume of LNG imported can be adjusted to meet market needs.

Importantly, importing LNG by ship allows AGL to access gas supply from other Australian States, and internationally, providing certainty of supply to the south-eastern states.

What happens when the ship is empty?

Once the FSRU is empty, another ship may arrive to refill the FSRU. AGL would source LNG from Australia or international markets and use an LNG tanker to bring it to Crib Point where the LNG tanker moors alongside the FSRU and refills the FSRU’s storage tanks – a process that should take less than 24 hours.
What are the risks associated with an FSRU?

Like all big industrial and resources projects an FSRU carries some risks. The key is to identify, minimise and manage the risks to the greatest extent possible. Ensuring that everyone goes home safely each day is a fundamental operating principle at AGL.

LNG contains large amounts of energy, however, in its liquid state it cannot explode or burn. Only in its gaseous state, and mixed with the correct amount of oxygen, can it ignite. (Methane needs to be diluted to 5-15% concentration in the atmosphere for ignition). An explosion could only occur if the methane gas had leaked into a confined space prior to igniting – just like a conventional gas explosion you might see in a house. LNG ships are some of the most sophisticated ships in the world and are equipped with automated leak detection and emergency shut down systems.

While unlikely to occur, the most likely fire scenario is a vapour cloud fire or pool fire (where some escaped gas settled on water). These fires would be lethal to those caught in the burn zone. However, while intense, methane fires burn inward at a rapid pace and there would be limited impact on those outside the burn zone.

In the past, on a few rare occasions, equipment faults and failures of safety practices overseas have resulted in incidents that have led to loss of life and property damage.

Fortunately, very few incidents have ever occurred at LNG import terminals and there are currently hundreds of LNG ships and LNG terminals safely operating, so these risks are well understood and can be managed. The FSRU and the ships that transport LNG have advanced safety features as will the jetty itself.

Double hulls increase the structural strength of the hull and provide additional protection for the cargo tanks in the case of an accidental collision, grounding of the vessel or a deliberate attack.

All containment systems include cargo monitoring, measuring, control and safety systems designed to operate at cryogenic temperatures. Nitrogen gas is used to purge the spaces between the tanks, the insulation and the hull. Nitrogen is an inert non-flammable gas used to displace the oxygen in these spaces and prevent fire.

All FSRUs and LNG ships are equipped with Emergency Shut Down (ESD) Systems. The ESD system is programmed to automatically stop the transfer of LNG or methane gas and close isolating valves should an issue arise. If the ship and/or the FSRU moved out of position during cargo transfer for example or if the FSRU tanks are accidentally overfilled by the LNG ship then emergency shutdown occurs before any damage can be done.

FSRUs terminals are sited with strict separation distances from potential ignition points. They are also sufficiently isolated from other facilities to avoid a fire damaging their neighbours. The distances are calculated as part of a safety case which is conducted during the project regulatory approval process.

If the project goes ahead the vacant berth 2 at Crib Point (shown above) will be home to the FSRU.
What are the potential environmental impacts of having an FSRU moored at Crib Point?

Noise
The FSRU is an industrial plant and as such will generate some noise. Most of the audible noise coming from the ship when it is operating is from engine room vent fans. There is some additional noise from the flow of water through heat exchangers when they are in operation. The FSRU is designed to minimize the impact of noise, including to the crew that stays on board the ship, often for weeks or months at a time. AGL is also undertaking background noise assessments of Crib Point to understand what impacts, if any, ship noise may have on the area and any mitigating strategies that may need to be implemented.

Cool water discharge
The use of sea water to heat LNG results in seawater being returned at the Crib Point jetty that is initially 6-7°C cooler than the ambient temperature. AGL is investigating how quickly the water returns to ambient temperature and what the potential impacts of this are on the local marine ecology. All studies suggest that the water returns to ambient temperature within the mixing zone well within the berthing pocket occupied by the FSRU. If the impacts cannot be managed effectively there are alternate heating methods that can be used on the ship such as burning some of the cargo to drive the regassification process.

Plant defouling processes
The intake of seawater into any pipe or plant system will lead to biofouling of the system. Biofouling is the accumulation of microorganisms, plants, algae, or animals from sea water on the internal seawater piping systems. To combat this hypochlorite is typically used to disinfect pipe and plant systems. Hypochlorite is produced by running an electric current through seawater, a process known as electrochlorination. (A similar process to salt water pool systems). This process can produce residual chloride content in this water, which quickly decays upon return to the mixing zone. While this is a commonly-used process for plants using seawater for electrochlorination, AGL is studying the marine ecology in the area and the hypochlorite decay rates in Western Port.

Western Port Mangroves and Seagrass
AGL is committed to minimising the environmental and social impacts from its projects and has commissioned independent studies by flora and fauna specialists. While construction of a new jetty in a different location may have required removal or damage to mangrove or seagrass populations, the advantage of Crib Point is that it has an existing operating jetty and is not expected to have impact in the Western Port mangroves or seagrass.

Do the LNG ships entering Western Port or the FSRU discharge ballast water?
The LNG jetty at Crib Point is for unloading only and there are no plans to export LNG. Ships will arrive full of LNG and will not need to discharge ballast water. Rather, they will take on ballast water in Westernport as they unload their cargo.

At Crib Point, the FSRU will take ballast from Westernport and return ballast to Westernport as necessary to control the stresses on the ship’s hull. However, as it is always in a ‘harbour condition’ it will not be exposed to seagoing stresses so will not need to take full ballast so the amount pumped in and out is reduced.

We are aware that all ships, even with full cargo, may have remnants of ballast water on board as the bottom ballast tanks have an un-pumpable ballast spread across all the ballast tanks that can’t be pumped.

To manage this, ballast water is exchanged at sea (at least 200 miles offshore and in greater than 200m water depth) to ensure any aquatic organisms have been pumped out and tanks are backfilled with clean ballast – it is this clean ‘deep ocean’ water that would remain in the tanks from discharge at the time of LNG loading.

For more information visit www.engageagl.com.au