



Pioneering methods of delivering gas from the ship to the pipeline have shown themselves to be effective, **Andrew Lansdale** reports

The traditional method of discharging natural gas from ship to shore is as liquid natural gas (LNG) at a berth alongside. This method has proved successful and safe since the first cargo delivery in 1964. Once ashore, the LNG is regasified at facilities usually situated near or in the port.

Two innovative ways of getting LNG to shore as natural gas, as opposed to its liquid form, have emerged in the past six years. Both are based on putting gas into the pipeline straight from the vessel without passing through a shoreside regasification plant.

There are several advantages:

- Cost-efficiency
- Offloading possible where it may be difficult to provide onshore facilities because of high cost, lack of available land or opposition from residents
- Offers direct entry to areas with a high gas demand such as industrial zones
- No draught restrictions for large tankers

■ No land-side storage or regasification facilities are required. LNG expands around 600 times when turned into gas.

The first option is a floating storage and regasification unit (FRSU) deployed out at sea. An example is being commissioned off the Italian west coast port of Livorno. It comprises a converted LNG tanker – the 138,000m³ *Golar Frost* – which will receive feeder vessels alongside to transport the gas ashore (see box below right).

A similar process is being considered to supply gas to the Vasilikos power station on the south coast of Cyprus, near Larnaca. A regasification plant out at sea is considered preferable in this tourist-focused region to a shore-based facility. Commissioning is expected to take place in 2014.

The second innovation is to use an LNG regasification vessel (LNGRV). Texas-based Excelerate Energy has developed a fleet of nine such vessels (see box above right). These ships can be used as traditional LNG tankers but also have the ability to regasify cargoes on board and to tie up to a turret mooring system. Vince Braniff, contracts manager for pipelines at engineering company Murphy Group, told *Ports & Harbors* that in theory any port with deep enough draught, offloading arm and shoreside access to a pipeline with a 'flanged end' can receive natural gas from these vessels.



Photo: Murphy Group

Excelsior converts its liquid cargo to gas at Teesside GasPort, UK

He also added that Excelerate Energy's vessels could, in the future, accommodate a loading arm requiring even less infrastructure from the port.

Excelerate has been operating at Northeast Gateway, an offshore offloading facility 18nm off the US port of Boston, Massachusetts, since 2008. After an LNGRV picks up a mooring it draws a conical fitting up from the seabed that docks in a bay under the bow of the ship.

The LNG on board is regasified on board and pumped ashore into the Massachusetts gas network. An Excelerate spokesperson told *P&H* that the total operation takes from five to seven days.

Gulf Gateway, 116nm off the Louisiana coast, offers a similar service. Excelerate said that ships have been specially designed to operate with both full and part cargoes without compromising the ship's stability, which is especially important during bad weather. The company told *P&H* that its LNG offloading was the only cargo operation that continued in the Gulf of Mexico region during hurricane Katrina.

Plans to develop a similar terminal 21nm off Santa Monica, California, with a pipeline coming ashore at Los Angeles airport, have been put on hold. The proponents of the plan, Woodside Petroleum, initially applied for consent for two facilities, but local opposition forced it to halve its ambitions on environmental grounds. In the end, the high-profile residents in the area forced the entire plan to be shelved until January 2011.

Excelerate also utilises three shoreside reception facilities that take advantage of LNGRV flexibility. One is in Bahía Blanca in Argentina, where ships go alongside and spend several days degasifying their cargoes and pumping them ashore; another in Teesside, in northeast England; and the third at Mina al Ahmadi, Kuwait. The last facility receives cargoes from Sakhalin Island in the Russian Far East.

The Teesside location was chosen because this major industrial area lacked its own gas supply, said Braniff who was involved in the project along with PD Ports. Gas manufacturer BOC's plant, just 3km away, was another incentive, as the natural gas must be blended with nitrogen to meet UK standards and enter the national grid, he explained.

"The total cost of the Teesside GasPort was less than £40M (\$62M), whereas a conventional land-based facility of comparable size would likely cost more

Excelerate's LNGRV fleet

Vessel	Capacity (m ³)	Built
Excelsior	138,000	Jan 2005
Excellence	138,000	Apr 2005
Excelerate	138,000	Oct 2006
Explorer	150,900	Apr 2008
Express	150,900	Apr 2009
Exquisite	150,900	Sep 2009
Expedient (idle, Pusan)	150,900	Nov 2009
Exemplar (building)	150,900	Jun 2010

Source: Excelerate Energy

than £400M (\$617M)," PD Ports said in a statement.

The terminal is designed to be able to handle up to four LNG cargoes a month, each of which contains approximately 3Bn ft³ of natural gas.

Two further regasification vessels are now competing with Excelerate's fleet. Höegh LNG and MOL ordered two 145,000m³ vessels: *GDF SUEZ Neptune*, delivered on 20 November last year, and *GDF SUEZ Cape Ann*, scheduled for delivery this month (May). These two vessels form part of the Neptune Project, being developed by GDF Suez and Höegh LNG.

The two LNGRVs have been designed to service Neptune LNG Terminal, an offshore discharging facility situated in Massachusetts Bay. When complete the facility will link into an existing pipeline and be capable of handling enough gas to supply 2.8M homes.

"The vessels can operate in 11m seas and a wind force of 68kt," Julie Vitek head of corporate communication for GDF Suez LNG told *P&H*. She noted that a force 12 hurricane represents 64kt and above. "We have a support vessel in attendance to assist with the buoy pick-up line, but are not employing tugs. The ships' masters are trained to berth the ships and no berthing masters are required," she concluded. Together with the support vessel, this operates from Gloucester, Massachusetts.

Excelerate has strategically positioned itself in locations where it can hook up with a pipeline either at sea or in port. Braniff is confident more LNG will be regasified on board vessels in the future. **PH**

All at sea

Golar Frost will be deployed at a permanent mooring 12nm off the coast in a water depth of about 120m, a role for which it is being converted at Dubai Drydocks World. The cost of conversion is about \$90M, and involves providing the ship with the ability to take feeder LNG tankers alongside.

Cargo from these feeder ships will be taken on board the *Golar Frost*, stored in liquid form and then regasified before being piped ashore and added into the country's gas grid. The mooring, gas pipeline and shore facilities add a further \$160M to the overall cost.

Conversion of the ship should be completed in June. Its planned capacity is 3Bn m³ a year, but if required the *Golar Frost* is said to be capable of processing 6Bn m³.

Should the Livorno project prove a success, a further installation will be planned for the northern Adriatic.

Sergio Bassi, of Livorno shipagent Gastaldi Tramp, told *Ports & Harbors*: "Of course, when the weather is bad they will require harbor tugs for berthing and perhaps a pilot or berthing master, and the port will have a small servicing role for the ship."