LNG WORLD SHIPPING

Regasification: innovation on land and sea

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Dreifa's regasification concept targets smaller and medium-scale regasification requirements (credit: Dreifa)

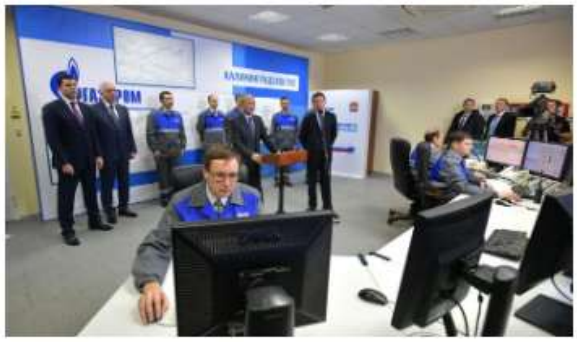
The high number of planned new import terminals makes for an ideal environment to showcase the latest regasification technologies

As demand for LNG grows, so too does the need for regasification technology that allows floating storage and regasification unit (FSRUs) and other terminals to meet requirements and ensure national infrastructure remains supplied with gas.

On 8 January, the Kremlin announced that Vladimir Putin had formally activated Gazprom's first FSRU, *Marshal Vasilevsky*, a converted tanker named for Aleksandr Mikhaylovich Vasilevsky, a former Marshal of the Soviet Union and Soviet Defence Minister.

Marshal Vasilevsky is moored off Kaliningrad on the Baltic Sea and provides an alternative energy supply for the Kaliningrad Oblast exclave, which is separated from the rest of Russia on land by Latvia, Lithuania and Belarus. The terminal is located 5 km offshore in water depths of 19 m and is protected by a breakwater.

The vessel itself is 300 m long by 46.5 metres wide. The temperature in its reservoirs, which can carry 174,000 m^3 of LNG, is maintained at -163°C. It has a speed of 19.5 knots and is the first vessel of the Arc4 ice class. It is Russian-flagged and registered with the Russian Maritime Register of Shipping. Mr Putin said: "We are all certainly well aware that delivering a primary energy resource such as natural gas over such a distance by pipeline makes better economic sense and is a cheaper option.



Gazprom's first FSRU Marshal Vasilevsky was activated by Vladmir Putin on 8 January (credit: Russian government)

"But for us, for [the] Kaliningrad Region, the project will most likely be a backup, and will substantially minimise, or more precisely, mitigate all transit risks."

He noted that the FSRU's capacity of 2.7Bn m^3 of gas per year means it is capable of entirely covering the energy requirements of the Kaliningrad Oblast, without the need for gas to be delivered via pipeline.

"It is hard to overestimate the importance of this terminal for the region's energy security and consolidation of the local energy base, given the geographical location of Kaliningrad Region," Mr Putin added.

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On 11 January, Sovcomflot (SCF) announced it would be providing technical management for the FSRU.

SCF's executive vice president and chief technical and operating officer Igor Tonkovidov said: "It is a great honour for Sovcomflot to provide technical management for the *Marshal Vasilevskiy* FSRU, an offshore facility that is so important for the stable operation of Kaliningrad Region's gas supply system.

The implementation of [this] project became possible, among other things, thanks to the extensive experience accumulated by SCF's crews in operating our gas tanker fleet. From a technical standpoint, *Marshal Vasilevskiy* is one of the best vessels in her class and complies with the highest environmental and energy efficiency standards. The vessel's high Arc4 ice class allows her to operate safely in the Baltic Sea basin all year-round."

Further west in Europe, Germany may soon get its first LNG import terminal. On 18 December 2018, Uniper SE and Mitsui O.S.K. Lines released a joint announcement confirming they would seek to develop an FSRU LNG import terminal at Uniper's site in Wilhelmshaven, Germany's only deepwater port.

The planned terminal would have a sendout capacity of 10Bn m^3 per year (bcm/yr), a storage capacity of 263,000 m^3 and could be in operation by the second half of 2022.

It is planned that Mitsui O.S.K Lines will own, operate and finance the facility, while Uniper SE will act as project developer, liaising with relevant authorities to procure the necessary permits for the operation of the facility and gathering interest for regasification capacity from additional market participants.

Uniper SE's chief commercial officer Keith Martin said: "We are glad that we were able to get such an experienced partner as Mitsui O.S.K. Lines on board for the development of Germany's first LNG terminal … Our partnership with MOL, combined with the FSRU technology as well as Wilhelmshaven's uniqueness in Germany, provide the fastest and most economical way to realise LNG imports directly into Germany."

Meanwhile in Latin America, on 14 January Brazil's National Agency of Petroleum, Natural Gas and Biofuels (ANP) submitted a plan to the country's antitrust regulator CADE that would see semi-public oil major Petrobras' LNG regasification terminals designated as "essential national infrastructure."

If ANP's proposal is approved by CADE, third-party private companies would be able to access unused capacity at the regasification plants.

Developments in APAC

Shipbuilding expertise in the Asia-Pacific region came to the fore in November 2018 when Singapore-headquartered PaxOcean, a shipbuilder focused on rigs and specialist offshore vessels with yards in Singapore, Indonesia and China, announced the delivery of the largest Chinese-built FSRU to date, *Karunia Dewata.*

Owned by Jakarta-based Jaya Samudra Karunia (JSK), *Karunia Dewata* has a storage capacity of 26,000 m^3 and a maximum regasification throughput of about 50M standard cubic feet per day. It is the first FSRU to be built with Type-C cargo tanks.

PaxOcean's engineering director Bian Lixin said: "The design is focused on simple and reliable operation for Indonesian water.

"By working closely with Lloyd's Register (LR) on classification requirements, and international maritime legislations for vessels carrying liquefied gases in bulk, we have successfully delivered *Karunia Dewata* to JSK.

"Our achievement in delivering it on schedule is a result of our execution excellence and good teamwork with JSK, LR and Korean Register"

As more projects launch, technology is now becoming available that makes small- and medium-scale regasification projects more feasible.

Announced at Gastech 2018 in Barcelona, Philippines-based infrastructure engineering firm AG&P has brought two such technologies to market.

The first is based around a standardised water-bath vaporisation (WBV) technology. This utilises fire tubes to transfer heat to a bath of water by convective and conductive heat transfer. The design can include low NOx burner technology and a waste heat recovery economiser, to boost efficiency and reduce emissions.

The second is based around fast ambient-air vaporisation (FAV) technology. This is especially well-suited for subtropical and tropical locations, with ambient air temperatures greater than 15°C and with adequate available space.

The two new technologies mean that AG&P can offer three different regasification options, each with their own benefits.

Comparison of AG&P's three regasification technologies

Comparison factor	Fan ambient air vaporisation	Glycol-water shell and tube vaporisation	Water-bath type vaporisation
Heating medium	Air	Glycol-water/seawater	Hot waterbath
Regasification technology	Direct vaporisation with air	Indirect vaporisation with glycol-water as intermediate fluid heated with seawater	Indirect vaporisation with waterbath heated with submerged combustion firetube and waste-heat economiser
Nominal capacity (standard module) in million cubic meters per day	38.1	38.1	38.1
Vaporiser required utilities	Electrical power	Electrical power Glycol water Seawater	Electrical power Fuel gas
Single-train module envelope in metres	45 x 14 x 16	17 x 11 x 11	21 x 21 x 3

Advantages	Provides full vaporisation duty with no supplemental heating in warmer climate (above 20°C) Simple operation and maintenance Able to recover chilled water No seawater required Minimum air emissions	Provides vaporisation duty with use of 'available' heat from seawater Minimum air emissions	Smaller footprint when plot space is limited Optimise energy usage with waste-heat recovery No seawater required Ultra-low NOx burners

Source: AG&P

Writing for GasTech in November 2019, AG&P's vice president of process engineering and operations Nancy Ballout outlined the company's ethos.

"AG&P is not focused on any particular size of LNG infrastructure, but rather, its designs offer scalability and flexibility," she said.

"This approach allows solutions to be configured from the customer's perspective, using the right combination of onshore and offshore assets, with the flexibility to expand over time."

Ms Ballout added that AG&P's configurations, combining scalable, standardised regasification modules with floating storage, can improve scheduling at terminals while reducing bottlenecks. This has three benefits she explained: capital cost is reduced and efficiently utilised during development; infrastructure is the right size for current demand, which means efficiency is boosted and surplus is eliminated, while key components to support future demand are pre-invested; and modular assets can be built quickly, resulting in projects starting up faster and investors receiving earlier returns.

The Manila-based company looks set for growth, announcing in November 2018 it would be boosting its workforce by 5,000 to support heavy manufacturing and infrastructure projects in the Philippines.

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A combined approach

Dreifa's regasification concept targets smaller and medium-scale regasification requirements (credit: Dreifa)

Further developments in regasification technology aimed at the smaller-scale market were showcased at the LNG World Shipping Ship/Shore Interface Conference that took place in London on 22-23 November 2018.

Dreifa Energy's co-founder Jostein Ueland gave an update on his company's innovative solution, which is based around splitting the FSRU concept in two, with large floating storage units (FSUs) and a smaller floating regasification unit (FRU), based around a converted platform supply vessel.

Started in 2016, Dreifa identified and secured a candidate vessel for the FRU, the PSV *Blue Betria*. The project received a NKr600,000 grant from Innovation Norway in June 2017 and so far agreements have been signed with Citec to conduct basic engineering work on the FRU and with Wärtsilä Oil and Gas Systems to provide the regasification module. An agreement was signed with Bernhard Schulte Shipmanagement in November 2016 to develop the project. DNV GL granted Approval in Principle for the project in November 2017 and has given the FRU the notation 1A OSV REGAS GAS FULLED. It has regasification capacity for between 50M-300M square cubic feet per day of gas at delivery pressures between 50 and 100 bar.

Mr Jostein suggested that rather than constructing new cryogenic LNG storage, chartering in an existing steam LNG carrier to act as the FSU can result in significant capex reductions. He noted that existing LNG carriers are available and inexpensive, and that using them as FSUs has limited conversion risk compared with FSRUs. They are also compatible with the existing conventional LNG supply chain, and avoid the need for expensive small-scale LNG carriers.

Dreifa estimates the FSU and FRU offers a 40% reduction in total terminal costs, covering regasification and storage including fuel, as compared to a newbuild FSRU. The company also estimates a total 80% reduction in balance sheet exposure, comprising accumulated capex lease rates and an owner's residual value, compared to newbuild FSRUs.

Mr Jostein outlined several potential applications for the Dreifa concept. In a deepwater phased development, the FSU and FSRU combo could be used in the first, medium-demand phase; when demand outstrips the capacity of the FSU, it can be replaced with a higher-capacity FSRU. In a shallow-draft port, while a conventional LNG carrier would not be suitable for use as the FSU, the FRU would still be suitable and a shallow-draft LNG carrier can be moored alongside it.

A combination of an FSU and FRU is ideal for medium-scale or phased developments, or developments where an interim solution is required. This is because the floating elements allow for maximum flexibility and offer a cost-efficient storage solution compared to land-based storage or FSRUs, according to Mr Jostein. With 70% of identified floating regasification projects worldwide having demand of less than 1.5M tonnes per annum, this represents a lucrative market.