Fuelling the future in Europe

The S/F SamueLNG project is laying the foundations for innovative LNG fuelling processes in the Atlantic Arch

Hubert Louys, Dragages Ports, project manager of the S/F SamueLNG project

Liquefied natural gas (LNG) is increasingly recognised as a relatively clean fuel that will enable the maritime industry to meet the International Maritime Organization (IMO) goal of significantly reducing sulphur emissions from marine fuels to 0.5% by 2020.

Prompted by more stringent requirements, the European maritime sector is collaborating on projects that will address the sustainability of maritime transport in the region. The focus is on developing an alternative fuel infrastructure for ports, while also addressing the need for marine fuels with lower SO_x content and particulate matter emissions.

Ports are in the process of conducting feasibility studies for LNG bunkering and are gearing up to provide LNG storage and supply in, or near, their facilities.

Collaborative venture

As part of an EU-funded project named Spanish/French Sustainable Atlantic Motorways of the Seas Using as Fuel for Engine LNG (S/F SamueLNG), the Port of Vigo, along with engineering design companies Inova Labs and

GHENOVA, have worked together to develop an innovative concept to provide LNG bunkering and on-shore power supply services from a barge.

The project, S/F SamueLNG for a Blue Atlantic Arch, aims to accelerate the infrastructure that will enable the implementation of LNG as a marine fuel, and focuses on the Atlantic Corridor as one of the most important shipping routes of the European Union.

The two main objectives of the project are the preliminary studies, which will lead to the development of innovative solutions for an LNG supply chain in several ports in the region and the LNG retrofit of trailing suction hopper dredger (TSHD) *Samuel de Champlain*.

The first stage of the project, involving preliminary studies for the development of a floating LNG barge designed to supply clean energy to berthed vessels at the Port of Vigo, are now complete, along with innovative designs for the supply barge itself.

The project results were presented at the Green Energy Ports Conference at the Port of Vigo in June 2017. Some details about retrofitting *Samuel de Champlain* are given below with the majority following in a future issue.

Demand and design constraints

The study at Port of Vigo combined a recent study by class society DNV GL with analysis that used a range of scenarios focusing on roll-on/off (ro-ro) vessels, cruise ships, and container ships.

Partners and contributors

▷ **The S/F SamueLNG for a Blue Atlantic Arch project is** co-ordinated by Dragages Ports and supported by a consortium of 12 partners from along the Atlantic Arch, representing France, Spain, and the Netherlands.

The partners working alongside Dragages Ports are five public port authorities – Nantes Saint-Nazaire (GPMNSN), Le Havre (GPMH), Rouen (GPMR), Port Authority of Gijon (APG), Port Authority of Vigo (APV) – plus Inova Labs, GHENOVA, Energias de Portugal (EDP), Gas Natural Fenosa, Suardiaz, and the Central Dredging Association (CEDA). The project is co-financed by the EU Connecting Europe Facility.

The contributors are:

Port of Vigo
- Study of potential global LNG demand at Port of Vigo
- LNG supply chain study and study on the location of an intermediate LNG storage

Ghenova Engineering
- Conceptual design of the multimodal energy barge

Flota Suardíaz
- Study on adaptation of the vessel (ship-side)
- Study on energy demand (ship-side)

Inova Labs
- Technical design of the intelligent control system
- Operational and environment analysis.

The project is supported by Central Dredging Association (CEDA) as communications partner.

Port of Vigo is studying potential LNG demand

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The selection was based on a study of the vessels that operate in Vigo.

Ro-ro and container ships were selected because they visit the port most frequently – more than 10 times per year. The cruise ships were selected because of the growing interest in LNG for this type of vessel and the increasing number of LNG cruise ships being built.

These three types of vessel have regular routes and were considered to be most likely to be potential end-users. Without detracting from other types of vessel using the port, the decision was made to focus initially on those visiting most often.

The DNV GL study, part of which covered the LNG demand and supply for the Atlantic Corridor, was conducted as part of the EU-funded CORE LNGas Hive project. The study indicated that, following the increased need for compliance with emissions regulations, the demand for LNG fuels was expected to rise.

The results predicted that 2 million m^3 of LNG would be bunkered by ships by the year 2030, rising to 8 million m^3 by 2050.

The supply chain logistics analysis was based on three key factors: how much was needed (demand value), when it was needed (timeframes), and the cost of supplying it. The logistics analysis for the floating LNG unit also took into account the vessel loading point and the availability of access.

The study considered seven storage and supply scenarios for the LNG terminal, with varying buffer storage and supply points, highlighted in the table below.

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Operating environment

Using meteorological data provided by MeteoGalicia, for key weather impact factors for the Atlantic Corridor, the preliminary study considered the likely operating environment for the floating device. Based on data for the period January 2014–December 2016, the following highlights show that conditions at Port of Vigo are favourable for barge operations:

- Wind scale: 80% of the time, wind speeds were below 20 m/s (Gale force 7 on the Beaufort scale). Wind force was only considered to be strong enough to adversely affect navigational conditions for about 1% of the time.
- Wave height and frequency: according to wind force statistics, 11% of days recorded sea conditions (ranging from high to phenomenally high) that could hamper bunkering operations.
- Lightning storms: during 2016, stormy days were recorded in the Vigo operating area for less than 6% of the time.

Beyond the key factors, the impact of air temperature and light rain was not expected to present difficulties for more than 1% of the barge's operative time in the area.

Analysis of vessel traffic corridors in the region surrounding the port showed that established marine routes did not cross, or interfere with, the estimated safety zone of a 200 m radius from barge operations.

Designing an LNG floating device

Following the initial studies, work progressed on developing the optimal design for the floating barge, given the predicted operating conditions for Port of Vigo.

The search for an innovative conceptual design combined key parameters including required LNG storage capacity, the potential to accommodate other fuels,

Supply options considered

Scenario	Source	Buffer storage		Supply point	End user
1				LNG truck	
2		LNG truck		LNG barge	
3		LNG truck		On-shore small-scale terminal	
4	LNG terminal	LNG supply vessel		LNG barge	Ro-ro vessels Cruise vessels Container ships
5				LNG supply vessel	
6		LNG supply vessel		On-shore small-scale terminal	
7		LNG supply vessel	On-shore small-scale terminal	LNG barge	

Source: Inova Labs

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Two LNG barges with a common body: the one on the left does not have its own propulsion, while the other is self-propelled

whether the barge would be self-propelled or assisted, and the modular construction of the tanks.

In addition, the project looked at shore-side power options, for the floating barge to supply energy to berthed vessels, and the development of an intelligent integrated control system for barge operations.

The study considered various designs for self-propelled and non-self-propelled barges with different configurations of fuel storage tanks, including membrane-type and C-type tanks, with storage capacities ranging from 300 m^3 to 600 m^3. The demand studies for LNG fuels suggested that a larger/more flexible tank capacity would be needed so the initial designs with 300m^3 capacity tanks were rejected.

Barge design evolution

Two preferred design options for the flexible bunkering station emerged from the study: one non-self-propelled and one self-propelled version. The selected designs have a common main body with a moulded depth to the main deck of 4.80 m, a moulded width of 13.82 m, and a C-type tank with an LNG capacity of 600 m^3. Both have two LNG 500 kW generators, under the main deck, with the capacity to provide a power supply of up to 1MW.

The non-self-propelled barge has an overall length of 47.81 m. Housing the LNG tank on the double bottom, rather than on the deck, greatly improves its stability. Also, as there is no propulsion plant, the construction costs are much lower than for the self-propelled barge.

The self-propelled barge has an overall length of 52.93 m, to accommodate the propulsion plant, the bridge and crew, and also houses the LNG tank on the double bottom. With a top speed of about 10 kt, it also has azimuthal propellers and bow thrusters, which make it more manoeuvrable than the non-self-propelled barge.

The construction of the floating LNG barge is outside of the remit of the current SamueLNG project but its development has been proposed for the next phase.

Intelligent control system

An additional part of the project was the development of a smart control system, which will play an important role in ensuring optimal operations management for the floating unit. The design of the control system has been developed using Port and Harbour Intelligent and Low-risk Energy Advanced System (PHILEAS) and internet of things (IoT) technology. The system will monitor, manage, and feedback on a range of parameters including: real-time barge status and position, barge/vessel scheduling management, smart prediction of power requirements, and predictive alarms.

Each of the ports involved in the project has different requirements, dependent on likely demand, traffic, and operational and environmental conditions, and will use the results from the project studies to develop the best LNG facilities for its particular set of conditions.

Port of Gijon has started a study on the design of LNG bunkering services specifically for ports used by smaller vessels that may experience lower LNG demand. Its study is scheduled to be completed in March 2018.

Work on the retrofit conversion of TSHD *Samuel de Champlain* to dual-fuel engines is expected to begin towards the end of 2017. It has been chosen as a good subject for an upgrade as part of this project because the main propulsion motor, dredge pump, bow thruster, and jet pump are electrically powered. The main conversion will be of the diesel-fuel generators to dual fuel and is expected to be completed in late 2018.

contact@samuelng.eu