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The Current State of LNG Bunkering in the US

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It's no longer a "Chicken or the Egg" scenario, it's now become "Keeping up with the Jones' "

LNG has been used as a marine fuel for over 60 years, it's not a new concept. Yet, for most of that history it's been used only as a burn-off fuel for LNG carrier fleets, because it was already on board as cargo. Over the last fifteen years, LNG has really been getting its foot in the door as an alternate fuel for all other fleets. Why the increase in use? Well, there are a few reasons:

- The International Maritime Organization's (IMO) emissions reduction requirements
- New gas source discoveries which have made LNG more available in the US
- Cost comparison between LNG and other low sulfur fuels
- Incentives in other countries to ship owners to use cleaner fuels

Chicken and the Egg

Around 2010, the European Union (EU) began implementing stricter future rules for emissions from ships. With these rules, the EU offered incentives to ship owners that include carbon trades, tax reductions and loan guarantees for green energy projects. Using the powerplant technology already used on LNG carriers, new duel-fuel ship orders began for container, car carrier, and cruise ship fleets. This started something referred to as the "Chicken and the Egg" years in the US, because for LNG fuel providers, there was an expected initial investment in fuel infrastructure without knowing the reward. So do companies invest in infrastructure before the ships arrive, or do they wait until the demand is clearer? One way that providers got some guarantee of a return-on-investment was to have signed contracts for delivering fuel to vessels yet to be built.

There were many ideas in those early years for the best way to deliver LNG fuel to ships; trucks, ISO containers, rail cars, existing LNG facilities, new small scale LNG facilities, small LNG carriers or barges.

The first delivery systems involved the construction of two new small scale LNG facilities. Both facilities were built for fueling of specific vessels and not intended to fuel the foreign vessel market. One was built by Puget Sound Energy (PSE) in Tacoma, Washington to fuel a TOTE Mariner Class RO-RO vessel being converted to use dual fuel. The other was built in Port Fourchon, Louisiana to fuel the Harvey Gulf OSV, HARVEY ENERGY. Neither of these

facilities would be built in time to meet the delivery dates of the vessels, so truck-to-ship transfers provided the LNG as a stop-gap measure to meet the demand. Following the EL FARO tragedy, the TOTE vessel that was supposed to be homeported in Tacoma was re-positioned to Jacksonville, Florida. Again, with no other option, the vessel was fueled by trucks as a stop-gap measure.

One of the demands of the foreign ship owners was that the delivery of fuel needed to be efficient, meaning that it should have a minimal effect on the ships' schedule and port operations. The only way to meet this demand was to deliver the LNG to the ship's location. Requiring a ship to shift berths for fueling would cost additional time (6 hours or more) in port and money (pilot and ship handling fees).

To meet the ship owner's needs, LNG bunker barges have become the accepted solution that meets the demands that we see today. Currently there are five US Flagged LNG bunker barges in service and more either in the process of being built or planned. All are located on the East Coast or Gulf Coast.

Why are barges the best solution for delivering bunkers to large ships? Vessel-to-vessel transfers come with less regulatory oversight as compared to land-based facilities. Barges are easily moved to where the demand is located, with the capabilities of meeting the demand in more than one port. Simultaneous Operations (SIMOPS) on the quayside experience minimal disruptions.

Keeping up with the Jones'

The current supply and demand of LNG fuel are in balance today, but what about the future? Are we ignoring innovations where the current delivery system won't be efficient for the demand?

The IMO's vision is to reduce the carbon intensity of international shipping in 2030 by at least 40%, compared to 2008 levels. According to Maritime Education; In 2024, 515 new alternative-fuel ships (excluding LNG carriers) were ordered, which is a 38% jump from 2023. Not all of these vessels will be LNG fueled; some will use other low carbon novel fuels. If this number is accurate and only 20-25% will include US transit routes, then this will significantly increase the need for fuel sources.

With the EU incentives due to expire in 2033, if all goes as planned, these ships should be delivered in the next 10 to 20 years. The question then becomes whether the future barge fleet will be overwhelmed by the influx of new and existing vessels or more importantly will the source facilities where the barges load be adequate to meet the demand. Currently there are two facilities supplying LNG to bunker barges, the Pivotal facility in Jacksonville, Florida and the Shell facility located on Elba Island, Georgia. Two other facilities are planned to be built within the next five years. If the future is as bright as being reported, then barge owners will need to begin securing sources of LNG to meet the

demand. There are also no active solutions in two major areas, the West and Northeast Coasts. Currently the West Coast is serviced by Canadian interests.

Wait, don't forget about the little guys. Another future customer segment to keep on the radar is smaller LNG fueled vessels. In 2012, one of the tasks given to the National Towing Safety Advisory Committee (T-SAC) involved the drafting of bunker safety regulations for towing and push vessels using LNG as fuel. At the time the use of LNG as fuel in the brown-water fleet looked like it was far in the future because power providers weren't interested in developing smaller engines for these vessels, and existing vessels didn't have the space available for dual-fuel tanks or could not go through a conversion process because of intrinsically safe engine room requirements.

In 2019, a design in principle was given to Rolls Royce and a Canadian designer for a LNG fueled shallow water push boat. Now smaller vessels that work the rivers, intracoastal waterways, Great Lakes and sounds may have a need for future LNG bunkering. For these types of vessels, LNG bunker barges may not be cost effective. These smaller vessels will have the advantage over large vessels when bunkering, they will be bunkered in less time and can be mobile, so the bunkering source does not necessarily have to come to them.

Currently there are no bunker facilities in areas where most of these vessels operate. The PSE facility mentioned above may be a good example of what a brownwater facility may look like. Its location was chosen primarily to provide fuel for the TOTE vessel, but it also serves as a peak shaver to the area's needs. It has truck racks for road transport and an outgoing pipeline system for feeding the energy grid.

So, what are the fueling options for smaller vessels? The simplest option is to use a truck-to-vessel bunker. This typically consists of filling LNG trucks from regional smaller scale liquefaction and storage facilities, transporting the trucks to the vessel, and connecting the trucks to either a mobile pump or pump skid which transfers LNG to the vessel.

Why are trucks a good option for smaller bunkering volumes? Trucks can be deployed where the vessel is berthed, one to two tank trucks can fuel a smaller vessel where multiple trucks would be needed to fill a large ship. Additionally, truck-to-vessel bunkering has a small footprint and flexibility in its operational configuration, it can be quickly moved once bunkering operations are completed, and it can be deployed to ports on an as-needed basis to support customers.

The simplicity of the truck-to-vessel bunkering requires minimal infrastructure needs after the permitting process. While federal regulations from USCG are largely the same from port to port, each state may have different Fire Marshal requirements which may incorporate different code requirements for temporary and mobile facilities. These types of projects have been successful in Europe, Canada, the Great Lakes, and other areas as mentioned above as a stop-gap measure.

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Another advantage that trucks have for smaller vessel bunkering is that in most cases SIMOPS will not be affected because there are no cargo loading/unloading operations and therefore not subject to a tight schedule.

But a truck is not the only option for small vessel bunkering. Push boats and tugs have down time in their schedules, therefore, if a small LNG facility can be located in the right area, these vessels can easily come to bunker at the facility. The key would be to choose the optimal facility placement.

What is the current regulatory environment?

The US Coast Guard oversees the safety and security of LNG bunkering operations, and their approval is required before such operations can be conducted. Coast Guard requirements for approval typically include:

- Developing the engineering and design parameters for the project
- Developing a Bunkering Proposal summarizing the main design parameters
- Developing a Risk Assessment Plan
- Conducting the Risk Assessment with appropriate project stakeholders
- Conducting Simultaneous Operations (SIMOPS) Risk Assessment
- Performing a Compatibility Assessment between the receiving vessel and fueling configuration
- Developing the Operations, Maintenance, and Emergency Manuals for the project

Guidance to meet Coast Guard requirements is provided in OES policy Letter 01-17, OES Policy Letter 01-25 and NCOE Field Notice 01-2017.

One grey area for regulations that have not been addressed or updated involves small scale (non FERC-regulated) facilities that are built to fuel vessels or load bunker barges. When loading bunker barges, the LNG is considered a cargo even though the barge is delivering it to a ship for fuel. Since it is considered a cargo transfer, the facility must face the same 33 CFR 127 requirements that a large import/export facility must follow. These regulations are rarely waived but there are alternatives to some requirements that achieve the same level of safety.

The Future of LNG Bunkering Looks Bright

You bet. There is still a push to reduce emissions and many companies have invested in LNG powered ships to be delivered over the next 10 to 20 years. There have been land based bunkering facilities, bunkering vessels, and many truck-to-ship temporary fueling projects implemented successfully across the US in the last decade, with more areas of the country having a need for fuel sources and delivery systems and new fueling opportunities constantly under development.

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Are We Missing Anything? The future of LNG as a fuel source looks to be rock solid, but we would be remiss if we didn't also talk about what other low carbon fuels are on the horizon and should be watched. Both ammonia and methanol fueled ships are being built and operating in the EU. An ammonia fueled re-fitted 1957 tugboat is operating in the Hudson River and Royal Caribbean will be operating a boiler on one of their ships with methanol, that will be bunkered in Miami. Hydrogen use for smaller vessels has been sporadic in the US over the last 25 years; however, it is rapidly growing in Europe. The Scripps Institution of Oceanography in San Diego is currently developing a research vessel that will be hydrogen fueled. Nuclear and wind powered vessels will have their own challenges, but bunkering isn't one of them. After reviewing several low carbon fueled ship orders forecasts, all fuels had a steady increase, though the highest increase shown year after year was for LNG.

About BLUE Engineering and Consulting

BLUE is an engineering and consulting firm that provides services to the LNG industry. We have provided engineering design, permitting, hazard modeling, risk assessments, process safety, emergency response plan, and other associated services for LNG bunkering projects across the US.

About the Authors

John Reinert has been involved with the marine industry for more than 34 years as a US Coast Guard Officer and maritime consultant, and has worked on safety, security and environmental protection projects around the world. He is considered a subject matter expert in bunkering transfers of low flash-point novel fuels. Over the last 15 years he has facilitated risk assessments for a majority of LNG bunkering locations in the US and Caribbean.

Phil Suter has been involved in the LNG industry for over 20 years providing engineering design, regulatory/permitting, PHA/risk assessment facilitation, emergency response plan development, and other process safety services for dedicated land based, bunker barge, and truck to ship bunkering projects.