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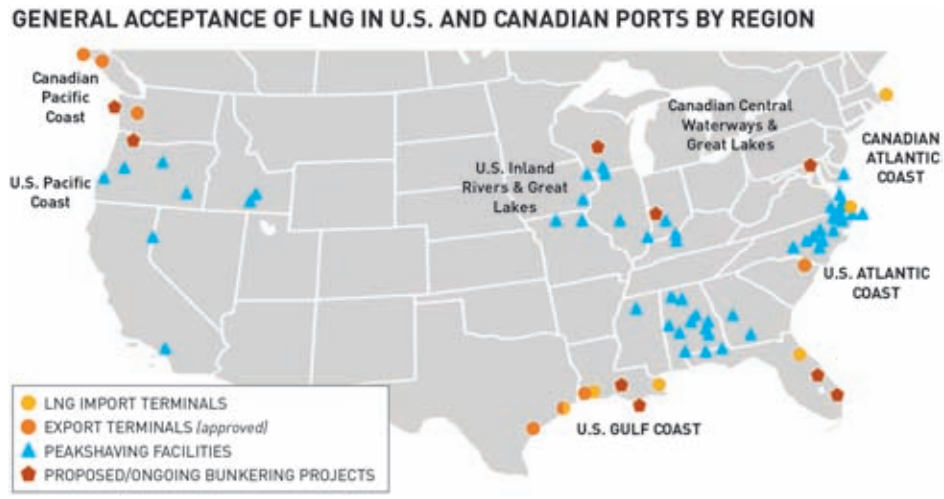
# ABS makes progress on LNG fuel guide for North American ships and ports

*Bunkering guide for US and Canada covers use of ships, terminals and trucks*

Since the American Bureau of Shipping report was initially issued in March 2014, significant progress has been made in North America with the use of LNG as a fuel for marine vessels.

Of particular note, is the first LNG bunkering and gas-fueled vessel operation in North America. Harvey Gulf International Marine, LLC (HGIM) has conducted the first gas fuel bunkering procedure of their newest Offshore Support Vessel (OSV), "Harvey Energy".




**LNG bunkering situation in North American ports by region**

## Classed

"Harvey Energy" was constructed by Gulf Coast Shipyard Group and is a dual-fuel diesel offshore supply vessel and the first gas-fueled ship to be constructed in North America.

It is United States-flagged, and classed by ABS.

The bunkering event occurred on February 6, 2015, at Martin Energy Services facility in Pascagoula, Mississippi and was supported by Harvey Energy's crew and other companies and agencies, including Gulf Coast Shipyard Group, Shell, ABS and the US Coast Guard (USCG).

The bunker transfer included a truck to vessel transfer of Liquefied Nitrogen, used to cool the LNG fuel tank and condition the Type C tank and LNG.

LNG was transferred from truck to vessel utilizing pressure differential. Three LNG delivery trucks provided approximately 28,700 gallons of LNG.

The duration of the bunkering operation was around six hours. After LNG was bunkered, the engines were tuned with gas and have since conducted successful gas fuel trials.

The Harvey Energy LNG bunkering debut has advanced the maritime industry in North America. Gas is now the new marine fuel in the US and has joined the historic vessel power transitions of sail to coal then coal to oil and now oil to gas.

## Final stages

Harvey Gulf Marine is completing the final stages to operate the first LNG marine bunkering facility in Port Fourchon, Louisiana. Future gas bunkering evolutions for "Harvey Energy" will be conducted at the Port Fourchon facility.

This second edition of "Bunkering of Liquefied Natural Gas-fueled Marine Vessels in North America" was developed to meet the growing needs of industry and to provide guidance and clarification on areas of interest based on feedback received on the first edition.

Feedback on the initial version indicates that collectively, people using the report have referenced or used information from the entire report.

"Accordingly, we are, for the most part, retaining the original structure of the report to maintain familiarity and ease of use and have added and updated material in the appropriate sections. Significant enhancements have been provided," ABS said.

Details on "Lessons Learned from First Adopters of LNG-fueled vessels" covers insights gained from the first adopters of LNG vessels and bunkering projects. This will help to guide future users through the challenges and solutions achieved by existing projects.

Several projects in North America are well underway, and in some cases completed, and provide valuable information to complete the value chain of LNG supply, port infrastructure and end user.

A "Project Guide" provides a "road map" guide of the regulatory, stakeholder and technical issues associated with developing an LNG bunkering project.

There is also a Port Directory and Survey. ABS said it contacted and visited ports in North America to collect details from stakeholders, Port Authorities, Harbor Safety Committees, regulators (including USCG) and other vested parties interested in LNG and LNG bunkering at their respective port.

## Discussions

Questions from these visits and discussions centered on plans for LNG development, state or local regulations, ongoing projects and local development processes for including LNG within ports.

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Stakeholder discussions addressed:

- Current LNG use in the port (if any)
- LNG bunkering projects under way
- Interest in / study of / planning for future LNG bunkering activities
- Existing or proposed state / local regulations that would apply to LNG bunkering operations
- Agencies implementing LNG-specific regulations and / or issuing facility permits
- Studies done regarding future LNG use
- Active efforts by the port to make LNG fuel available to support future business plans

ABS also developed a comprehensive listing of North American ports providing key contact information and insights into current LNG activity and interest at each port.

The information in this database provides the necessary groundwork for initial research into developing an LNG bunkering project. Insights gained from our direct experience assisting clients on bunkering projects guided the development of this resource listing.

## Regulations

Due to increasingly stricter environmental regulations controlling air pollution from ships implemented through International Maritime Organization (IMO) Annex VI and other local air quality controls, together with the potential for favorable price conditions, the use of LNG as a fuel, instead of conventional residual or distillate marine fuels, is expected to become more widely adopted in the future.

In anticipation of this trend, the marine industry is looking for ways to provide flexibility and capability in vessel designs to enable a future conversion to an alternative fuel, such as LNG.

Existing USCG regulations address the design, equipment, operations, and training of personnel on vessels that carry LNG as cargo in bulk and address fueling systems for boil-off gas used on LNG carriers.

The use of LNG as fuel for ships other than those carrying LNG as cargo is a relatively new concept in North America. USCG policy for vessels receiving LNG for use as fuel are in development to address this option for marine fuel. USCG policy for LNG fuel transfer operations and for waterfront facilities conducting LNG fuel transfer operations are in CG-OES Policy Letters 01-15 and 02-15.

The ABS Guide for LNG Fuel Ready Vessels provides guidance to shipowners and shipbuilders indicating the extent to which a ship design has been prepared or "made ready" for using LNG as a fuel.

## Assistance

ABS is providing further guidance to assist LNG stakeholders by developing this study by addressing North American (US and Canada) federal regulations, state, provincial and port requirements, international codes, and standards.

"The study has been widely recognized by both industry and regulators as an information resource to guide users through many of the complex and interconnected requirements for bunkering projects. Therefore, the bulk of the information in the original report has been retained in this revision for reference," the ABS said.

The effect of increasingly stricter air emissions legislation implemented through IMO Annex VI and other local air quality controls, together with favorable financial conditions for the use of natural gas as a bunker fuel is increasing the number of marine vessel owners that are considering the use of LNG as a fuel.

Existing USCG regulations address the design, equipment, operations, and training of personnel on vessels that carry LNG as cargo in bulk and address fueling systems for boil-off gas used on LNG carriers.

## Policies

As stated previously, US and Canada regulations and USCG policy for vessels receiving LNG for use as fuel are in development to address this option for marine fuel.

USCG policy for LNG fuel transfer operations and for waterfront facilities conducting LNG fuel transfer operations are in CG-OES Policy Letters 01-15 and 02-15.

"LNG has different hazards than traditional fuel oil; therefore, operators must clearly understand the risks involved with LNG bunkering.

"An assessment of various bunkering operations and the associated hazards and risks is provided. Templates are provided for stakeholders to use in conducting appropriate Hazard Identification (HazID) and analysis," the ABS said.

Local regulations are widely varied in maturity and content. To assist stakeholders in the planning and execution of LNG bunkering projects, the study provides a structured process for implementing an LNG project with regard to seeking compliance with local regulations.

Decisions to convert to LNG involve consideration of factors primarily involving:

- Compliance with emissions regulations
- Economic and cost drivers, including fuel costs, repowering and new builds, availability, and cost of LNG
- Commitment to environmental stewardship

Once these factors support the business case for converting to gas- or dual-fueled vessels, then the issues of bunkering infrastructure and reliable supply of LNG come into play.

## Emissions

The IMO has adopted emission standards through Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL).

The emission regulations in Annex VI include, among other requirements, a tiered compliance system introducing increasingly stricter limits on emissions of sulfur oxide (SOx), nitrogen oxide (NOx), and particulate matter (PM).

In addition to global requirements, designated areas called Emission Control Areas (ECAs) are since January 2015 subjected to more stringent requirements for the same emissions.

Two separate ECAs are currently enforced in the North American region: the North American ECA and the US Caribbean Sea ECA.

In addition, two regional regulations limit SOx emissions from ships: California Air Resources Board and European Union Sulphur Directive.

NOx tier II requirements are currently in effect for applicable marine engines, and in ECA areas, more stringent tier III requirements will be applied to marine diesel engines installed on ships constructed on or after January 1, 2016.

## Deadlines

The Tier III requirements will not apply to marine diesel engines installed on ships constructed prior to January 1, 2021 of less than 500 gross tonnage (gt), of less than 24 meters (m) in length which have been designed and will be used for recreational purposes.

Complying with the international and US Environmental Protection Agency (EPA) regulations requires switching

either to a distilled fuel, such as Marine Diesel Oil (MDO) or Marine Gas Oil (MGO), using another alternative fuel such as natural gas, or installing an exhaust gas scrubber system.

*North America shale gas accounts for a significant portion of US natural gas production.*

"Critical among these regulations are the measures to reduce SOx emissions inherent with the relatively high sulfur content of marine fuels. Ship designers, owners and operators have three general routes to achieve SOx regulatory compliance," the ABS stated.

Marine fuel that meets the sulfur content requirements can be produced through additional distillation processing.

Currently, low-sulfur MDO and MGO fuels are nearly double the cost of the Heavy Fuel Oil (HFO).

## Change-over

Switching a ship from HFO to MDO/MGO fuel could result in a significant increase in overall vessel operating costs. In addition, these costs are expected to increase over time as demand for low sulfur fuel increases.

"Convert or install new machinery to operate on an inherently low sulfur alternative fuel, such as LNG. The sulfur specification of LNG in numerous Sale and Purchase Agreements translates to about 0.004% m/m, which is well below the 0.1% limit in ECAs," the report pointed out.

Another way forward is to install an exhaust gas cleaning after-treatment system (scrubber).

The third emissions compliance option is to use a scrubber installed in the exhaust system that treats the exhaust gas with a variety of substances, including seawater, chemically treated freshwater, or dry substances, to remove most of the SOx from the exhaust and reduce PM. After scrubbing, the cleaned exhaust is emitted into the atmosphere. All scrubber technologies create a waste stream containing the substance used for the cleaning process, plus the SOx and PM removed from the exhaust.

"While scrubbers offer the potential for lower operating costs through the use of cheaper high sulfur fuels, purchase, installation, and operational costs associated with scrubbers would also need to be considered.

"These costs should be assessed against the alternatives of operating a ship on low sulfur distillate fuel or an alternative low sulfur fuel, such as LNG. Fuel switching, meaning using higher sulfur fuel where permitted and lower sulfur fuel where mandated, has its own complications and risks, but should also be considered as part of the evaluation of possible solutions to the emissions regulations.

"Refer to the ABS Fuel Switching Advisory Notice for more information on the issues related to fuel switching," it said.

## Economics

Natural gas is increasingly becoming a global issue and less the regional market it has been. Two examples include the 2014 announcement of a deal between Russia and China for pipeline gas previously destined for Europe, and the North American push to export LNG globally.

"Seemingly overnight, the US has become a swing oil producer, responding swiftly to market selloffs but likely to respond swiftly when demand/supply are rebalanced and prices recover. Assuming a trend toward increased global LNG trade, North America may become a global LNG supplier, as well.

"Operators considering the option of installing new machinery (or converting existing machinery where possible) designed to operate on an inherently low sulfur alternative fuel are seeing the LNG economic factors move in a favorable direction.

"North America shale gas accounts for a significant portion of US natural gas production. Gross withdrawals from shale gas wells increased from 5 Billion cubic feet per day (Bcf/d) in 2007 to 33 Bcf/d in 2013, representing 40% of total natural gas production, and surpassing production from non-shale natural gas wells.

"Up from near zero in 2000, shale gas is predicted to account for about half of US gas output by 2040. A significant effect of the fracking revolution has been in LNG. In 2010, the US Energy Information Administration (EIA) released estimates putting US natural gas reserves at their highest level in four decades, and in 2012 the US became the number one gas producer in the world.

## Supplies

"The abundant gas supply is leading many utilities and manufacturers to switch from oil to natural gas as their feedstock, and may lead to new manufacturing in energy intensive industries.

"Given the previous 40 years of US reliance on energy imports, near energy independence has not resulted in swift regulatory approvals for energy export projects," the ABS report said.

The report said Asia remains a growing consumer, particularly with (1) China's latest Five-Year Plan calling for an increase in natural gas usage, (2) Japan replacing lost nuclear capacity with gas-fired plants, and (3) Indonesia committing to increased gas use for power generation, road vehicles, and ships.

"Middle Eastern, Australian, and North American LNG projects are all vying for a projected 3.1 Tcf per year by 2040 of additional LNG imports to China to meet its anticipated demand growth," it added.

## Japan

The ABS recalled that Japan was once one of the largest producers of nuclear generated electricity. Following the meltdown of the Fukushima Dai-ichi reactor on March 11, 2011 and subsequent shutdown of Japan's other reactors, more than 86 percent of Japan's generation mix is now fossil fuels (coal, LNG, and fuel oil).

The Japanese government anticipates bringing back online a few nuclear facilities in 2015. After four years of disruption, nuclear power will return to the mix, though not at the pre- 2011 level for some time yet. Japan's current (2014) energy policy emphasizes energy security, economic efficiency, and greenhouse gas emissions reduction.

European demand for LNG is uncertain given its unsteady economic recovery, global leadership on climate change, and cost advantages for coal. In some cases, LNG buyers with take-or-pay contracts have benefitted by taking delivery and re-exporting cargoes to other markets.

"Implications of abundant North America gas supply and lower relative costs are leading some vessel operators with a significant portion of their voyages within ECAs to consider US LNG bunker fuel to be a reasonable fuel solution.

"Small-scale LNG suppliers need assurance that the LNG bunker fuel demand is real before committing to supply projects which are not export driven," the ABS said.

## Regulatory

To meet the growing demand for LNG bunkering, US and Canadian regulatory bodies and international organizations are working to develop safety and environmental standards to help ensure LNG marine fuel transfer operations are conducted safely throughout the global maritime community.

US regulations for waterfront facilities handling LNG are in effect; however, they are written primarily to address large quantities of LNG imported or exported as cargo.

Nevertheless, there is a robust regulatory framework containing requirements that apply when LNG is being transferred between vessels and shore-based structures, including tank trucks and railcars.

"There are no Canadian regulations directly addressing LNG bunkering or use of LNG as fuel for vessels; however, Canada is actively studying the issue.

"In late 2012, the West Coast Marine LNG project (of which ABS was a participant) was launched to study a variety of issues including: technology readiness, infrastructure options, training, regulatory requirements, and environmental and economic benefits.

## Bunker options

The ABS said there are multiple options for bunkering LNG on to vessels,

depending on how the LNG is sourced and whether or not a bulk storage tank or bunkering vessel is present at the bunkering location. This study considers three general options and an alternative LNG bunkering option.

**Option 1: Terminal Storage Tank to Vessel:** Vessels arrive at a waterfront facility designed to deliver LNG as a fuel to the vessel. Fixed hoses and cranes or dedicated bunkering arms may be used to handle the fueling hoses and connect them to the vessels. Piping manifolds are in place to coordinate fuel delivery from one or more fuel storage tanks.

**Option 2: Truck to Vessel:** A tank truck typically consists of a large-frame truck. The mobile facility arrives at a prearranged transfer location and provides hoses that are connected to the truck and to the vessel moored at a dock. Sometimes the hoses are supported on deck and in other arrangements supported from overhead. The transfer usually occurs on a pier or wharf, using a 2-4 inch (0.05-0.1 m) diameter hose.

**Option 3: Vessel to Vessel:** Some marine terminals allow barges to come alongside cargo ships while at their berths, thus allowing cargo to be loaded and the vessel to be fueled at the same time. Vessel fueling can also occur at anchorages. Vessel-to-vessel transfers are the most common form of bunkering for traditional fuel oil.

**Alternative Option: Portable Tank Transfer:** Some operators are considering using portable LNG tanks (i.e., ISO tanks) as vessel fuel tanks. In this concept, these fuel tanks, when empty, would be replaced by preloaded tanks staged at any facility capable of transferring containers to a vessel moored at the dock.

These tanks are modular and can be moved efficiently via truck or rail, and they would be certified to meet the appropriate codes and standards. ■

*The article is based on extracts from the 200-page "Bunkering of Liquefied Natural Gas-fueled Marine Vessels in North America" 2ND EDITION, from the American Bureau of Shipping. Firth details are available on the ABS Web site www.eagle.org.*