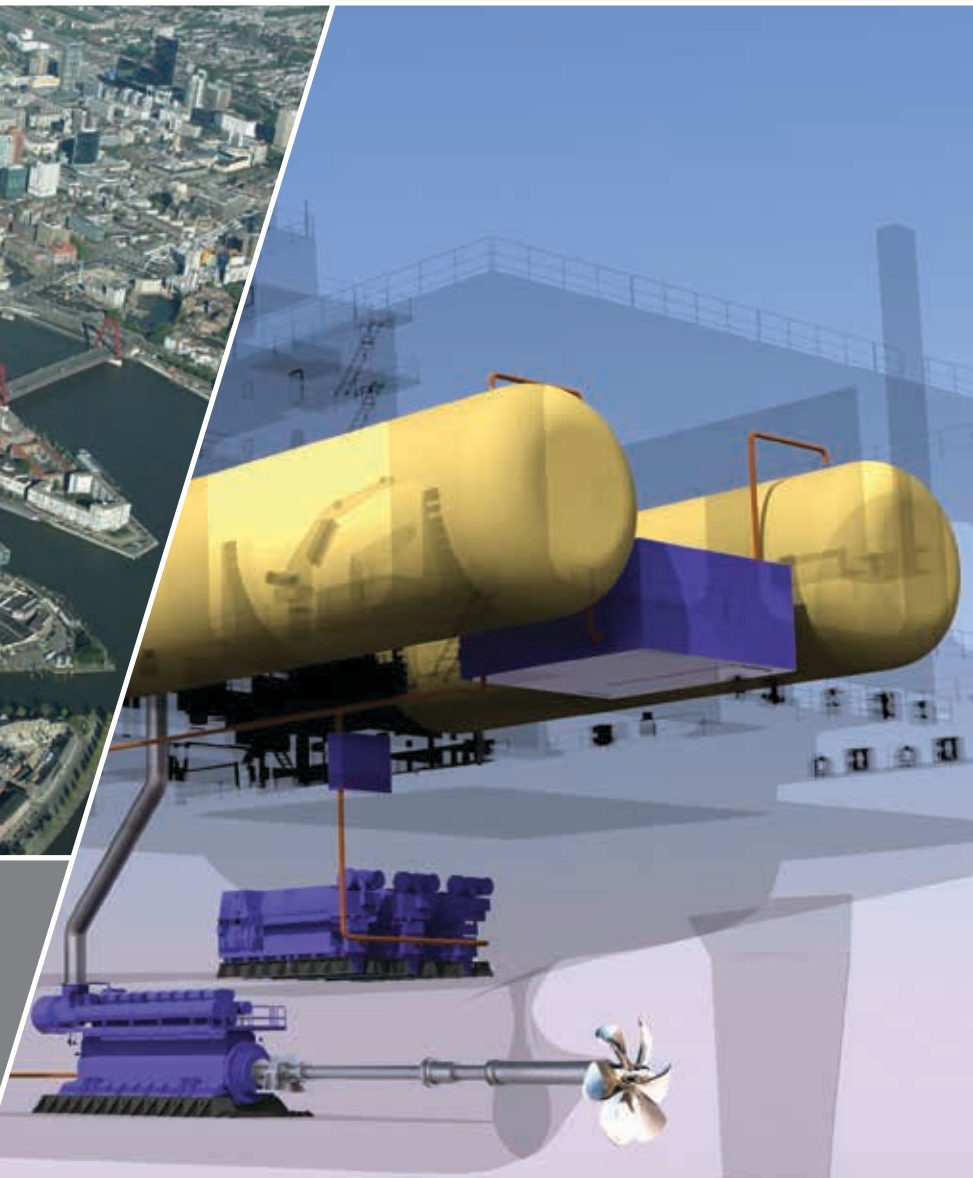


Bunkering of Liquefied Natural Gas-fueled Marine Vessels in North America

2ND EDITION



Our Mission

The mission of ABS is to serve the public interest as well as the needs of our members and clients by promoting the security of life and property and preserving the natural environment.

Health, Safety, Quality & Environmental Policy

We will respond to the needs of our members, clients and the public by delivering quality service in support of our mission that provides for the safety of life and property and the preservation of the marine environment.

We are committed to continually improving the effectiveness of our health, safety, quality and environmental (HSQE) performance and management system with the goal of preventing injury, ill health and pollution.

We will comply with all applicable legal requirements as well as any additional requirements ABS subscribes to which relate to HSQE aspects, objectives and targets.



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Acronyms

| | |
|-----------------|--|
| ABS | American Bureau of Shipping |
| AOR | Area of Responsibility |
| ASME | American Society of Mechanical Engineers |
| ATEX | Explosive Atmosphere |
| BC | British Columbia |
| Bcf/d | Billion cubic feet per day |
| BLEVE | Boiling Liquid Expanding Vapor Explosions |
| CDC | Certain Dangerous Cargo |
| CEAA | Canadian Environmental Assessment Agency |
| CFD | Computational Fluid Dynamics |
| CFR | Code of Federal Regulations |
| CG-OES | Commandant, USCG HQ, Office of Operating and Environmental Standards |
| CH ₄ | Methane |
| CNG | Compressed Natural Gas |
| COE | Corps of Engineers |
| COTP | Captain of the Port |

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| CSA | Canadian Standards Association |
| DEC | Department of Conservation |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| ECA | Emission Control Area |
| ECO | Edison Chouest Offshore Companies |
| EIA | US Energy Information Administration |
| EPA | Environmental Protection Agency |
| EPC | Engineering, Procurement and Construction |
| ESD | Emergency Shutdown |
| FAQ | Frequently Asked Question |
| FERC | Federal Energy Regulatory Commission |
| FRA | Fire Risk Assessment |
| FSA | Facility Security Assessment |
| FSO | Facility Security Officer |
| FSP | Facility Security Plan |
| GE | General Electric |
| GLMRI | Great Lakes Maritime Research Institute |
| HazID | Hazard Identification |
| HAZOP | Hazard and Operability |
| HECO | Hawaiian Electric Company, Inc. |
| HFO | Heavy Fuel Oil |
| HGIM | Harvey Gulf International Marine, LLC |
| HI Gas | Hawaii Gas |
| HQ | Headquarters |
| HSE | Health, Safety and Environmental |
| HTW | Human Element, Training and Watchkeeping (IMO subcommittee) |
| IACS | International Association of Classification Societies |
| IAPH | International Association of Ports and Harbors |
| IGC Code | International Code for the Construction and Equipment of Ships carrying liquefied Gases in Bulk |
| IGF Code | International Code of Safety for Ships using Gases or other Low-flashpoint Fuels |
| IEC | International Electrotechnical Commission |
| IMO | International Maritime Organization |
| ISM Code | International Safety Management Code |
| ISO | International Organization for Standardization |
| kW | kilowatt |
| LGCNCOE | Liquefied Gas Carrier National Center of Expertise |
| LNG | Liquefied Natural Gas |
| LSMGO | Low-sulfur Marine Gas Oil |
| m/m | mass/mass |
| MARAD | Maritime Administration |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MARSEC | Maritime Security |
| MDO | Marine Diesel Oil |
| MEPC | Marine Environment Protection Committee |
| MERPAC | Merchant Marine Personnel Advisory Committee |
| MGO | Marine Gas Oil |
| MMC | Merchant Mariner's Credential |

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| MSC | Maritime Safety Committee |
| MSC | Military Sealift Command |
| MTSA | Maritime Transportation Security Act |
| MTSR | Marine Transportation Security Regulations |
| NFPA | National Fire Protection Association |
| NGA | Natural Gas Act |
| NOx | Nitrogen Oxides |
| NVIC | Navigation and Vessel Inspection Circular |
| NYC | New York City |
| NYCDOT | New York City Department of Transportation |
| OGP | International Association of Oil and Gas Producers |
| OPEC | Organization of the Petroleum Exporting Countries |
| OSHA | Occupational Safety and Health Administration |
| OSV | Offshore Supply Vessels |
| PHA | Process Hazard Analysis |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| PIC | Person in Charge |
| PM | Particulate Matter |
| ppm | parts per million |
| PSE | Puget Sound Energy |
| PSM | Process Safety Management |
| QRA | Qualitative or Quantitative Risk Assessment |
| RFP | Request for Proposal |
| RMP | Risk Management Program |
| RMPlan | Risk Management Plan |
| RO/RO | Roll-on/Roll-off |
| RPT | Rapid Phase Transitions |
| SIGTTO | Society of International Gas Tanker and Terminal Operators |
| SIMOPS | Simultaneous Operations |
| SNG | Synthetic Natural Gas |
| SOx | sulfur oxides |
| SOLAS | Safety of Life at Sea |
| SOP | Standard Operating Procedure |
| STCW | Standards of Training, Certification and Watchkeeping for Seafarers |
| STQ | Société des Traversiers du Québec |
| Tcf | Trillion cubic feet |
| TCMSS | Transport Canada Marine Safety and Security |
| TERMPOL | Technical Review Process of Marine Terminal Systems and Transshipment Sites |
| TEU | Twenty-foot Equivalent Unit |
| TOTE | Totem Ocean Trailer Express |
| TSAC | Towing Safety Advisory Committee |
| TVNCOE | Towing Vessel National Center of Expertise |
| TWIC | Transportation Worker Identification Credential |
| US | United States |
| USCG | United States Coast Guard |
| WPMV | WesPac Midstream – Vancouver, LLC |
| WSA | Waterway Suitability Assessment |
| WSF | Washington State Ferries |

1. Introduction

Since this 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 ENERGY¹.

HARVEY ENERGY, constructed by Gulf Coast Shipyard Group, is a Dual Fuel Diesel OSV and the first gas fueled vessel to be constructed in North America. It is United States (US) flagged, and classed by ABS. The vessel is powered by three Wärtsilä 6L34DF dual fuel gensets providing 7.5 megawatts of power that are supplied fuel via Wärtsilä's LNGPac system.

The bunkering event shown in Figure 1 occurred on February 6, 2015, at Martin Energy Services facility in Pascagoula, Mississippi and was supported by HARVEY ENERGY's crew, Wärtsilä, Martin Energy, Gulf Coast Shipyard Group, Shell, ABS and the United States Coast Guard (USCG).



Figure 1. First LNG Bunkering in North America

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 approximately six hours. After LNG was bunkered, the engines were tuned with gas and have since conducted successful gas fuel trials.

¹ Ship & Bunker, "Harvey Gulf Claims First North American LNG Bunkering of OSV," (<http://shipandbunker.com/news/am/990001-harvey-gulf-claims-first-north-american-lng-bunkering-of-osv>), 10 February 2015.

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.

HGIM is completing the final stages to operate the first LNG marine bunkering facility in Port Fourchon, Louisiana. Future gas bunkering evolutions for the HARVEY ENERGY will be conducted at the Port Fourchon facility.

1.1. What's New

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, primarily in the areas of:

Lessons Learned from First Adopters of LNG-fueled vessels – Insights gained from the first adopters of LNG fueled vessels and bunkering projects help 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. This information is detailed in Chapter 2.

Project Guide – This provides a “road map” guide of the regulatory, stakeholder and technical issues associated with developing an LNG bunkering project. The included poster size infographic provides a comprehensive guide for working through the various issues for a project. The graphic provides input for LNG bunkering facilities, gas-fueled vessels and LNG bunkering vessels. This information is detailed in Section 0.

Port Directory and Survey – ABS 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. Questions from these visits and discussions centered on receptivity/plans for LNG development, state/local regulations, ongoing projects (exploratory/pre-production, current production and post-production phases), and local development processes for including LNG within their port.

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

Figure 2 summarizes responses about the general acceptance of LNG in the region and provides the location of potential LNG sources and proposed/ongoing LNG bunkering projects. This information is detailed in Chapter 7 with Section 7.4.2 providing discussion of the port survey and stakeholder discussions.

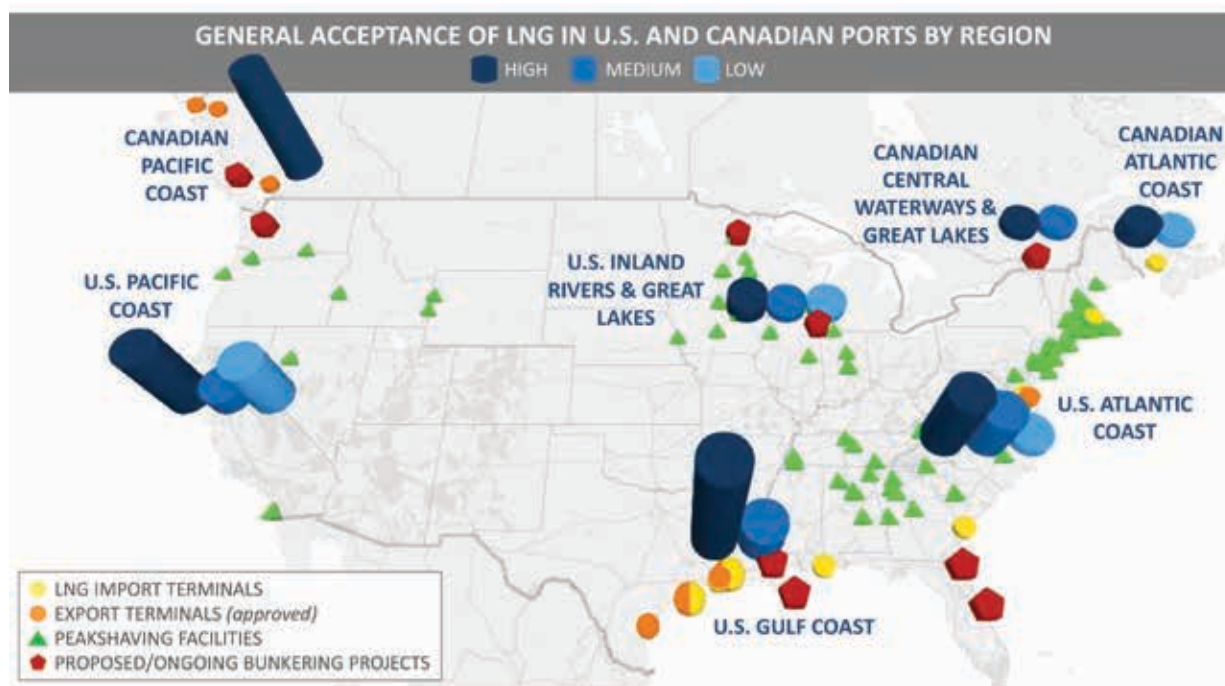


Figure 2. LNG General Acceptance by Regions vs. Potential LNG Sources and Proposed/Ongoing Bunkering Project Locations

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. This information is detailed in Appendix E.

Other updates – Section 1.5 provides additional clarification on how to use this study, as well as further guidance on new material provided in this update.

1.2. LNG Drivers

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 01-15² and 02-15³.

The ABS Guide for LNG Fuel Ready Vessels⁴ provides guidance to shipowners and shipbuilders indicating the extent to which a ship design has been prepared or "ready" for using LNG as a fuel. ABS is providing further guidance to assist LNG stakeholders by developing this study, *Bunkering of Liquefied natural Gas-fueled marine Vessels in North America*. ABS developed the first edition in 2014 to assist LNG stakeholders in implementing the existing and planned regulatory framework for LNG bunkering and to help owners and operators of gas-fueled vessels, LNG bunkering vessels, and waterfront bunkering facilities by providing information and recommendations to address 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 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. The use of LNG as fuel for ships other than those carrying LNG as cargo is a relatively new concept in North America. 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.

This study was developed to assist LNG stakeholders in implementing the existing and planned regulatory framework for LNG bunkering. This study helps owners and operators of gas-fueled vessels, LNG bunkering vessels, and waterfront bunkering facilities by providing information and recommendations to address North American (US and Canada) federal regulations, state, provincial and port requirements, international codes, and standards.

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.

2 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

3 USCG Policy Letter, CG-OES Policy Letter No 02-15, "Guidance Related to Vessels and Waterfront Facilities Conducting Liquefied Natural Gas (LNG) Marine Fuel Transfer (Bunkering) Operations", 25 February 2015.

4 American Bureau of Shipping. "ABS Guide for LNG Fuel Ready Vessels," December 2014.

Details on LNG production in the US and Canada and LNG sources in various geographic regions provide an overview of the current North American infrastructure to support LNG bunkering operations. Local regulations are widely varied in maturity and content. To assist stakeholders in planning and execution of LNG bunkering projects, this 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.

1.2.1. Emissions Regulations

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 (SO_x), nitrogen oxide (NO_x), and particulate matter (PM). In addition to global requirements, designated areas called Emission Control Areas (ECAs) are 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 SO_x emissions from ships: California Air Resources Board and European Union Sulphur Directive.

NO_x 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. 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.⁵

The tiered approach for sulfur means that the existing global maximum sulfur content of 3.5% mass/mass (m/m) (outside an ECA) will be reduced to 0.5% m/m, in 2020. A Marine Environment Protection Committee (MEPC) correspondence group was created to determine the availability of compliant fuel oil and publish a report of its findings by 2018. If the group determines the availability of compliant fuel oil is too limited, then this requirement could be postponed to January 1, 2025. A progress report on the group's research is expected in 2015. In designated ECA areas, the sulfur fuel requirement has been reduced to 0.1% effective January 1, 2015.

⁵ Annex 12 Environmental Protection Agency (EPA); Amendments to MARPOL Annex VI and the NO_x Technical Code 2008; Chapter 3, Regulation 13, Parts 4 and 5. Requirements for control of emissions from ships; Resolution MEPC.251(66), (www.epa.gov/otaq/documents/oceanvessels/resolution-mepc-251-66—4-4-2014.pdf), 4 April 2014.

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.⁶

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

Use low sulfur residual or distillate marine fuels in existing machinery. 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). 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.

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 SO_x 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 SO_x 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 Notice⁷ for more information on the issues related to fuel switching.

1.2.2. Economic Factors

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

6 Part II Environmental Protection Agency (EPA); 40 CFR Parts 80, 85, 86, et al. Control of Emissions From New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder; Final Rule; Federal Register / Vol. 75, No. 83 / Friday, 30 April 2010 / Rules and Regulations, (<http://edocket.access.gpo.gov/2010/pdf/2010-2534.pdf>).

7 Fuel Switching Advisory Notice, ABS, Houston, TX, (<http://www.eagle.org/eagleExternalPortalWEB/ShowProperty/BEA%20Repository/References/ABS%20Advisories/FuelSwitchingAdvisory>).

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.⁸ Up from near zero in 2000, shale gas is predicted to account for about half of US gas output by 2040.⁹ 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.¹⁰ 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.

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. The Russian-Chinese pipeline gas deal in 2014 will supply 1.3 Trillion cubic feet (Tcf) of gas per year for 30 years starting in 2018, potentially increasing to 2.1 Tcf per year. The contract price is linked to international crude oil prices on a take-or-pay basis.¹¹ China has 1,115 Tcf of technically recoverable shale gas, and development of domestic reserves is an important part of the government's natural gas strategy, along with imports of LNG. 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.

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% 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.¹²

8 U.S. Energy Information Administration. "Shale Gas Provides Largest Share of U.S. Natural Gas Production in 2013," (www.eia.gov/todayinenergy/detail.cfm?id=18951), 25 November 2014.

9 The Baker Institute. Medlock, K. B., III. "The Impacts of the Natural Gas Shale Boom on U.S. Energy Security," (<http://bakerinstitute.org/files/3882/>), 29 December 2010.

10 U.S. Energy Information Administration. "U.S. Crude Oil and Natural Gas Proved Reserves," (<http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm>), 1 August 2013.

11 U.S. Energy Information Administration. "Russia-China Deal will Supply Siberian Natural Gas to China's Northern, Eastern Provinces," (<http://www.eia.gov/todayinenergy/archive.cfm>), 20 August 2014.

12 U.S. Energy Information Administration. "Japan plans to restart some nuclear plants in 2015 after Fukushima shutdown," (<http://www.eia.gov/todayinenergy/archive.cfm>), 11 February 2015.

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.

1.3. Regulatory Summary

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. Chapters 3, 4, and 5 provide details of the regulations and guidance on implementation.

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.

There are international guidelines (e.g., Society of International Gas Tanker and Terminal Operators [SIGTTO], Society of Gas as a Marine Fuel [SGMF]) and regulations (e.g., IMO) that provide guidance for the equipment and operation of natural gas-fueled engine installations on ships. Figure 3 shows potentially applicable regulations, codes and standards for LNG bunkering in the US.

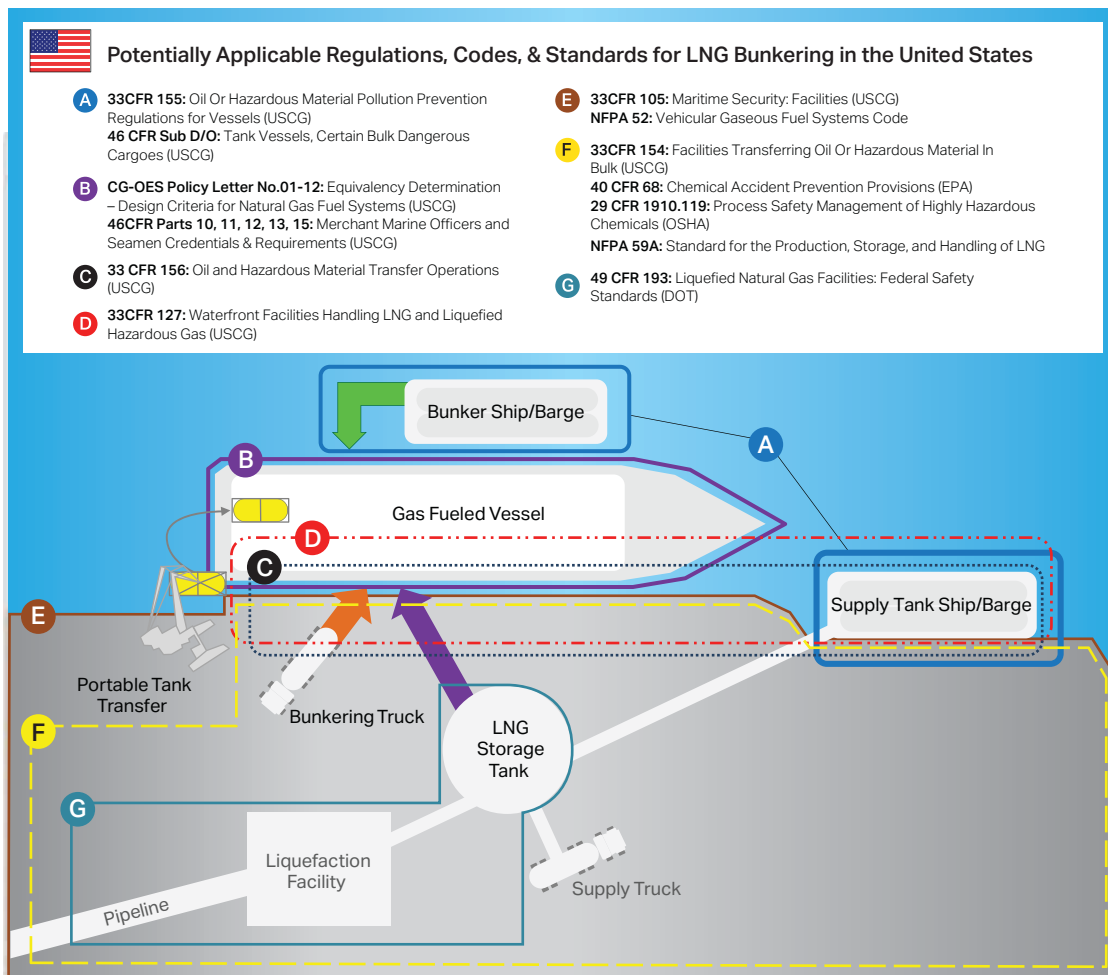


Figure 3. Potentially Applicable Regulations, Codes and Standards for LNG Bunkering in the US



The harmonization of Canadian regulations with international standards has been identified in the Government of Canada’s Cabinet Directive on Regulatory Management as a key approach to establishing an effective and appropriate regulatory framework. Transport Canada Marine Safety and Security (TCMSS) is participating at IMO to ensure Canadian interests are represented as part of the development of international safety requirements. The MSC in their 94th session, approved proposed amendments to make the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code), under Safety of Life at Sea (SOLAS) with the intent to adopt both the code and SOLAS amendments at the next session, Maritime Safety Committee (MSC) 95, scheduled for June 2015. Until adopted by MSC 95, interim guidance MSC.285(86) will address the safety requirements for these types of vessels. TCMSS is also participating at IMO in the development of a regime for the training and certification of vessel crews and will be taking into consideration the recently released draft International Organization for Standardization (ISO) Bunkering Standard as part of the development of the Canadian domestic regulatory regime. Even without an established Canadian regulatory framework, operators, such as British Columbia Ferries and Chantier Davie Canada, are moving forward with plans to build gas-fueled vessels for operation in Canada.

1.4. LNG Bunkering Options

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 (Figure 4).

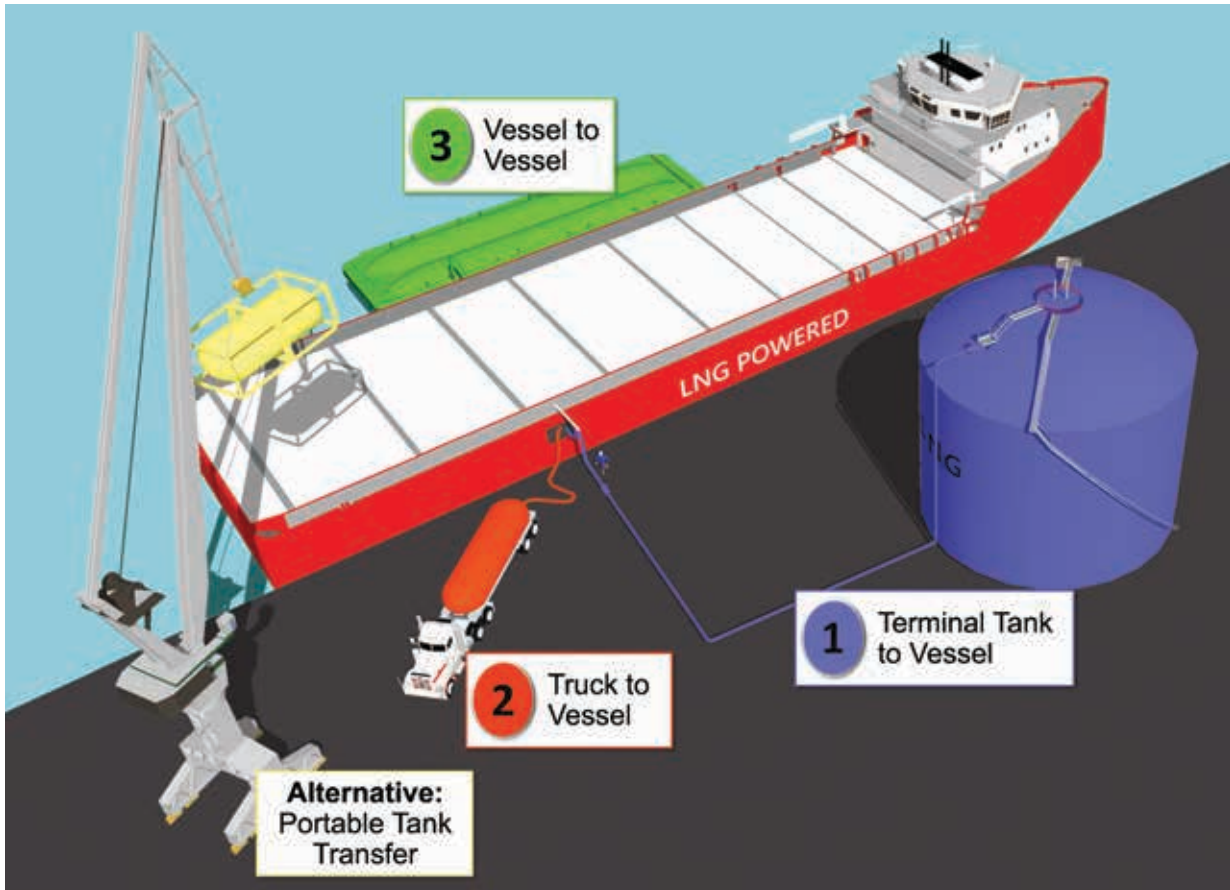


Figure 4. Standard LNG Bunkering Options

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 (e.g., American Society of Mechanical Engineers [ASME]/ISO 1496 Pt 3, USCG 46 Code of Federal Regulations [CFR] 173).

1.5. How to Use This Study

This study will help operators and owners of gas-fueled vessels, LNG bunkering vessels, and waterfront facilities who need background information and guidance to address North American (US and Canada) federal regulations, state/provincial and port requirements, international codes, and standards and potentially waterway requirements or restrictions as well as unique issues such as regional and local restrictions on storing LNG. This section is an overview of the document to help guide owners and operators to the chapter(s) applicable to their operations. It also provides guidance to direct the reader to the new material that is included in this revision of the report.

Chapter 2 is new material for this issue of the report and provides valuable insights and lessons learned from companies that have initiated LNG marine projects and are well underway in their development of LNG-fueled vessels and the corresponding infrastructure for LNG bunkering. LNG bunkering options and LNG hazard and risk information previously included in this chapter are in Chapters 1 and 6 respectively.

Chapters 3 and 4 provide guidelines for vessel operators and project developers. Each chapter provides a decision tree that will guide the user to the applicable regulatory framework. Then for each situation, the specific implementation requirements are tabulated. Chapter 3 provides guidelines for gas-fueled vessel operators; Chapter 4 provides guidelines for bunker vessel operators. The chapters have been updated to highlight and discuss the differences between the interim guidance of MSC.285(86), the approved in principle IGF Code, IGC Code, The Standards of Training, Certification and Watchkeeping (STCW) Convention and Code as well as USCG policy letters issued February 19, 2015 on guidance to the COTP and OCMI's regarding vessels that use natural gas as fuel and engage in fuel transfer operations as well as guidance to owners of vessels and waterfront facilities intending to conduct liquefied natural gas (LNG) fuel transfer operations.

Chapter 5 provides guidelines for bunkering facility operators and has been updated to provide guidance and input from the applicable regulatory bodies on the interpretation of regulations effecting bunkering facilities. Additional clarification on regulatory coverage from OSHA and EPA is provided in this update.

Chapter 6 describes specific studies that, in some cases, may be required in addition to or in support of the regulatory requirements. These studies play an important role in the permitting and approval of LNG bunkering projects and facilities. These sections have been expanded to provide additional detail and content for the studies.

Chapter 7 provides an assessment of the current North American infrastructure to support bunkering operations (1) giving operators information on LNG production in the US and Canada and LNG sources in various geographic regions and (2) providing an overall picture of the present

status. It also provides a recommended structured process for implementing an LNG bunkering project, giving consideration to the many local, regional, and port-specific issues that need to be addressed. New material is provided that includes lessons learned and insights gained from securing LNG supply for marine bunkering projects. These include the full range from defining the requirements of the supply to soliciting industry and negotiating contract terms.

Also included in Chapter 7 and Appendix E are the results of a comprehensive survey and discussions with port stakeholders to gain perspectives on the development of LNG projects in North American Ports. Appendix E has been added and provides a comprehensive contact list to support research efforts for potential project developers as they begin the communication tasks with port stakeholders.

Figure 5 is an overview of the document content including a listing of new material in this update.

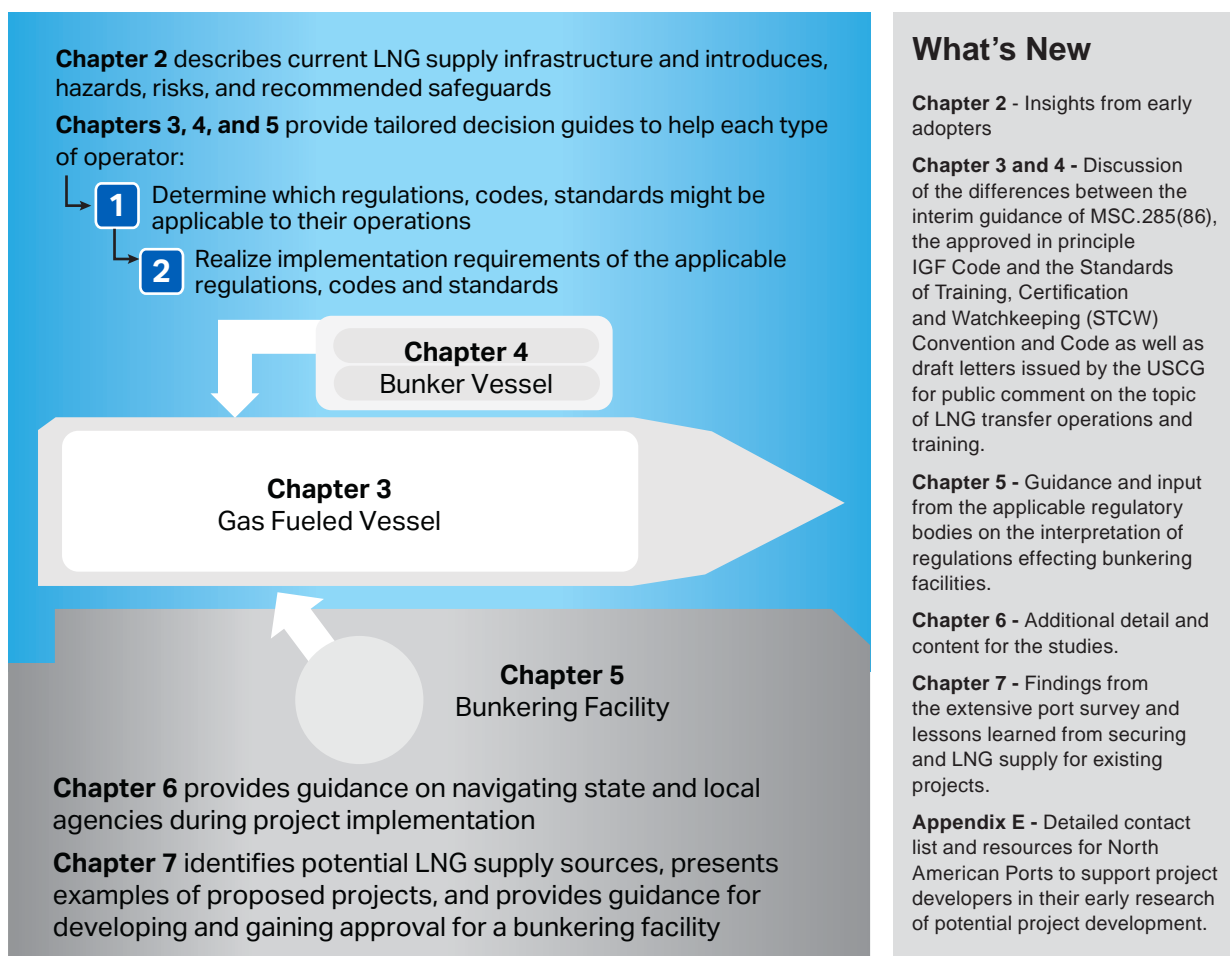


Figure 5. Document Guide

 Because Canada's approach to establishing an effective and appropriate LNG bunkering regulatory framework is one of harmonization of Canadian regulations with international standards, an implementation road map, like that of the US, is not currently applicable. For Canada, Chapters 3, 4, and 5 will identify the regulations, codes, and standards that are most relevant to each type of operator, but do not detail the implementation requirements since they do not exist yet.

1.6. Project Phases

The primary objective of this report is to provide users with a collection of tools, guidelines and references to aid in the concept and implementation of LNG projects. Included are LNG bunkering facilities, gas-fueled vessels, and LNG bunkering vessels. The enclosed wall-size poster (replicated as Figure 6) provides an overview of the process for each type of project. Cross references to the applicable sections in the report and to key requirements are provided.

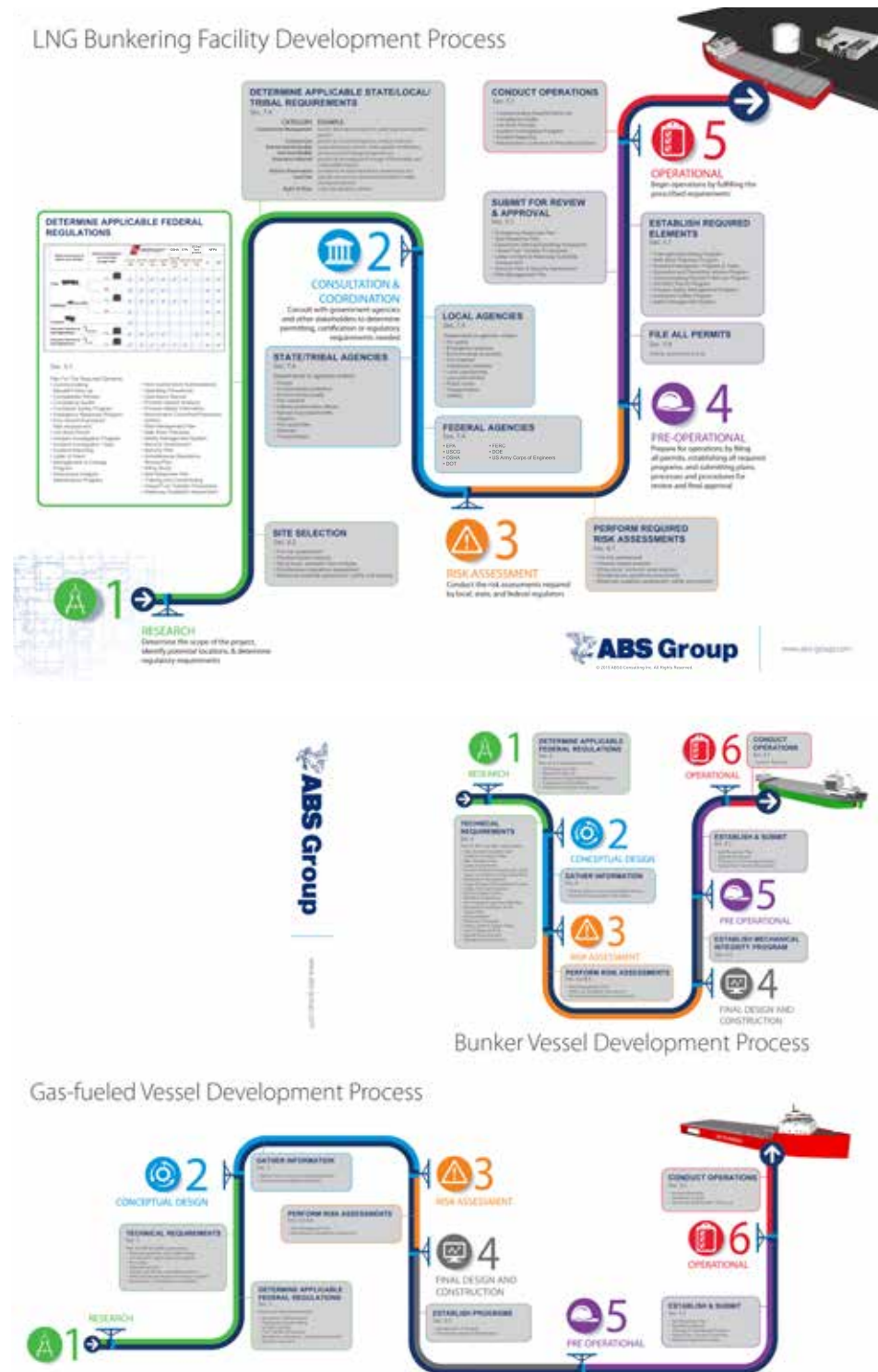


Figure 6. Project Phases

2. Lessons Learned from Early Adopters

Several companies have initiated and are well under way in their development of gas-fueled vessels and the corresponding infrastructure for LNG bunkering. Planning and execution of these projects involved a number of key decisions and resolution of regulatory, commercial and technical issues. The lessons learned from North America's first adopters of gas-fueled vessels provide valuable insight for future project developers who are considering making an investment in LNG as an alternative marine fuel.

One of the common threads among North America's early adopters is having gained the awareness that making the switch to LNG requires patience and persistence navigating an uncharted course. When making the decision to build or convert vessels powered by gas, shipowners and operators must consider a number of regulatory factors and address technical challenges associated with applying new technology to their fleets for the first time. The process to develop the first wave of gas-fueled initiatives in North America has required close collaboration, open communication, and shared best practices among classification societies, regulatory bodies such as the USCG and port authorities, vessel designers, and shipyards to establish a baseline for these next-generation vessels.

Key lessons learned from early adopters about making the switch to LNG as a fuel include:

The adoption of LNG as a marine fuel requires a dedicated team. Adoption of the new technologies and addressing the regulations is not a part time job. There is a lot to be considered, reviewed, and engineered and it takes a dedicated team to bring the whole project together.

The drivers for conversion to LNG are both economic and a commitment to environmental stewardship. Economics drive the decision for conversion but the commitment to environmental stewardship on the part of the early adopters weighs significantly in the business case for conversion.

Use trusted advisors and partners to leverage the limited industry experience in gas-fueled vessels. Experience is limited in this emerging industry and the relationships and partnerships used are critical during the transition to LNG fuel.

LNG is readily available for marine bunkering, however, access to (transportation) and traditional bunkering contracts (spot market) are challenges to address when accessing those supplies.

Proper crew training is essential to promote the safe use of LNG as a marine fuel. Just like when making any change within an existing program, **training is fundamental.** Recognizing this is new technology and personnel are well versed in the old diesel world, resources have to be applied to provide necessary crew training.

Relationship with the Regulators. Early and often dialogue with the regulatory bodies, primarily the USCG, is essential to establishing formal lines of communication at all levels.

2.1. Decision to use LNG

The primary drivers for selecting LNG as fuel were competitive pricing in terms of long-term prospects and environmental stewardship and sustainability. Companies view this conversion as a significant step to reduce their carbon footprint, which is a major concern to customers across industry that are prioritizing “greener” ship designs with technology aimed at reducing emissions to the strictest limit within the North American ECA. Because many ships run against demanding schedules requiring no lost time, one of the most effective ways to reduce the carbon footprint is to use fuels that are much more eco-friendly than HFOs.

The amount of time transiting or operating in the ECA is a key factor. Companies are developing specific ECA strategies that consider navigation routes and weather contingencies for gas-fueled fleets. For some shippers, time spent in the ECA ranges from 40 to 100 percent, where calculations indicate that if vessels spend more than 30 percent of their time in the ECA, LNG is worth considering. At least one ship owner envisions LNG fuel capacities large enough to propel vessels in trans-ocean services; eventually eliminating the use of HFO's altogether.

Another deciding factor is the age of the existing fleet. For newer vessels, the life cycle economics favored conversion at the time of consideration. For older vessels, on the other hand, new-build programs provided the opportunity for LNG construction. Jones Act business creates an expectation of a 30-year life for new-builds. That service life is more maintenance driven as opposed to being driven by heavy construction. Companies who adopt LNG as a fuel should expect to invest more time to maintain and care for their vessels to meet that 30-year life cycle. On the positive side, the use of methane, with its lower carbon content, some of the maintenance intervals move out as much as 80% longer. With carbon as being the major wear component of any engine, less carbon in the engine causes the wear factor to diminish significantly. Some operators are looking at moving maintenance intervals out on major components as much as 50%.

In terms of obstacles faced following the initial decision, early adopters unanimously agree that one of the biggest challenges has involved learning the myriad complexities of the operation and project work scope, not only technically, but from a regulatory standpoint; thus requiring a full-time commitment to the project.

2.2. Partner Selection & Communication

In the case of shifting to gas-fueled vessels, the industry has had to rely on a synergy from which to draw expertise and understanding about LNG technology. No single person or organization has all the necessary expertise, yet; therefore, the key is to draw on multiple people's areas of expertise and understanding and to spread the information around to lean on a broader audience for the knowledge needed. For Jones Act vessels specifically, owners preferred to work with people who had designed and built LNG fueled vessels, as opposed to individuals who had minimal LNG background experience.

Effective communication during the design and construction phase between the designer, shipyard, equipment suppliers, owner, USCG, and class society is critical to ensure the applicable requirements are properly addressed and implemented. The installation of LNG dual fuel engines and associated systems is well understood in many areas of the world where LNG carriers are under construction; however, the experience with dual fuel engines and LNG systems is limited in

the US Relative to the standards and requirements applicable to LNG carriers, the requirements for gas fueled ships are in their infancy. Additionally, the requirements established for one part of the world may not be adequate for the expansion of gas as a marine fuel in another part of the world. All LNG stakeholders should acknowledge that the basic requirements have been established for gas-fueled ships, but all aspects of a new design cannot be foreseen. As such, effective communications among all parties is imperative.

Close coordination and open communication among the organizations also promotes consistency between the reviews and ultimately a better understanding by all parties of the systems, associated hazards, and best practices to promote safety. ABS provides a series of technical training programs aimed to enhance the understanding of the design, operational, and regulatory aspects of using LNG as a fuel. ABS also provides surveyors experienced with LNG systems to the US from other divisions to support the installation, testing, and commissioning of the LNG fuel gas systems.

2.3. Vessel Decisions

Owners have made strategic decisions to use proven designs as a foundation and modify the designs as little as possible to accommodate the fuel gas systems and equipment. When possible, using a sister vessel design for which one vessel was already delivered, the project can be simplified and allows the USCG, class society, owner and other partners to focus only on the gaps. Another strategic decision was to select a single service provided for the entire natural gas and power systems consisting of a fueling station, LNG fuel storage tank, vaporizers and associated piping within a tank connection space (cold box), gas valve unit enclosures, generator sets for propulsion and auxiliary power, and the associated control system.

2.4. LNG Supply Availability

LNG suppliers are plentiful and there is confidence among them that there is an abundant supply of gas. Shippers often work with outside consultants to arrange for LNG supply and availability. In many respects, the single most important consideration in LNG supply for bunkering is lead time. There is currently no developed spot market for LNG for the volumes that most vessel operators/owners require. Unlike traditional bunker fuel supply, LNG supply and bunker decisions need to be made well in advance of the launch of the vessel, particularly, if new build liquefaction and bunkering facilities are required to meet the need for LNG.

Actual experience in arranging for a gas supply revealed a significant number of creative solutions to provide LNG. Options ranging from local plants to railroad car transportation have been proposed and from a logistics standpoint, local suppliers are preferred so that weather issues do not affect supply.

Shippers prefer buying fuel on the spot market whereas the LNG market is pushing for longer term fuel contracts so there are contract issues to negotiate. Companies are confident they will have a reliable supply of gas and believe with the quantities they are proposing to consume that any number of partners will put a program together that gets the gas liquefied, gets it on a barge and gets it alongside.

Section 7.3.3 of this report is new material for this update and provides additional information on securing an LNG supply.

2.5. Engaging with Regulators and Stakeholders

Companies are being cautious while operating in the current environment since there are policy letters, but there is no adopted regulation to work to. Regulations are going to come after the fact so companies are trying to maintain constant communication with the USCG and the USCG has made a concerted effort to have one voice, a position appreciated by industry. Industry understands there will be some regulatory differences between the ports, but the USCG is making efforts to have one USCG-wide view so companies do not have to worry about different regulations from port to port.

The USCG has been extremely supportive of the move to gas-fueled vessels and LNG bunkering. They recognize gas-fueled vessels and LNG bunkering is the future and is where business is moving. Accordingly, they want to ensure everything is being done properly and with stakeholder involvement. To ensure this effort, the USCG asked for and received industry's guidance and input into the policies so that best practices are implemented.

One of the key issues for shippers is whether or not the USCG will allow operators to bunker during cargo operations. Project developers may be moving forward at risk. There will be significant negative economic impacts for running LNG vessels without the ability to bunker during cargo operations. USCG Policy Letter 01-15 dated 19 February 2015, Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels Using Natural Gas as Fuel, states that a formal operation risk assessment may be conducted to help determine whether the simultaneous operations may be conducted safely.

The recently issued ISO Technical Specification¹⁴ provides guidance for conducting risk assessments to support bunkering during cargo operations and/or bunkering with passengers on-board or embarking/disembarking. Section 6.3 in this study provides additional guidance on conducting risk assessment for Simultaneous Operations (SIMOPS).

2.6. Training

Recognizing this is new technology and personnel are well versed in the diesel world, crews will have to be brought up to speed on the gas side. The IMO Human Element, Training and Watchkeeping (HTW) Sub-Committee developed interim guidance on training for seafarers on ships using gases or other low-flashpoint fuels.¹⁵ This interim guidance provides training for different types of seafarers. The guidelines provide basic and advanced training on the risks and emergency procedures associated with fuels addressed in the IGF Code. Basic and advanced training requirements are outlined in Sections 3.2 and 4.1.3 for gas fueled vessels and bunker vessels respectively.

14 International Organization for Standardization. "Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships, Technical Specification, ISO/TS 18683," 15 January 2015.

15 International Maritime Organization. "Interim Guidelines on Training for Seafarers on Ships Using Gases or Other Low-flashpoint Fuels, IMO Circular 23, STCW.7," 9 December 2014.

2.7. Summary

Going forward, each gas fueled ship will have unique challenges. Equipment and solution providers will differ, as such; one solution for a particular vessel may not work on another. However, the experience gained by all parties for the first vessels using LNG as a fuel has the potential to make future projects even more successful.

Several lessons have already been learned and will continue to be learned that may assist others as we enter this era of gas with an inevitable growth of LNG as a fuel. It's important to remember, shipbuilding is a challenging job for the most basic of ships, but adding new technology to the process requires even more reliance on communication, use of lessons learned, solid partnerships and dedication to the process.

3. Guidelines for Gas-fueled Vessel Operators

This chapter provides operational and training guidelines for owners and operators of vessels that will use LNG as fuel. Given the various international and North American regulations, a decision tree guides the reader through the applicable regulatory framework, including interim guidelines that have been established. Specific regulatory requirements and guidelines are discussed to provide gas-fueled operators with a comprehensive means to navigate the operational and training requirements.

International guidelines for natural gas-fueled ships are currently being developed by the IMO. In June 2009, the IMO published interim guidelines outlining the criteria for the arrangement and installation of machinery for propulsion and auxiliary purposes using natural gas as fuel.¹⁶ These guidelines also provided operational and training requirements for personnel working on board gas-fueled ships. The interim guidelines were intended to provide criteria that would provide an equivalent level of safety as that which is achieved with new and comparable conventional oil fueled machinery. Following the publication of the interim guidelines, the IMO MSC continued to work on development of the IGF Code with a view towards incorporating the arrangement and system interim guidelines into the IGF Code.

Since the publication of MSC Resolution MSC.285(86), several actions have occurred to fully adopt the interim guidelines into various IMO Conventions and Codes. In November 2013, the Standards of Training and Watchkeeping Sub-Committee agreed to consider the operational and training guidelines contained in the MSC Resolution MSC.285(86) for future incorporation into the STCW Convention and Code. In November 2014, the MSC approved, in principle, the draft IGF Code, and also approved proposed amendments to make the Code mandatory under SOLAS. It is anticipated that MSC will formally adopt the IGF Code and the SOLAS amendments in June 2015. If adopted, the IGF Code will enter into force in January 2017.

In February 2014, the Sub-Committee on HTW, developed interim guidance on training for seafarers on ships using gases or other low-flashpoint fuels. These interim guidelines supersede the training set out in Resolution MSC.285(86), and were published by IMO in December 2014.¹⁷ On February 19, 2015, the USCG published a policy letter providing guidelines for LNG transfer operations and training of personnel on vessels using natural gas a fuel.¹⁸ Until the IGF Code is adopted as new amendments to SOLAS and the STCW Code, and until incorporated by reference into USCG regulations, owners and operators of US flag and foreign flag vessels operating in North America and using LNG as a fuel should follow the USCG guidelines contained in the February policy letter. The new IGF Code requirements will be effected per a schedule discussed in detail below.

16 International Maritime Organization. "Interim Guidelines on Safety for Natural Gas-Fueled Engine Installations in Ships, IMO Resolution MSC.285(86)," adopted 1 June 2009.

17 International Maritime Organization. "Interim Guidelines on Training for Seafarers on Ships Using Gases or other Low-flashpoint Fuels, IMO Circular 23, STCW.7," 9 December 2014.

18 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

3.1. Ship Arrangements and System Design

The MSC approved, in principle, the Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels, IGF Code, as well as two amendments to SOLAS Chapter II-1:

- One amendment introduces a new Part G which mandates the application of the IGF Code to cargo ships ≥ 500 gt and passenger ships using natural gas fuel; and
- A second amendment revises Part F Regulation 55 to account for the IGF Code requirement that ships using other low-flashpoint fuels (methanol, propane, butane, ethanol, hydrogen, dimethyl ether, etc.) need to comply with the functional requirements of the Code through the alternative design regulation based on an engineering analysis. Operationally-dependent alternatives are not permitted.

If adopted at MSC 95 in June 2015, it is expected that the mandatory provisions will enter into force on January 1, 2017 and will apply to new ships:

- With a building contract placed on or after January 1, 2017; or
- In the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after July 1, 2017; or
- Regardless of the building contract or keel laying date, the delivery is on or after January 1, 2020.

Ships which commence a conversion on/after January 1, 2017 to use low-flashpoint fuels or use additional or different low-flashpoint fuels other than those for which it was originally certified, will need to comply with the IGF Code. IMO plans to develop additional parts of the IGF Code to provide detailed requirements for other specific low flashpoint fuels, such as methanol, LPG, etc., at a later date and as industry experience develops. It was clarified the IGF Code is not intended to apply to gas carriers. Currently, low-flashpoint fuel means gaseous or liquid fuel having a flashpoint lower than 60° Celsius (C). However IMO agreed to ask the Sub-committee on Ship Systems and Equipment to review the flashpoint requirements for oil fuel considering a proposal to lower this to 52°C. That proposal was made by the US and Canada in light of the permissible sulphur content for oil fuels being reduced to 0.10% m/m for ships operating in any of the four designated ECAs as of January 1, 2015 and that low-sulphur fuels are known to have flashpoints slightly less than 60°C. Despite the debate around the SOLAS threshold of 60°C for low flashpoint fuels, it has been recognized by the IGF Code working group that it is not the intent to apply the IGF Code to conventional liquid low flashpoint fuels, such as those permitted under SOLAS II-2/4.2.1.2 in emergency generators at the 43°C threshold.

The more significant provisions of the Code include:

- **Risk assessment** – is to be conducted to ensure that risks arising from the use of gas-fuel or low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed. Consideration is to be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure. The scope and methodology of this risk assessment remains to be clarified and IACS is in the process of developing a unified requirement on this.

- **Machinery spaces** – are to be either “gas safe” (a single failure cannot lead to release of fuel gas) or “ESD-protected” (in the event of an abnormal gas hazard, all non-safe equipment/ignition sources and machinery is automatically shut down while equipment or machinery in use or active during these conditions is to be of a certified safe type). Engines for generating propulsion power and electric power shall be located in two or more machinery spaces.
- **Fuel system protection** – the IGF Code includes deterministic tank location criteria requiring that tanks are not to be located within:
 - B/5 or 11.5 m, whichever is less, from the side shell;
 - B/15 or 2.0 m, whichever is less, from of the bottom shell plating; and
 - 8% of the forward length of the ship.

The IGF Code also includes a probabilistic alternative that may permit tank location closer to the side shell with different acceptability threshold values for passenger and cargo ships of 0.02 and 0.04, respectively. As previously decided by the IMO, the location of fuel tanks below accommodations is not excluded, subject to satisfactory risk assessment. Fuel pipes are not to be located less than 800 millimeter (mm) from the ship’s side. Single fuel supply systems are to be fully redundant and segregated so that a leakage in one system does not lead to an unacceptable loss of power.

- Limit state design – structural elements of the fuel containment system are to be evaluated with respect to possible failure modes taking into account the possibility of plastic deformation, buckling, fatigue and loss of liquid and gas tightness.
- Air locks – direct access between non-hazardous and hazardous spaces is prohibited except where necessary for operational reasons, through a mechanically ventilated air lock with self-closing doors. Such an air lock is also required for accesses between ESD-protected machinery spaces and other enclosed spaces.
- Hazardous areas – the IGF Code applies International Electrotechnical Commission (IEC) principles for the classification of hazardous areas. It should be noted that the hazardous areas associated with tank relief valve vents are smaller than those in the IGC Code.
- Gas detection – is required at ventilation inlets to accommodation and machinery spaces if required by the risk assessment.

3.2. Operational and Training Requirements for Personnel

The IMO HTW Sub-Committee developed interim guidance on training for seafarers on ships using gases or other low-flashpoint fuels.¹⁹ This interim guidance provides training for different types of seafarers. All seafarers serving on board ships subject to the IGF Code should receive appropriate ship and equipment specific familiarization as currently required in STCW regulation I/14.5. The guidelines provide additional basic and advanced training on the risks and emergency procedures associated with fuels addressed in the IGF Code. Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of fuels addressed in the IGF Code. These basic and advanced training requirements are outlined in Table 1.

¹⁹ International Maritime Organization. “Interim Guidelines on Training for Seafarers on Ships Using Gases or Other Low-flashpoint Fuels, IMO Circular 23, STCW.7,” 9 December 2014.

Table 1. Crew Member Training Levels

| If crew members are... | Then the following training should be conducted: |
|---|--|
| Responsible for designated safety duties | Basic Training |
| Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and fuel systems | Advanced Training |

Competencies for basic and advanced training, contained in draft amendments to the STCW Code, are found in Table 2. Appendix B contains detailed information on the specific knowledge, understanding, and proficiencies being considered by the IMO for each of the competencies listed in Table 2.

Table 2. Standards of Competence

| Level of Training | Standards of Competence |
|-------------------|--|
| Basic Training | Receive basic training or instruction so as to: <ul style="list-style-type: none"> • Contribute to the safe operation of a ship subject to the IGF Code. • Take precautions to prevent hazards on a ship subject to the IGF Code. • Apply occupational health and safety precautions and measures. • Carry out firefighting operations on a ship subject to the IGF Code. • Respond to emergencies. • Take precautions to prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code. |
| | Provide evidence of having achieved the required standards of competence to undertake their duties and responsibilities through: <ul style="list-style-type: none"> • Demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and • Examination or continuous assessment as part of a training program. |
| Advanced Training | Receive advanced training or instruction so as to: <ul style="list-style-type: none"> • Gain familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code. • Operate remote controls of fuel related to propulsion plant and engineering systems and services on ships subject to the IGF Code. • Be able to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code. • Plan and monitor safe bunkering, stowage, and securing of the fuel on board ships subject to the IGF Code. • Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code. • Monitor and control compliance with legislative requirements. • Take precautions to prevent hazards. • Apply occupational health and safety precautions and measures on board ships subject to the IGF Code. • Have knowledge of the prevention, control and firefighting and extinguishing systems on board ships subject to the IGF Code. |
| | Provide evidence of having achieved the required standards of competence to undertake their duties and responsibilities through: <ul style="list-style-type: none"> • Demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and • Examination or continuous assessment as part of a training program. |

3.3. United States

Existing USCG regulations cover the design, operation and manning of certain type of US flag vessels. However, the USCG has not developed new regulations for the operations and training of personnel on vessels that use LNG as a fuel. The USCG has issued guidance on the design criteria for natural gas fuel systems²⁰ as well as guidelines for fuel transfer operations and training of personnel on gas-fueled vessels.²¹ When the IMO makes the IGF Code mandatory, the USCG may consider requiring full compliance with this Code by incorporating the IGF Code into US regulations. This section lists and describes the current guidelines, rules and codes applicable to US flag gas-fueled vessels and foreign flag gas-fueled vessels operating in US. In addition, USCG may define requirements for foreign flag vessels operating in the US in the near future. The current understanding is that for foreign flag vessels the USCG would not require full compliance with the requirements applicable to US flag vessels. However, the USCG would perform an evaluation of the vessel, including the design standards used and approvals obtained by the vessel's flag state and classification society.

Table 3 lists the current guidelines, rules, and codes related to the use of LNG as a fuel that may be applicable for US flag gas-fueled vessels. In addition to these guidelines, codes and regulations, the owners and operators of vessels using LNG as a fuel will need to comply with existing requirements based on the type of vessel. These existing regulations govern the design, inspection, maintenance, and operations of these vessels, as well as prescribe standards for training, certification of mariners, and the manning of vessels. Additional pollution prevention regulations are contained in Title 33 CFR Subchapter O, which outlines requirements for pollution prevention, especially during transfer operations. These existing requirements, outlined in Table 4, are based on the type of vessel and not necessarily applicable due to the use of LNG as a fuel.

Table 3. Guidelines, Regulations, Codes and Standards unique to Gas-fueled Vessels

| IMO |
|---|
| <ul style="list-style-type: none"> • International Code of Safety for Ships using Gases or other Low flashpoint Fuels (IGF Code) • IMO STCW.7 Circular 23 – Interim Guidance on Training for Seafarers on Ships using Gases or other Low-flashpoint fuels |
| USCG |
| <ul style="list-style-type: none"> • CG-521 Policy Letter 01-12 Equivalency Determination: Design Criteria for Natural Gas Fuel Systems • CG-OES Policy Letter No. 01-15 Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel |
| ABS |
| <ul style="list-style-type: none"> • Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships • Guide for LNG Fuel Ready Vessels |

20 USCG Policy Letter, CG-521 Policy Letter 01-12, "Equivalency Determination; Design Criteria for Natural Gas Fuel Systems," 19 April 2012.

21 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

Table 4. Existing US Coast Guard Regulations for Certain Vessel Types

| Vessel Type | US Coast Guard Regulations |
|-------------------------|---|
| Towing Vessel | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter C – Parts 24-28 |
| Fishing Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter C – Parts 24-28 |
| Tank Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter D – Parts 30-39 |
| Passenger Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter I – Passenger Vessels – Parts 70-80 |
| Cargo Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter I – Cargo and Miscellaneous Vessels – Parts 90-105 |
| Small Passenger Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter K – Small Passenger Vessels carrying more than 150 passengers or with overnight accommodations for more than 49 passengers – Parts 114-122 |
| Offshore Supply Vessels | <ul style="list-style-type: none"> • 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter L – Offshore Supply Vessels – Parts 125-134 |

Figure 7 is a simple decision tree to assist vessel operators in identifying the regulations, codes, and standards that may be applicable to their vessels specifically related to the use of LNG gas fuel based on whether the vessel (1) will be classed, (2) will be inspected by the USCG, and (3) will operate in international waters. Note that gas carriers fueled by cargo boil-off are currently regulated by the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and are not a primary focus of this study, with the exception of bunker vessels, which are discussed in Chapter 4. Answering those three simple questions categorizes a prospective vessel into one of eight unique gas-fueled vessel cases.

| Will the vessel be classed? | Will the vessel be inspected by the US Coast Guard? | Will the vessel operate in International waters? | Gas Fueled Vessel Cases | IMO | | United States Coast Guard U.S. Department of Homeland Security | | | ABS |
|-----------------------------|---|--|-------------------------|----------|------|---|----------------------------|----------------------------------|---|
| | | | | IGF Code | STCW | CG-521 Policy Letter 01-12 | CG-OES Policy Letter 01-15 | Guide for LNG Ready Fuel Vessels | Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships |
| YES | YES | YES | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | NO | 2 | | | ✓ | ✓ | ✓ | ✓ |
| | | YES | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | NO | 4 | | | ✓ | ✓ | ✓ | ✓ |
| | NO | YES | 5 | ✓ | ✓ | ✓ | ✓ | | |
| | | NO | 6 | | | ✓ | ✓ | | |
| | | YES | 7 | ✓ | ✓ | ✓ | ✓ | | |
| | | NO | 8 | | | ✓ | ✓ | | |

Figure 7. Gas-fueled Vessel Decision Tree

Table 5 presents key elements required under each code, standard, or guideline, and identifies which of the eight gas-fueled cases from Figure 7 are applicable to each key element.

Table 5. Key Elements of Applicable Codes, Standards and Guidelines for Gas-fueled Vessels

| Key Elements | IMO | | United States Coast Guard U.S. Department of Homeland Security | | | ABS | | | | |
|--|------------------------------------|--------------------|---|----------------------------|--------------------|--------------------|--|--|--|--|
| | IGF Code | STCW | CG-521 Policy Letter 01-12** | CG-OES Policy Letter 01-15 | ABS Guide | | | | | |
| | Applicable Gas Fueled Vessel Cases | | | | | | | | | |
| | 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | | | | |
| Training and credentialing | ✓ | ✓ | | ✓ | | | | | | |
| Incident reporting | | | | ✓ | | | | | | |
| Ship arrangements and system design | ✓ | | ✓ | | ✓ | | | | | |
| Fire safety | ✓ | | ✓ | ✓ | ✓ | | | | | |
| Electrical systems | ✓ | | ✓ | | ✓ | | | | | |
| Control, monitoring and safety systems | ✓ | | ✓ | | ✓ | | | | | |
| Compressors and gas engines | ✓ | | ✓ | | ✓ | | | | | |
| Manufacture, workmanship and testing | ✓ | | ✓ | | ✓ | | | | | |

3.3.1. USCG Regulations and Guidelines Specifically for LNG Fueled Vessels

As discussed above and shown in Table 5, certain US flag vessels are subject to existing USCG regulations. However, the use of LNG as a fuel is relatively new among US flag vessels and foreign vessels operating in US waters. While existing USCG regulations apply to LNG fuel transfer operations, the USCG has established equivalency guidelines and has developed interim operating and training guidelines for vessels using LNG as fuel.

US flag vessels that use LNG as a fuel are subject to USCG regulations outlined in various Subchapters of Title 46 CFR. The specific regulations governing these vessels depends on the type of vessel, such as towing vessel, fishing vessel, tank vessel, cargo vessel, etc. The USCG has not established specific regulations for vessels that receive LNG as fuel. In the interim, the USCG published guidance on February 19, 2015 for fuel transfer operations and training of personnel work on vessels that use natural gas as fuel and conduct LNG fuel transfers.

3.3.1.1. Equivalency Determination: Design Criteria for Natural Gas Fuel Systems – CG-521 Policy Letter 01-12

Existing USCG regulations address the design, equipment, operations, and training of personnel on vessels that carry LNG as cargo in bulk. The regulations also address the fueling systems for boil-off gas used on LNG carriers. However, there are no US regulations explicitly addressing gas-fueled vessels.

In April 2012, the USCG published CG-521 Policy Letter Number 01-12, which established design criteria for natural gas fuel systems that provide a level of safety at least equivalent to that provided for traditional fuel systems in the regulations for various types of vessels inspected and certificated by the USCG.²² This policy letter, which is based on international standards established by the IMO, serve as interim guidance for vessel owners and operators until such time as the USCG regulations are revised and the IGF Code enters into effect.

For US flag vessels, there are currently two methods to obtain USCG approval and an equivalency determination to use LNG as a fuel. First, operators must ensure the vessel design meets CG-521 Policy Letter Number 01-12. Alternatively, a vessel-specific concept review may be requested by the USCG to establish a design basis or framework of regulations equivalent to that provided for traditional fuel systems. The concept review would be conducted by the USCG MSC, and a design basis letter would be issued detailing the specific requirements for the project. In both cases, plan review by the USCG MSC and inspection by the local USCG inspector are required.

²² USCG Policy Letter, CG-521 Policy Letter 01-12, "Equivalency Determination; Design Criteria for Natural Gas Fuel Systems," 19 April 2012.

3.3.1.2. Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel

On February 19, 2015, the USCG issued guidelines for liquefied natural gas transfer operations and training of personnel working on US and foreign vessels using natural gas as fuel and conduct LNG fuel transfer operations in waters subject to US jurisdiction.²³ These guidelines will be used by the Coast Guard to evaluate whether natural gas fueled vessels are operated, and affiliated personnel are trained, in a manner that provides a level of safety that takes into account characteristics specific to LNG fueled ships and LNG fuel transfer operations. The guidelines would apply to vessels equipped to receive LNG for use as fuel, but not to vessels carrying LNG as cargo that use boil-off gas as fuel.

Enclosure 1 of the policy letter includes guidelines that are derived from the Coast Guard's regulations governing the safe design, construction, equipment inspection testing and operations of vessels that carry oil and hazardous materials in bulk and includes guidance for the following aspects of bunkering operations on gas-fueled vessels:

- The applicability of existing regulations for vessels and facilities providing LNG as Fuel
- Operations, emergency, and maintenance manuals as discussed in 33 CFR 127.305 – 127.309
- Transfer operations, including
- Person-in-Charge (PIC) designation
- Qualifications of the PIC
- Notification of Transfer
- Transfer procedure requirements contained in 33 CFR 155 and 33 CFR 156
- Simultaneous operations
- Safety and Security areas
- Conduct before a LNG fuel transfer
- Conduct during a LNG fuel transfer
- Conduct after an LNG fuel transfer
- Vessel equipment such as the bunkering system, deck lighting, personnel protection, portable gas detectors, radio and communications equipment, LNG fuel transfer hoses, the LNG bunkering manifold, spill protection emergency shutdown systems, and alarms and indicators

Enclosure 2 of the policy letter contains excerpts from interim guidelines established by the International Maritime Organization for the safety of natural gas-fuelled engine installations in ships including:

- Fuel bunkering system and distribution system outside machinery spaces
- Bunkering system
- Fuel tank monitoring
- Gas supply system maintenance

²³ USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

Owners and operators of gas-fueled vessels will need to take into account the emerging requirements for crew certification and training that are being developed by the IMO and that are being considered by the USCG for incorporation into US regulations. Current regulations in Title 46 CFR Parts 10, 11, 12, 13 and 15 provide credentialing, training and manning requirements for US merchant mariners. Mariners on US vessels must be familiar with the vessel characteristics (46 CFR 15.405) as must receive basic training before assuming their duties and responsibilities (46 CFR 15.1105). Mariners on foreign flag vessels are required to receive familiarity training based on the International Convention on STCW Regulations I/14. The USCG recognized that the current national regulations do not adequately address training and experience requirements for mariners onboard vessels that use LNG as fuel and that will be subject to the IGF Code and provided guidance in Enclosure 3 of CG-OES Policy Letter No. 01-15. The guidelines state that mariners should receive appropriate training on the risks and emergency procedures associated with the use of gases or other low flashpoint fuels. Enclosure 3 of the policy letter outlines standards of competence for basic training for mariners responsible for designated safety duties and advanced training masters, engineer officers and any person with immediate responsibility for the case and use of gases or other low flashpoint fuels being used a fuel. Mariners should ensure that they have documentary evidence that they have successfully completed the basic or advanced training and should participate in regular emergency exercises on board the vessel.

The USCG also issued guidelines that pertain to vessels and waterfront facilities conducting LNG marine fuel transfer operations. These guidelines are further discussed in Chapter 5.

3.3.2. ABS Guidance

3.3.2.1. Guide for Propulsion and Auxiliary Systems for Gas-fueled Ships

ABS has developed guidelines for propulsions and auxiliary systems for gas-fueled ships,²⁴ in order to provide guidance for the design and construction of propulsion prime mover arrangements, auxiliary power generation arrangements, and associated systems for gas-fueled ships. It may be applied to all vessel types other than those covered by the IMO IGC Code, that use natural gas as fuel.

To assist shipowners and shipbuilders with meeting these guidelines, ABS also published the Guide for LNG Fuel Ready Vessels.²⁵ The intent of this guide is to provide guidance to shipowners and shipbuilders indicating the extent to which a ship design has been prepared or "ready" for using LNG as a fuel. The actual ABS requirements to be applied to gas fueled ships are detailed in the *ABS Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships* (herein after referred to as the *Gas Fueled Ships Guide*). The purpose of this Guide is to indicate the extent to which a vessel has been prepared or "ready" for compliance with the *Gas Fueled Ships Guide*. This document will be very dynamic in its efforts to keep current with regulations, rules and lessons learned. ABS will update the *Gas Fueled Ships Guide* to reflect future developments concerning use of LNG as a fuel.

24 American Bureau of Shipping. "Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships," May 2011.

25 American Bureau of Shipping. "Guide for LNG Fuel Ready Vessels," December 2014.

3.4. Canada

3.4.1. Marine Personnel Requirements

Owners and operators of Canadian gas-fueled vessels will need to take into account the existing Marine Personnel Regulations established by Transport Canada under the Canadian Shipping Act of 2001.²⁶ As with the US, Transport Canada is considering additional regulations that may be required for seafarers operating on Canadian gas-fueled vessels. Personnel working on foreign flag vessels operating in Canadian waters will need to comply with the interim guidelines being developed by the vessels' flag state. Canada and other flag states signatory to STCW convention should refer to the Interim Guidance on Training for Seafarers on Ships Using Gases or Other Low-Flashpoint Fuels for training and certification requirements being considered by the IMO.²⁷

3.4.2. Gas-fueled Vessel Requirements

Within the Transport Canada Safety and Security organization is the Marine Safety and Security Department. This department is responsible for developing, administering, and enforcing national and international laws and policies governing marine safety, security, and pollution prevention and for the administration of the Canada Shipping Act 2001 and other marine related acts.

Currently, there are no Canadian regulations explicitly addressing gas-fueled vessels. Further, the Canadian regulations currently do not permit the use of low flashpoint fuels. As such, vessels using LNG as a marine fuel must be approved by the Marine Safety and Security Department on an individual basis using an alternative process called the Marine Technical Review Board until the international regime is complete and Canadian regulations have been modified. Transport Canada will most likely adopt the IGF Code for new vessel construction and existing vessel conversion projects. The standards will be applied in combination with the Marine Technical Review Board process. The process allows owners and operators to apply for equivalences or exemptions to existing regulatory requirements on a ship-by-ship basis, and it may require certain additional conditions to permit the vessel to operate using LNG as a fuel. A formal risk assessment will be required for the vessel design and bunkering operations

26 Canada Justice Laws. "Canada Shipping Act of 2001- Marine Personnel Regulations," (<http://laws-lois.justice.gc.ca/eng/regulations/SOR-2007-115/>), 2001.

27 International Maritime Organization. "Interim Guidelines on Training for Seafarers on Ships Using Gases or Other Low-flashpoint Fuels, IMO Circular 23, STCW.7," 9 December 2014.

There are a number of resources currently available or in development that may be applied to develop the Canadian regulatory framework for gas-fueled vessels, including:

IMO

- International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code), which incorporates MSC.285(86) guidelines – MSC94 approved the IGF code
- International Convention on STCW – IMO Subcommittee on HTW, developed draft amendments to STCW and interim guidance addressing standards of competency for basic training, which will be considered for adoption into the STCW Convention and Code
- International Safety Management Code (ISM Code)
- International Convention for SOLAS – MSC94 approved proposed amendments to make the IGF Code mandatory for ships subject to SOLAS

Transport Canada

- Acceptance of an Alternative Regulatory Regime for Inspection, Construction, and Safety Equipment (TP13585)
- Liquefied Natural Gas: A Marine Fuel for Canada's West Coast published April 2014 is a condensed version of the Transport Canada report TP 15248 E, Canadian Marine Liquefied Natural Gas (LNG) Supply Chain Project – Phase 1 – West Coast

ABS

- Rules for Building and Classing Steel Vessels (ABS 1)
- Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships
- ABS Guide for LNG Fuel Ready Vessels

4. Guidelines for Bunker Vessel Operators

This chapter provides guidelines for owners and operators of LNG bunkering vessels. Given the various international and North American regulations, a decision tree guides the reader through the applicable regulatory framework, including interim guidelines that have been established.

4.1. International

4.1.1. International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

Owners and operators of LNG bunkering vessels that operate on ocean or coastwise voyages will need to comply with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, commonly known as the IGC Code.²⁸ The code provides international standards outlining the design and construction standards, along with the equipment that should be carried to minimize risks to the vessel, crew, and the environment where the vessel is in operation. In May 2014, the IMO's MSC met for its 93rd session and adopted a completely revised IGC Code. The newly adopted IGC Code will enter into force on January 1, 2016 and apply to gas carriers constructed on or after July 1, 2016.

4.1.2. International Organization for Standardization

Owners and operators of LNG bunkering vessels are also encouraged to use the guidelines established by the ISO. These include:

- ISO 28460:2010, "Petroleum and Natural Gas Industries – Installation and Equipment for Liquefied Natural Gas – Ship-to-shore Interface and Port Operations"
- ISO/TS 16901: 2013, "Guidelines on Performing Risk Assessments in the Design of Onshore LNG Installations Including the Ship/Shore Interface"
- ISO 31010:2009, "Risk Management – Guidelines on Principles and Implementation of Risk Management"
- ISO 17776:2000, "Offshore Production Installations – Guidelines on Tools and Techniques and Risk Assessment"
- ISO/TS 18683:2015, "Guidelines for systems and installations for supply of LNG as fuel to ships"

²⁸ International Maritime Organization. "The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk," IMO Publishing, 1993.

4.1.3. Standards for Training, Certification, and Watchkeeping for Seafarers

Seafarers operating LNG bunkering vessels must meet the provisions of the Standards for Training, Certification, and Watchkeeping for Seafarers (STCW) Code, 1978. Chapter 5 of the STCW Code contains guidance for special training requirements for personnel on tank vessels, including vessels carrying liquefied gas cargoes.²⁹ These include:

- Knowledge of the ship's rules and regulations
- Health hazardous and precautions to be taken
- Fire prevention and firefighting
- Pollution prevention
- Safety equipment and its use
- Emergency procedures
- Dangers and precautions related to handling and storage of cargoes at cryogenic temperatures

4.2. United States

Owners and operators of LNG bunkering vessels that operate in US waters will also need to comply with various International and domestic codes, regulations, guidance and rules. LNG bunker vessels are essentially cargo vessels and must meet the existing regulations for LNG bulk cargo vessels. While this report primarily focuses on the emerging use of LNG as fuel for non-LNG cargo vessels, this section provides a summary of the current codes, regulations, guidance and ABS class rules addressing LNG bunker vessels. Table 6 is a listing of codes, regulations, guidance and ABS class rules that may apply to LNG bunkering vessels.

Table 6. Codes, Regulations, Guidance and ABS rules for LNG Bunker Vessels

| |
|--|
| IMO |
| <ul style="list-style-type: none">• International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) |
| USCG |
| <ul style="list-style-type: none">• 46 CFR Subchapter O – Part 154• 46 CFR Subchapter D – Part 38• 33 CFR 155 – Oil or Hazardous Material Pollution Prevention Regulations for Vessels• 33 CFR 156 – Oil and Hazardous Material Transfer Operations• USCG Policy Letter (CG-OES Policy Letter No. 02-15), "Guidance Related to Vessels and Waterfront Facilities Conducting LNG Marine Fuel Transfer (Bunkering) Operations" |
| ABS |
| <ul style="list-style-type: none">• Steel Vessel Rules Part 5C, Chapter 8 – Vessels Intended to Carry Liquefied Gases in Bulk• Steel Barge Rules Part 5, Chapter 2, Section 5 – Liquefied Gas Tank Barges• LNG Bunkering – Technical and Operational Advisory |

²⁹ International Maritime Organization. "Standards of Training, Certification and Watchkeeping for Seafarers, 1978, Including the Manila Amendments," IMO Publications, 2010.

Figure 8 is a simple decision tree to assist potential LNG bunker vessel operators in identifying which of the current codes, regulations, guidance and rules that may be applicable to their vessels based on whether the vessel will (1) be classed, (2) be a self-propelled tank ship or a barge, and (3) operate in international waters. Answering those three questions categorizes a prospective vessel into one of eight unique bunker vessel cases.

| Will the bunker vessel be classed? | Will the bunker vessel be a self-propelled tank ship or a barge? | Will the bunker vessel operate in international waters? | Bunker Vessel Cases | IMO | | United States Coast Guard U.S. Department of Homeland Security | | | ABS | |
|------------------------------------|--|---|---------------------|----------|---------------------------------|---|------------|----------------|--------------------------------------|-------------------------------------|
| | | | | IGC Code | USCG Policy Letter CG-OES 02-15 | 33 CFR 155 | 33 CFR 156 | 46 CFR Sub D/O | Steel Vessel Rules Part 5C Chapter 8 | Steel Barges Rules Part 5 Chapter 2 |
| YES | Self-Propelled Tank Ship | YES | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | | NO | 2 | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | Barge | YES | 3 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | NO | 4 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| NO | Self-Propelled Tank Ship | YES | 5 | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | | NO | 6 | | ✓ | ✓ | ✓ | ✓ | | |
| | Barge | YES | 7 | | ✓ | ✓ | ✓ | ✓ | | |
| | | NO | 8 | | ✓ | ✓ | ✓ | ✓ | | |

Figure 8. Bunker Vessel Decision Tree

Table 7 presents key elements required under each, code, guideline, regulation and rule and identifies which of the eight bunker vessel cases from Figure 7 are applicable to each key element.

| Key Elements | IMO |  United States Coast Guard U.S. Department of Homeland Security | | | |  Steel Vessel Rules Part 5C Chapter 8 Steel Barges Rules Part 5 Chapter 2 | | | | | | | | | | | | | |
|--|----------|--|------------|------------|----------------|--|---------|---------|---------|---------|--|--|--|--|--|--|--|--|--|
| | IGC Code | USCG Policy Letter OC-OES 02-15 | 33 CFR 155 | 33 CFR 156 | 46 CFR Sub D/C | Applicable Gas Fueled Vessel Cases | | | | | | | | | | | | | |
| | | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | | | | | | | | | |
| | | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | 5 6 7 8 | | | | | | | | | |
| Ship Survival Capability and Location of Cargo Tanks | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Ship Arrangements | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Cargo Containment | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Process Pressure Vessels and Liquid, Vapor and Pressure Piping Systems | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Materials of Construction | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Cargo Pressure/ Temperature Control | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Cargo Tank Vent Systems | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Environmental Control | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Electrical Installations | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Fire Protection and Fire Extinction | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Mechanical Ventilation in the Cargo Area | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Instrumentation | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Personnel Protection | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Filling Limits for Cargo Tanks | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Use of Cargo as Fuel | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Special Requirements | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Operating Requirements | ✓ | ✓ | | | ✓ | ✓ | ✓ | | | | | | | | | | | | |
| Spill Response Plan | | ✓ | ✓ | | | | | | | | | | | | | | | | |
| Operations Manual | | ✓ | | ✓ | | | | ✓ | | | | | | | | | | | |
| Mechanical Integrity/ Maintenance Program | | | ✓ | | | | | ✓ | | | | | | | | | | | |
| Training and Credentialing | | ✓ | ✓ | | | | | | | | | | | | | | | | |
| Vessel Fuel Transfer Procedures | | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |

Table 7. Key Elements of Applicable Regulations, Codes, Guidance, Regulations and Rules for Bunker Vessels

The following sections detail the bunker vessel regulations, codes, and standards listed in Table 7 by organization.

4.2.1. USCG Regulations

On February 19, 2015, the USCG issued a policy letter CG-OES Policy Letter 02-15, Guidance Related to Vessels and Waterfront Facilities Conducting LNG Marine Fuel Transfer (Bunkering) Operations.³⁰ These guidelines identify minimum safety and security requirements, as outlined in the federal regulations, for LNG fuel transfer operations conducted from LNG bunker vessels and facilities. The guidelines in the policy letter include transfers conducted from tank vessels, including tank ships and tank barges, waterfront facilities and portable tanks containing LNG.

Enclosure 2 of the policy letter outlines existing regulations applicable to vessels providing LNG for use a fuel, along with the USCG's recommendations for safe vessel-to-vessel transfer of LNG fuel. The policy letter outlines the following regulations and recommendations for vessels bunkering LNG including vessel design and operating regulations, as well as regulations for personnel involved in transfer operations contained in:

- 46 CFR Subchapter D for tank vessels
- 46 CFR Part 35 tank vessel and personnel requirements
- 46 CFR Subpart 38.15
- 46 CFR Part 154 for self-propelled tank ships
- 33 CFR Parts 155 and 156
- Risk management guidelines established by the SIGTTO in their LNG Ship to Ship Transfer Guidelines, 1st Edition, 2011
- Vessel Compatibility Assessment should be conducted to confirm the suitability of vessels participating in LNG fuel transfer operations
- Transfer operations, including:
 - Person in Charge (PIC) requirements as outlined in 46 CFR 35.35-1, 46 CFR 154.1831 and 33 CFR 155.700
 - Qualifications of PIC as outlined in 33 CFR 155.710
 - Limitations of the PIC, as outlined in 33 CFR 156.115
 - Transfer procedures contained in 33 CFR 155.720 through 33 CFR 155.760 and 33 CFR Part 156
 - Contents of transfer procedures listed in 33 CFR 155.750
 - Job Aids for establishing global standards
 - Advance notice of transfer, which may be required by the local USCG Captain of the Port (COTP)
 - Requirements for transfer contained in 33 CFR 156.120
 - Conduct before, during and after an LNG fuel transfer
 - Equipment requirements, including:
 - Firefighting equipment
 - Emergency shutdown
 - Fuel transfer hoses
 - Bunkering manifold
 - Radio and communications
 - Deck lighting
 - Personnel protection equipment
 - Portable gas detectors

³⁰ USCG Policy Letter, CG-OES Policy Letter No 02-15, "Guidance Related to Vessels and Waterfront Facilities Conducting Liquefied Natural Gas (LNG) Marine Fuel Transfer (Bunkering) Operations."

These policies will serve as guidance for fuel transfer operations and training of personnel working on US and foreign vessels that use natural gas as a fuel and conduct fuel transfer operations in US waters.

4.2.1.1. Regulations for Certain Bulk Dangerous Cargoes – 46 CFR Sub O

The USCG has established regulations for all vessels carrying liquefied gases as cargo to provide for a correct and uniform administration of the vessel inspection requirements applicable to tank vessels. The regulations in Title 46 CFR 154 apply to self-propelled vessels carrying LNG and include:

- General requirements
- Inspection and testing requirements
- Design, construction and equipment requirements
- Special design requirements
- Operating requirements

US flag self-propelled vessels carrying LNG must be issued a Certificate of Inspection endorsed for the carriage of LNG. Foreign flag vessels operating in US waters are authorized to carry LNG if they have a Certificate of Compliance endorsed by the USCG. In addition to special design requirements in 46 CFR Subpart D and the operating requirements in 46 CFR Subpart E, there are specific regulations pertaining to the design, construction, and equipment for vessels subject to 46 CFR Part 154, those regulations cover:

- Hull structure
- Ship survival capability/cargo tank location
- Ship arrangement
- Cargo containment systems
- Integral tanks
- Membrane tanks
- Semi-membrane tanks
- Independent Tank Type A
- Independent Tank Type B
- Safety equipment
- Secondary barrier
- Independent Tank Type C and process pressure vessels
- System support
- Cargo and process piping systems
- Cargo hose
- Materials
- Construction
- Cargo pressure and temperature control
- Cargo vent systems
- Firefighting system: dry chemical
- Electrical
- Firefighting
- Cargo area: mechanical ventilation system
- Instrumentation
- Atmospheric control in cargo containment systems
- Insulation

Inasmuch as the regulations in 46 CFR 154 only applies to self-propelled vessels, the USCG asked for input from the chemical transportation industry on development of design standards for barges carrying LNG cargo for transfer to other vessels for use as fuel. In October 2014, an LNG working group for Chemical Transportation Advisory Committee submitted its recommendations to the USCG for design standards to develop an LNG Unmanned Barge Policy Letter. These recommendations will be considered by the USCG for future updates to 46 CFR 154.

To view the recommendations visit the USCG HOMEPORT CTAC website at:

https://homeport.uscg.mil/mycg/portal/ep/channelView.do?channelId=-18420&channelPage=/ep/channel/default.jsp&pageTypeId=13489&BV_

4.2.1.2. Oil or Hazardous Material Pollution Prevention Regulations for Vessels- 33 CFR 155

The owner and operator of US or foreign flag vessels conducting transfer operating in the US must ensure that personnel involved in transfer operations possess the appropriate qualifications and understand the procedures to complete a safe transfer. The requirements of 33 CFR Part 155 Subpart C to transfer personnel, procedures, equipment, and records are listed in Table 8.

Table 8. Transfer Personnel, Procedures Equipment, and Records Requirements

| 33CFR | Requirement |
|--------------|--|
| §155.700 | Designation of PIC |
| §155.710 | Qualifications of PIC |
| §155.715 | Contents of letter of designation as a PIC of the transfer of fuel oil |
| §155.720 | Transfer procedures |
| §155.730 | Compliance with transfer procedures |
| §155.740 | Availability of transfer procedures |
| §155.750 | Contents of transfer procedures |
| §155.760 | Amendment of transfer procedures |
| §155.770 | Draining into bilges |
| §155.775 | Maximum cargo level of oil |
| §155.780 | ESD |
| §155.785 | Communications |
| §155.790 | Deck lighting |
| §155.800 | Transfer hose |
| §155.805 | Closure devices |
| §155.810 | Tank vessel security |
| §155.815 | Tank vessel integrity |
| §155.820 | Records |

4.2.1.3. Oil and Hazardous Material Transfer Operations – 33 CFR 156

Vessels transferring or receiving natural gas as fuel must have transfer procedures that meet the applicable requirements of 33 CFR 156 when transferring LNG to or from the vessel or from tank to tank within the vessel.

4.2.1.4. Training and Credentialing Requirements – 46 CFR Subchapter B

Title 46 CFR Subchapter B provides credentialing requirements for US merchant mariners working on LNG bunkering vessels, including training requirements. These regulations currently require that shipboard personnel involved in the transfer of LNG hold endorsements as Tankerman PIC (LG), Tankerman Engineer (LG), and/or Tankerman Assistant (LG).

4.2.2. ABS Rules and Guidance

4.2.2.1. Steel Vessel Rules Part 5C, Chapter 8 – Vessels Intended to Carry Liquefied Gases in Bulk

This chapter of the Steel Vessel Rules is based on the technical requirements of the IGC Code, which are all contained in their entirety and are required for classification. There are additional items which are classification requirements and are not based on the codes presented in Chapter 8. These parts include interpretations of the codes with their source such as IMO, IACS, etc., and additional ABS requirements.

4.2.2.2. Steel Barge Rules Part 5, Chapter 2, Section 5 – Liquefied Gas Tank Barges

These requirements are intended for steel barges, regardless of their size, engaged in carriage of liquefied gases having a vapor pressure exceeding 2.8 bar absolute at a temperature of 37.8°C and other products, as shown in Section 5C-8-19 of the Steel Vessel Rules, when carried in bulk. This section provides requirements for both manned barges and unmanned barges (as established by the Flag Administration) intended for unrestricted service and carrying the liquid gases addressed by the IGC Code.

4.2.2.3. ABS LNG Bunkering – Technical and Operational Advisory

ABS has developed the “LNG Bunkering - Technical and Operational Advisory.”³¹ This Advisory was developed in order to respond to the need for better understanding by members of the maritime industry of the issues involved with bunkering vessels using natural gas. It is intended to provide guidance on the technical and operational challenges of LNG bunkering operations both from the bunker vessel’s perspective (or land-side source) and from the receiving vessel’s perspective. Some of the key areas that are addressed in the Advisory include:

- General Information on LNG
- General Considerations for LNG Bunkering
- Key Characteristics of LNG and Tank Capacity for Bunkering
- Vessel Compatibility
- Operational Issues aboard the Receiving Ship
- Special Equipment Requirements aboard Receiving Ship
- LNG Storage Tanks and Systems for Monitoring and Control of Stored LNG
- Operational and Equipment Issues from the Supplier Side

³¹ American Bureau of Shipping. “LNG Bunkering - Technical and Operational Advisory,” 2015.

- Bunker Operations
- Commercial Issues and Custody Transfer
- Regulatory Framework
- Safety and Risk Assessments
- List of Guidance Documents and Suggested References

4.3. Canada

4.3.1. Marine Personnel Requirements

Owners and operators of Canadian LNG bunker vessels will need to take into account the existing Marine Personnel Regulations established by Transport Canada under the Canadian Shipping Act of 2001. In addition, mariners responsible for the supervision of LNG cargo transfer, including LNG being transferred to a gas-fueled vessel, must obtain a specialized certificate as “Supervisor of a Liquefied Gas Transfer Operation” and meet the requirements in Table 9.³²

Table 9. Canadian Requirements for a Certificate as Supervisor of a Liquefied Gas Transfer Operation

| Item | Requirements | Specifications |
|------|---|---|
| 1 | Experience | At least 3 months of qualifying service performing duties relating to liquefied gas transfer operations involving one or more liquefied gas tankers or other vessels carrying liquefied gas as cargo. |
| 2 | Certificates to be provided to the examiner | (a) MED with respect to basic safety (b) marine basic first aid (c) training with respect to specialized liquefied gas tanker safety |

4.3.2. LNG Bunkering Vessel Requirements

Currently, there are no Canadian regulations explicitly addressing LNG bunker vessels. However, there are a number of resources currently available or in development that may be applied to develop the Canadian regulatory framework for bunker ships and barges, including:

IMO

- International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk – Cargo (IGC Code)

Transport Canada

- Canadian Supplement to the SOLAS Convention (TP15211)

ABS

- Rules for Building and Classing Steel Vessels (ABS 2)
- Rules for Building and Classing Steel Barges (ABS 10)
- ABS LNG Bunkering – Technical and Operational Advisory

³² Canada Justice Laws. “Canada Shipping Act of 2001- Marine Personnel Regulations SOR/2007-115, Part 1, Section 164,” (<http://laws-lois.justice.gc.ca/eng/regulations/SOR-2007-115/>), 2001.

5. Guidelines for Bunkering Facility Operators

5.1. United States

Regulatory bodies and international organizations are working to develop guidelines and regulations to help ensure LNG marine fuel transfer operations are conducted safely and uniformly in the global maritime community. Guidelines and policy for LNG bunkering remain a work in progress. Current federal regulations, codes, and standards addressing facilities handling LNG in the US are listed in Table 10. Although not approved for use in making LNG bunkering decisions, the USCG CG-OES Policy Letter No. 02-15 provides insight to owners and operators of vessels and waterfront facilities intending to conduct LNG fuel transfer operations, and COTPs who assess fuel transfer operations. When it is approved it will provide guidance on the use of existing codes, regulations and rules for LNG bunkering shown here.

Table 10. US Regulations, Codes, and Standards for LNG Facilities

| |
|---|
| USCG |
| <ul style="list-style-type: none"> • 33 CFR 105 – Maritime Security: Facilities • 33 CFR 127 – Waterfront Facilities Handling LNG And Liquefied Hazardous Gas • 33 CFR 154 – Facilities Transferring Oil Or Hazardous Material In Bulk • USCG Policy Letter CG-OES Policy Letter No 02-15, GUIDANCE related to vessels and waterfront facilities conducting liquefied natural gas (LNG) marine fuel transfer (bunkering) operations |
| Occupational Safety and Health Administration (OSHA) |
| <ul style="list-style-type: none"> • 29 CFR 1910.119 – Process Safety Management Of Highly Hazardous Chemicals |
| Environmental Protection Agency |
| <ul style="list-style-type: none"> • 40 CFR 68 – EPA Risk Management Rule |
| Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) |
| <ul style="list-style-type: none"> • 49 CFR 193 – LNG Facilities: Federal Safety Standards |
| National Fire Protection Association (NFPA) |
| <ul style="list-style-type: none"> • NFPA 52 – Vehicular Gaseous Fuel Systems Code • NFPA 59A – Standard For The Production, Storage, And Handling Of LNG |

Note: Federal Energy Regulation Commission (FERC) regulation 18 CFR 153 – Applications for Authorization to Construct, Operate, or Modify Facilities Used for the Export or Import of Natural Gas, which applies to LNG import/export terminals, does not apply to LNG bunkering facilities unless the bunkering facility is at an import/export terminal.

In addition to the federal regulations listed in Table 10, there may be several state and local regulations with which bunkering facility operators must comply.

Figure 9 is a simple decision tree to assist potential LNG bunkering facility operators in identifying which of the current federal regulations, codes, and standards may be applicable to their site based on (1) how LNG is being sourced to the facility and (2) whether or not the facility has an onsite bulk storage tank. Answering two simple questions categorizes a prospective operation into one of seven unique bunker facility cases. Note that each regulation is unique and there are many exceptions and exemptions that may affect the facility's requirements.












































| What is the source of LNG to your facility? | Will your facility have an onsite bulk storage tank? | Bunker Facility Cases | United States Coast Guard U.S. Department of Homeland Security | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|---|--|-----------------------|---|-----------|-----------|-----------|----------------|----------|-------------------------|------|-----|
| | | | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | 40CFR 68 | 49CFR 193 | 52 | 59A |
| Truck  | Yes  | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| | No | 2 | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| Ship/Barge  | Yes  | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| | No | 4 | ✓ | | | | | | | ✓ | ✓ |
| Container  | | 5 | ✓ | | | | | | | ✓ | |
| Interstate Pipeline w/ local liquefaction  | Yes  | 6 | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| Intrastate Pipeline w/ local liquefaction  | Yes  | 7 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ |


Figure 9 Bunker Facility Decision Tree


Table 11 presents key elements required under each regulation, code, standard, or guideline, and identifies to which of the seven facility bunker cases from Figure 9 each key element applies.


Table 11. Key Elements of Applicable Regulations, Codes, Standards & Guidelines for Bunker








| |  United States Coast Guard U.S. Department of Homeland Security | | | | OSHA | EPA | US Dept. Transportation | NFPA |
|---|--|---|---|---|---|---|---|---|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | | | | |
| Applicable Bunkering Facility Cases | | | | | | | | |
| Key Elements |  |  |  |  |  |  |  |  |
| Emergency Response Program | | | | | | | | |
| Emergency Response Program. Pre-planning and training to make employees aware of and able to execute, proper actions in the event of an emergency. |  |  |  |  |  |  |  |  |
| Spill Response Plan. Pre-planning to ensure facilities are prepared to respond in the event of a spill incident. | |  | | | | | | |
| Letter of Intent | | | | | | | | |
| Letter of Intent. Submission of a letter to the USCG COTP that documents owner/operator contact information, location, description and vessel traffic characteristics. |  |  |  | | | | | |
| Operations Manual | | | | | | | | |
| Operations Manual. Comprehensive documentation addressing full scope of bunkering operations, including: operating conditions, required equipment, equipment compatibility, mooring, pre-start checks, connection, transfer, disconnection, shutdown, safety equipment, training, communications, SIMOPS and emergency operations. |  |  |  |  | | | |  |


| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | OSHA | EPA | US Dept. Transportation | NFPA |
|--|--|---|---|---|---|---|---|---|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | | | | |
| | | | | | | | | |
| Applicable Bunkering Facility Cases | | | | | | | | |
| Key Elements |  |  |  |  |  |  |  |  |
| Operating Procedures. Documents providing clear instructions for safely conducting activities, which cover the process's operating limits and steps for conducting each operating phase, including: initial startup, normal operations, temporary operations, ESD, emergency operations, normal shutdown and startup after an emergency shutdown. | | | | | ✓ | ✓ | ✓ | ✓ |
| Management of Change Program. Thorough evaluation of proposed changes to fully assess their impact on employee safety and health and to determine needed changes to operating procedures. | | | | | ✓ | ✓ | ✓ | ✓ |
| Mechanical Integrity/Maintenance Program. Establish and implement written procedures to maintain the ongoing integrity of pressure vessels, storage tanks, piping systems, valves, relief/vent systems, ESD systems, controls and pumps. | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Training and Credentialing. Establish training program to ensure all personnel are aware of the hazards, safe work practices and understand all tasks for normal, non-routine and emergency operations. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|---|--|-----------|-----------|-----------|----------------|------|-----|-------------------------|------|----------|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | | | | | 40CFR 68 |
| | | | | | | | | | | |
| Applicable Bunkering Facility Cases | | | | | | | | | | |
| Key Elements | | | | | | | | | | |
| Compatibility Review* . Ship-to-shore interface review to ensure vessel and facility equipment is compatible to facilitate safe bunkering. | | | | | | | | | | |
| Vessel Fuel Transfer Procedures. Providing clear instructions for safely conducting transfers from the facility to the vessel. | | | | | | | | | | |
| Compliance Audits. Periodic certification evaluating compliance with the provisions of regulations. Audit must be developed and documented noting deficiencies that have been corrected. | | | | | | | | | | |
| Safe Work Practices. Documentation describing how to safely perform a task with minimum risk to personnel, equipment and the environment. | | | | | | | | | | |
| Contractor Safety Program | | | | | | | | | | |
| Contractor Safety Program. Program to ensure contract employees are trained in safe work practices, awareness of chemical hazards and emergency response. | | | | | | | | | | |
| Nonroutine Work Authorizations. Permit describing steps personnel must follow to obtain the necessary clearance to start the job. | | | | | | | | | | |

| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|---|--|-----------|-----------|-----------|----------------|------|-----|-------------------------|----------|-----------|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | | | | 40CFR 68 | 49CFR 193 |
| Applicable Bunkering Facility Cases | | | | | | | | | | |
| Key Elements | | | | | | | | | | |
| Process Hazard Review Program | | | | | | | | | | |
| Process Hazard Analysis* . Thorough, orderly, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals. | | | | | | ✓ | ✓ | | ✓ | ✓ |
| Process Safety Information . Compilation of written information on chemicals, technology and equipment used in the process. | | | | | | ✓ | ✓ | | | |
| Risk Management Plan | | | | | | | | | | |
| Risk Management Plan . Plan that includes: (1) an assessment of potential effects of an accidental chemical release, (2) a prevention program and (3) an emergency response program. | | | | | | | ✓ | | | |
| Simultaneous Operations Review/Plan* . Assessment of the safety risks associated with performing different activities simultaneously, and, if necessary, recommendations to control identified risk. | | | | | | | | | | |
| Waterway Suitability Assessment* . Assessment of the safety and security risks associated with LNG vessel operations within the port and, if necessary, recommendations to mitigate identified risk. | | ✓ | | | | | | | | |

| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|---|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------------|-----------------------|----------|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | | | | | 40CFR 68 |
| Applicable Bunkering Facility Cases | | | | | | | | | | |
| Key Elements | | | | | | | | | | |
| Incident Investigation Program | | | | | | | | | | |
| <p>Incident Investigation Program. Identification of the chain of events and causes of an incident that resulted in, or could reasonably have resulted in, a catastrophic release of highly hazardous chemicals in the workplace, so that corrective measures can be developed and implemented.</p> <p>Incident Investigation Team. Team consisting of at least one person knowledgeable in the process and other persons with appropriate knowledge and experience to investigate and analyze the incident thoroughly.</p> <p>Recommend Corrective and Preventive Actions. Establish system to address and resolve the incident report findings and recommendations.</p> <p>Communicating Results/Follow-up. Documented resolutions and corrective actions for review by all affected personnel whose job tasks are relevant to the incident findings.</p> <p>Incident Reporting. Notification of security breaches, spills, safety incidents, safety-related conditions, and annual pipeline summary data.</p> | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 | |
| | ✓ | | | | ✓ | | | | | |
| | ✓ | | | | ✓ | | | | | |
| | ✓ | | | | ✓ | | | | | |
| | ✓ | | | | ✓ | | | | | |
| ✓ | | | | | | | | ✓ | | |

| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|---|--|---|--|---|---|---|---|---|---|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | 40CFR 68 | 49CFR 193 | 52 | 59A |
| Applicable Bunkering Facility Cases | | | | | | | | | |
| Key Elements |  |  |  |  |  |  |  |  |  |
| Security Plan | | | | | | | | | |
| Security Assessment* . Documentation of security background information, on-scene survey, analysis of vulnerabilities and recommendations. | ✓ | | | | | | ✓ | | |
| Security Plan . Plan that identifies Facility Security Officer (FSO), addresses each vulnerability identified in the assessment and describes security measures. | ✓ | ✓ | | | | | | | ✓ |
| Safety Management System | | | | | | | | | |
| Safety Management System . System enabling proactive identification, evaluation and mitigation or prevention of chemical releases that could occur as a result of failures in process, procedures or equipment that could expose employees and surrounding populations to serious hazards. | | | | | ✓ | ✓ | | | |

| |  United States Coast Guard <small>U.S. Department of Homeland Security</small> | | | | OSHA | EPA | US Dept. Transportation | NFPA | |
|--|--|-----------|-----------|-----------|----------------|----------|-------------------------|------|-----|
| | 33CFR 105 | 33CFR 127 | 33CFR 154 | 33CFR 156 | 29CFR 1910.119 | 40CFR 68 | 49CFR 193 | 52 | 59A |
| Applicable Bunkering Facility Cases | | | | | | | | | |
| Key Elements | | | | | | | | | |
| Fire Hazard Evaluation | | | | | | | | | |
| Fire Hazard Evaluation/Risk Assessment* . Assessment of the fire risk at an LNG terminal by identifying fire scenarios of interest, their likelihood of occurrence and their potential consequences, and if necessary, identification of risk reduction measures. | | | | | | | | | |
| Hot Work Permit . Issued for hot work operations conducted on or near a covered process. | | | | | | | | | |
| Sitting Study* . Quantification of risks to populations outside the facility to ensure they do not exceed acceptable levels. | | | | | | | | | |
| | | | | | | | | ✓ | ✓ |
| | | | | | | | | ✓ | ✓ |
| | | | | | | | | ✓ | ✓ |
| | | | | | | | | ✓ | ✓ |

* These elements are discussed in Chapter 6 of this study. In some cases, the elements are not explicitly required by the regulations, but are recommended and are commonly prepared by operators to provide support for project applications and approval.

The following sections detail the bunker facility regulations, codes, and standards listed in Table 10 by organization.

5.1.1. USCG Regulations

5.1.1.1. 33 CFR 105 Maritime Security: Facilities

LNG bunkering terminals will be subject to the Maritime Transportation Security Act (MTSA) regulations under 33 CFR Part 105 – Maritime Security: Facilities. This regulation requires an owner/operator to conduct a Facility Security Assessment (FSA), develop a Facility Security Plan (FSP), and submit the FSP to the USCG for approval prior to operation of the terminal. The security requirements that must be addressed include:

- Defining security organizational structure
- Designating a FSO
- Performing a security assessment
- Developing and submitting a FSP
- Ensuring Transportation Worker Identification Credentials (TWIC) are properly implemented
- Ensuring restricted areas are controlled
- Ensuring adequate security coordination between the facility and vessels that call on it
- Ensuring timely implementation of additional security measures for increased Maritime Security (MARSEC) levels
- Ensuring security for unattended vessels
- Ensuring reporting of all security breaches
- Ensuring consistency between security and safety requirements
- Informing all facility personnel on their TWIC responsibilities

Since LNG is designated as a Certain Dangerous Cargo (CDC) by the USCG, there are additional security requirements that must be addressed to further protect the facility, including escort of visitors, vehicle restrictions, and increased searching of waterfront areas.

The FSA requires a collection of background information; the completion of an onsite security survey of existing protective measures, procedures, and operations; and an analysis of that information to recommend security measures for inclusion in the FSP.

5.1.1.2. 33 CFR 127 Waterfront Facilities Handling LNG and Liquefied Hazardous Gas

33 CFR Part 127 establishes regulations for waterfront facilities handling LNG. They are written primarily to address LNG imported or exported as cargo. Nevertheless, they contain regulations where LNG is being transferred between vessels and shore-based structures, including tank trucks and railcars. The regulations in 33 CFR Part 127 were established to ensure that a minimum level of safety is provided for LNG transfer operations conducted between shore structures and marine vessels. They outline requirements pertaining to: general information, general design, equipment, operations, maintenance, firefighting, and security.

The regulations cannot foresee all possible situations, thus provisions are incorporated to provide facility operators the option to address procedures, methods, or equipment to be used in place of the regulations written in Part 127. The procedures for considering alternatives are outlined in 33 CFR 127.017.

On February 19, 2015, the USCG released operating policies for LNG fuel transfer operations.³³ The first operations policy letter provides voluntary guidance for LNG fuel transfer operations on vessels using natural gas as fuel in US waters. The second operations policy letter discusses existing regulations applicable to vessels and waterfront facilities conducting LNG marine fuel transfer (bunkering) operations and provides voluntary guidance on safety, security, and risk assessment measures the USCG believes will ensure safe LNG bunkering operations.³⁴ The operations policy sets the expectation that a waterfront facility should comply with 33 CFR 127 to the extent practicable. It is understood that a waterfront bunker facility would not be able to comply with all the regulations applicable to large scale LNG import or export facilities and guidance in this regard is provided.

Once finalized, these policies will serve as guidance for the USCG COTPs and guidelines for owners and operators of waterfront facilities and bunker vessels that conduct LNG fuel transfer operations in US waters.

5.1.1.3. 33 CFR 154 Facilities Transferring Oil or Hazardous Material in Bulk

Though the Coast Guard policy letter 02-15 has indicated that all LNG over the water transfers from land, (no matter the mode) must meet the requirements found in 33 CFR part 127, we feel that regulations found in 33 CFR part 154 supplements those safety requirements for smaller facilities. 33 CFR part 154 establishes regulations for facilities transferring oil or hazardous materials, in bulk, to or from a vessel, where the vessel has a total capacity of 250 barrels. The regulation requires a variety of elements to ensure the safe transfer of oil or hazardous materials to and from vessels. Though it includes some of the same items found in 33 CFR part 127, it is also used as a reference for safety items found in 33 CFR part 155 and 33 CFR part 156: both of which are referenced in the policy letter 02-15. Facility operators transferring LNG over the water as fuel should use 33 CFR part 127 as the primary guidance and then look to 33 CFR part 154 to supplement the safety of the overall facility.

5.1.1.4. Oil and Hazardous Material Transfer Operations – 33 CFR 156

Vessels transferring or receiving natural gas as fuel should have transfer procedures that meet the applicable requirements of 33 CFR 156 when transferring LNG to or from the vessel or from tank to tank within the vessel.

33 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

34 USCG Policy Letter, CG-OES Policy Letter No 02-15, "Guidance Related to Vessels and Waterfront Facilities Conducting Liquefied Natural Gas (LNG) Marine Fuel Transfer (Bunkering) Operations", 25 February 2015.

5.1.2. Occupational Safety and Health Administration Regulation

5.1.2.1. 29 CFR 1910.119 Process Safety Management of Highly Hazardous Chemicals

OSHA's Process Safety Management (PSM) regulation establishes requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards. The regulation applies to:

- A process which involves a chemical at or above the specified threshold quantities listed in Appendix D to the regulation
- A process which involves a Category 1 flammable gas (as defined in 1910.1200(c)) or a flammable liquid with a flashpoint below 100° Fahrenheit (F) (37.8°C) on site in one location, in a quantity of 10,000 pounds (lb) (4536 kilograms [kg]) or more. This would apply to LNG since its primary component is methane, which is a flammable gas.

The PSM regulation as written would apply to most LNG facilities, based on LNG being primarily methane and large quantities stored at most LNG facilities. The PSM regulation does not include an LNG facility exemption in its regulatory language.

However, by law, OSHA cannot regulate an employer for a hazard that is adequately covered by another federal agency's regulatory authority and specific regulations. Since LNG facilities are typically connected to an interstate natural gas pipeline, they are regulated by the Department of Transportation (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA) under 49 CFR 193 - PART 193—*Liquefied Natural Gas Facilities: Federal Safety Standards*. OSHA specifically addressed coverage of LNG facilities in an interpretation letter published in 1998 (Fairfax to Runyan, December 9, 1998). It stated that:

"OSHA has concluded that current OPS regulations address the hazards of fire and explosion in the gas distribution and transmission process. Accordingly, OSHA has determined that the agency is precluded from enforcing the PSM rule over the working conditions associated with those hazards."

Note: The Office of Pipeline Safety (OPS) has since been replaced by PHMSA.

Also, as part of the preparation of this report, the ABS team confirmed with an OSHA Headquarters staff member that that specific interpretation letter was still valid. Also, it was clear from those discussions that OSHA would not choose to exempt bunkering facilities as "retail" facilities. In fact, OSHA has requested input on potential regulatory changes proposed for the PSM coverage that would eliminate retail exemption other than for facilities that only sell small quantities of PSM covered substances to end users.³⁵

35 Government Printing Office. "Federal Register- Rules and Regulations, Volume 78, Number 236," (<http://www.gpo.gov/fdsys/pkg/FR-2013-12-09/pdf/FR-2013-12-09.pdf>), Monday, 9 December 2013.

Table 12. Summary of OSHA PSM Regulatory Coverage for LNG Bunkering Facilities

| If a Bunkering Facility is ... | Then, the OSHA PSM Regulation |
|--|--|
| Regulated by PHMSA because it is connected to an interstate pipeline | Would not apply to the facility |
| Regulated by a State pipeline regulatory agency | Might apply and the facility developer should consult with the State pipeline agency and OSHA |
| Not regulated by PHMSA or another agency that OSHA accepts as managing the hazard of potentially catastrophic releases of flammable or other PSM covered chemicals | Would apply and the facility developer should implement the PSM elements prior to introducing LNG into the facility. Specific tasks prior to startup would include: developing process safety information, performing a process hazard analysis, resolving PHA recommendations, developing operating procedures and providing training to facility operators, and conducting a pre-startup safety review |

If the PSM regulation applies to a bunkering facility, the facility operator must develop a PSM program that addresses the 14 elements defined in the regulation:

- Employee participation
- Process safety information
- Process hazard analysis
- Operating procedures
- Training
- Contractors
- Pre startup safety review
- Mechanical integrity
- Hot work permit
- Management of change
- Incident investigation
- Emergency Planning and Response
- Compliance Audits
- Trade secrets

To meet these requirements, facility operators would need to ensure they document the required process safety information, use it to perform a process hazards analysis, and conduct a pre-startup safety review prior to introducing LNG into the facility. However, there is no review and approval by OSHA required for the facility's PSM program. The program compliance with the regulation would only be examined by OSHA if the agency chose to make an inspection after the facility was operating.

5.1.3. EPA Regulations

In addition to EPA regulations that would apply to any process facility (e.g., air and water pollution prevention requirements, waste disposal requirements), a stationary facility that stores more than 10,000 lb (4,536 kg) of methane will also be covered under EPA's Risk Management Program (RMP) rule (40 CFR 68). The RMP rule addresses the potential for impacts to offsite personnel and facilities due to accidental releases of flammable or toxic materials. It is expected that bunkering facilities with onshore storage will exceed that inventory level, so unless they are exempt, the facility will need to register with EPA and evaluate which RMP program level (e.g., Level 1, 2, or 3) applies to them. However, facilities that are regulated under the DOT natural gas pipeline and LNG facility regulations (49 CFR 192 and 193) would be exempt from EPA RMP coverage. This is very likely to be the case for liquefaction facilities that are connected to interstate pipelines; however, facilities that (1) involve only intrastate pipelines or (2) receive LNG instead of liquefying natural gas supplied by a pipeline, are expected to be RMP regulated. RMP does not pose licensing requirements or any form of pre-approval requirements, but the facility will need to assess

program coverage level, implement the appropriate accident prevention program requirements, and submit a Risk Management Plan (RMPlan) to EPA before bringing more than 10,000 lb (4,536 kg) of LNG on site.

Table 13. Summary of EPA RMP Regulatory Coverage for LNG Bunkering Facilities

| If a Bunkering Facility is ... | Then, the EPA RMP Regulation |
|--|---|
| Regulated by PHMSA under 49 CFR parts 192, 193, or 195 | Would not apply to the facility |
| Regulated by a State pipeline regulatory agency certified by DOT under USC. section 60105 | Would not apply to the facility |
| Not regulated by PHMSA or a certified state pipeline agency | Would apply and the facility developer should implement the accident prevention and emergency response elements prior to introducing LNG into the facility. Specific tasks prior to startup would include: developing process safety information, performing a process hazard analysis, resolving PHA recommendations, developing operating procedures and providing training to facility operators, conducting a pre-startup safety review, and developing and coordinating its emergency response plans with local emergency management agencies. |
| Potentially covered by RMP due to regulated quantities of RMP regulated substances other than methane (e.g., ammonia or other toxic or flammable substances). Note: This applies even if the facility is exempted from coverage of LNG as an EPA RMP flammable substance. | May apply and the facility should consult with EPA to ensure that EPA accepts the facility's accident prevention management program as adequately regulated by other agencies so it chooses not to apply the RMP regulation. |

The accident prevention program requirements for an LNG facility that has the potential to impact members of the public off site (based on an EPA-specified assessment protocol) is almost identical to the OSHA program described in the previous section, with very similar elements, but with a focus on public safety rather than the worker safety focus of OSHA's regulation.

The RMP rule establishes requirements for the owner or operator of a stationary facility to periodically submit an RMPlan. The RMPlan includes:

- Analysis of worst-case release scenarios
- Documentation of the five-year accident history
- Coordination with local emergency planning and response agencies
- Implementation of an RMP management system
- Conduct of a hazard assessment
- Development of an emergency response program
- Development of an accident prevention program

5.1.4. DOT Pipeline and Hazardous Materials Safety Administration Regulations

5.1.4.1. 49 CFR 193 – LNG Facilities: Federal Safety Standards

49 CFR 193 prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that is subject to the pipeline safety laws. It provides much of the safety systems and siting criteria that FERC uses in the approval process for large LNG facilities. It also incorporates references to NFPA 59A. Even for facilities that are not approved under the FERC process used for import and export facilities, it is likely that DOT will consider 49 CFR 193 applicable to facilities supplied by natural gas pipelines that then liquefy the gas for storage as LNG to support bunkering operations.

Some portions of those LNG bunkering facilities that involve natural gas pipeline may also be required to meet pertinent requirements of:

- 49 CFR Part 191—Transportation of Natural and Other Gas by Pipeline; annual reports, incident reports, and safety-related condition reports
- 49 CFR Part 192—Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

Implementation of inspection of facilities subject to these pipeline regulations can be under federal or state oversight, depending on the pipeline involved and the level of delegation of authority agreed to by the federal and state agencies involved.

5.1.5. National Fire Protection Association Standards

5.1.5.1. NFPA 59A Standard for the Production, Storage, and Handling of LNG

NFPA 59A applies to (1) facilities that liquefy natural gas, (2) facilities that store, vaporize, transfer, and handle LNG, (3) training of all personnel involved with LNG, and (4) the design, location, construction, maintenance, and operation of LNG facilities. It is referenced by the DOT LNG facility standard (49 CFR 193) and may be applicable under state or local requirements.

5.1.5.2. NFPA 52 Vehicular Gaseous Fuel Systems Code

NFPA 52 applies to the design, installation, operation, and maintenance of compressed natural gas (CNG) and LNG engine fuel systems on vehicles of all types and for fueling vehicle (dispensing) systems and associated storage, including those supporting marine vessels. It addresses:

- Original equipment manufacturers
- Final-stage vehicle integrator/manufacturer
- Vehicle fueling (dispensing) systems

It applies to the design, installation, operation, and maintenance of LNG engine fuel systems on vehicles of all types, to their associated fueling (dispensing) facilities, and to LNG storage in ASME containers of 70,000 gallon (gal) (265 cubic meters [m³]) or less. Although not as widely known in the LNG industry, NFPA 52 may be the appropriate standard for an LNG bunkering facility to use in meeting requirements in state and local ordinances that contain provisions that require facilities to meet recognized codes and standards applicable to the facility.

5.2. Canada

Currently, there are no Canadian regulations directly addressing LNG bunkering facilities. However, there are a number of resources currently available or in development that may be applied to develop the Canadian regulatory framework for bunkering facilities. The existing regulations, codes, standards, and guides most relevant to LNG bunkering are:

Canadian Standards Association (CSA)

- LNG – Production, Storage, and Handling (CSA Z276)

International Organization for Standardization (ISO)

- Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships (ISO/TC 18683)

Transport Canada

- Technical Review Process of Marine Terminal Systems and Transshipment Sites (TERMPOL Code (TP 743E)
- Maritime Transportation Security Regulations (MTSR) (SOR/2004-144)

Transport Canada is currently involved in studying what, if any, additional regulations are needed at the national level or whether other requirements should all be the responsibility of the province where the bunkering will take place.

Provincial

In addition to the national regulations, LNG bunkering facilities may be subject to a number of additional provincial regulations, depending on the facility's characteristics and location. Similar to the national regulatory framework, provincial regulations are not yet developed to explicitly address LNG bunkering; however, there are existing regulations that may be applied. Examples include:

- British Columbia: *Oil and Gas Activities Act* (SBC 2008, Chapter 36)
- Nova Scotia: *Gas Plant Facility Regulations* (Section 29 of the Energy Resources Conservation Act)

There are additional provincial government agencies that will cover various aspects of LNG bunkering facilities, including energy, natural resources, transportation, and environmental protection. Agencies will vary from province to province and must be identified, and their requirements must be addressed as part of the development process.

6. Specific Studies

In addition to the regulatory requirements identified in Chapters 3, 4 and 5, a number of the elements identified are considered specific studies. Table 11 above identifies which regulations require the specific studies, and the following sections provide more details about each. Whether any of these types of studies are needed and when they should be performed should be defined in early planning by a bunkering project and the applicable regulators.

6.1. Risk Assessment

In general, a bunkering facility should plan on providing a risk assessment that addresses bunkering activities to help define the risk reduction measures that should be considered. The risk assessment characterizes the losses that may occur during the operation of the LNG bunkering terminal. Risk assessment methods may be qualitative or quantitative and should follow recognized standards, such as ISO 31010: Risk management – Risk assessment techniques or ISO 16901: Guidance on performing risk assessment in the design of onshore LNG installations including the ship/shore interface. The scope of the risk assessment may be tightly defined or broad enough to meet the risk assessment requirements of other studies listed in this section, including: siting study, Fire Risk Assessment (FRA), Waterway Suitability Assessment (WSA), and security assessment. The risk assessment should address the following elements:

- Identification of potential hazards
- Assessment of the likelihood that the hazard will occur
- Assessment of the potential consequences; depending on the concerns of the owner/operator, the consequence assessment could consider a variety of impact types, including: impacts to people (both on site and off site), impacts to the environment, property damage, business interruption, and reputation
- Identification of risk reduction measures if risk for hazard is not considered acceptable

This study contains a general risk assessment in Appendix A for LNG bunkering alternatives using the HazID method.

6.1.1. Hazards

Natural gas, primarily composed of methane (CH₄), is a nontoxic flammable gas. LNG is created by cooling natural gas to a temperature below its boiling point of about -162°C (-260°F). This liquefaction process reduces the volume of the gas by a factor of 600, making it a much more efficient state for storage and transport. LNG is a cryogenic liquid that, if released from its storage or transfer equipment, presents unique hazards to nearby people and property when compared with traditional fuel oil. The primary hazards are:


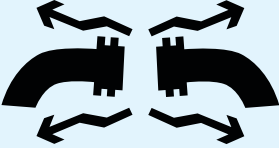
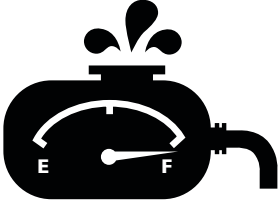

- **Serious injuries to personnel in the immediate area if they come in contact with cryogenic liquids.** Skin contact with LNG results in effects similar to thermal burns and with exposure to sensitive areas, such as eyes, tissue can be damaged on contact. Prolonged contact with skin can result in frostbite and prolonged breathing of very cold air can damage lung tissue.

- **Brittle fracture damage to steel structures exposed to cryogenic temperatures.** If LNG comes into contact with normal shipbuilding steels, the extremely cold temperature makes the steel brittle, potentially resulting in cracking of deck surfaces or affecting other metal equipment.
- **Formation of a flammable vapor cloud.** As a liquid, LNG will neither burn nor explode; however, if released from bunkering equipment, it will form a vapor cloud as the LNG boils at ambient temperatures. To result in a fire or explosion, the vapor cloud must be in the flammable range, which for methane is between 5.3% and 14% by volume in air, and there must be an ignition source present. There are a number of factors affecting the consequence potential of an LNG release, including: the surface it is released on, the amount released, air temperature, surface temperature, wind speed, wind direction, atmospheric stability, proximity to offsite populations, and location of ignition sources. Although LNG vapors can explode (i.e., create large overpressures) if ignited within a confined space, such as a building or ship, there is no evidence suggesting that LNG is explosive when ignited in unconfined open areas.
- **Asphyxiation.** If the concentration of methane is high enough in the air, there is a potential for asphyxiation hazard for personnel in the immediate area, particularly if the release occurs in confined spaces.

6.1.2. Risks

LNG's hazards are different (e.g., volatility, cryogenic conditions) from traditional fuel oil and potential operators must clearly understand the risks involved with LNG bunkering. While each of the three bunkering operations described in Section 0 is unique, there are a number of common initiating events that can result in a release of LNG posing hazards to nearby people, equipment, and the environment. Table 14 presents the four initiating events that are risk drivers for LNG bunkering operations and identifies common causes for each event. Appendix A introduces a risk assessment process and provides risk assessment worksheet templates that could be applied to assess the risk of specific bunkering operations.

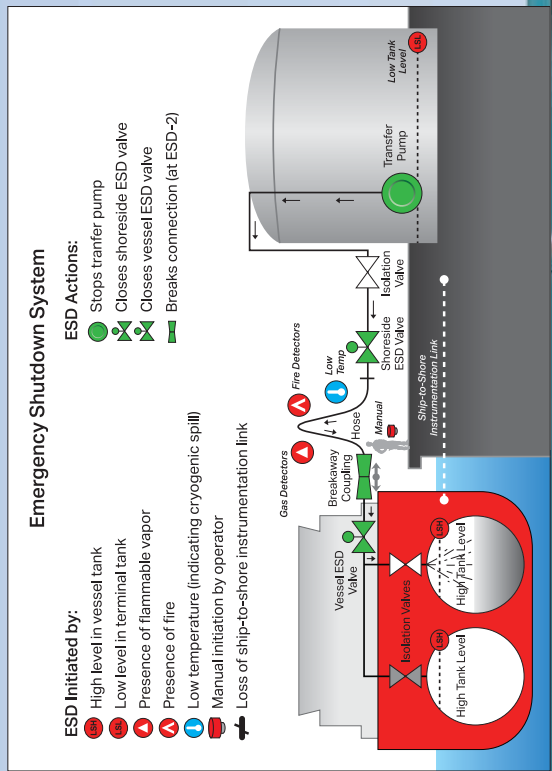
Table 14. LNG Bunkering Initiating Events and Causes

| Initiating Events | Common Causes |
|---|---|
| <p>Leaks from LNG pumps, pipes, hoses or tanks</p>  | <ul style="list-style-type: none"> • Corrosion/erosion • Fatigue failure • Hose failure • Improper maintenance • Piping not cooled down prior to transfer • Seal failure • Use of inappropriate hoses (e.g., not LNG rated) • Vibration • Improper installation or handling • Improper bunkering procedures |
| <p>Inadvertent disconnection of hoses</p>  | <ul style="list-style-type: none"> • Improper hose connection • Hose failure • Excessive movement of the loading arm or transfer system • Inadequate mooring or mooring line failure • Supply truck drives or rolls away with hose still connected • Supply vessel drifts or sails away with hose still connected • Extreme weather (wind, sea state) • Natural disaster (e.g., earthquake) |
| <p>Overfilling/overpressuring vessel fuel tanks</p>  | <ul style="list-style-type: none"> • Operator and level controller fail to stop flow when tank is full |
| <p>External impact</p>  | <ul style="list-style-type: none"> • Cargo or stores dropped on bunkering equipment (piping, hoses, tanks) • Another vessel collides with the receiving vessel or bunkering vessel • Vehicle collides with bunkering equipment |

6.1.3. Safeguards

Historically, carriage and the transfer of maritime LNG have an outstanding safety record, and the safeguards associated with LNG import/export terminals are proven. While LNG bunkering involves far lower quantities and transfer rates when compared to import/exports, many of the safeguards apply to help ensure safety (Figure 10).

Recommended Safeguards for LNG Bunkering Operations



- ### Additional Safeguards
- Standardized connections (1)
 - Periodic inspection/testing of equipment (3)
 - Periodic certification of hoses (4)
 - Controls and/or prohibitions on SIMOPS (7)
 - Comprehensive bunkering procedures (10)
 - Operator training (11)
 - Accepted ship design & construction standards (12)
 - Breakaway couplings (15)
 - Spark proof tools (20)
 - Vessel response plan (21)
 - Local emergency response plan (22)

Figure 10. Recommended Safeguards for LNG Bunkering Operations

The collection of safeguards, which were developed based on a thorough evaluation of LNG-related regulations, codes, and standards, including the International Association of Oil and Gas Producers (OGP) and ISO's Waterfront Facilities Handling LNG and Liquefied Hazardous Gas, NFPA's 59A – Standard for the Production, Storage, and Handling of LNG, and USCG's CFR33 127 – Waterfront Facilities Handling LNG and Liquefied Hazardous Gas, are illustrated in Figure 10. Collectively, they are designed to prevent accidental releases of LNG and mitigate the consequences if releases do occur. Each safeguard plays a unique role. Some are designed to prevent certain initiating events from occurring, others are designed to mitigate certain types of consequences, and some play a role in both prevention and mitigation. Table 15, Table 16, and Table 17 introduce each of the safeguards and describe their role in reducing risk of LNG bunkering operations.

Table 15. Prevention Safeguards

| Prevention Safeguards | |
|-----------------------|--|
| 1 | Standardized connections at bunkering station to prevent inadvertent leaks or hose disconnects. |
| 2 | Independent high level alarms on vessel fuel tanks to alert operators prior to tank overfill. Note: Separate high level switch initiates emergency shutdown (ESD) (See safeguard # 8). |
| 3 | Periodic inspection and testing of equipment prior to bunkering to ensure system is functional and there are no leaks |
| 4 | Periodic testing and certification of hoses to ensure hoses and fittings will not leak or disconnect during transfer. |
| 5 | Ship-to-shore communications to ensure information can be shared between parties involved in bunkering (e.g., person in charge [PIC], ship crew, truck driver). |
| 6 | Constant supervision by PICs on both vessel and facility. |

Table 16. Safeguards that Prevent and Mitigate

| Prevention Safeguards | Mitigation Characteristics |
|--|---|
| 7. Controls and/or restrictions on SIMOPS | |
| Reduces likelihood of dropping cargo or stores on LNG transfer equipment or external impact from vehicles or equipment involved in simultaneous operations. | Reduces crew/passenger population in hazardous areas and reduces potential ignition sources from simultaneous operations. |
| 8. ESD system | |
| Reduces likelihood of overfilling vessel fuel tanks through automatic shutdown on high level. | Reduces the amount of LNG release by closing valves and stopping transfer pumps during hazardous conditions. |
| 9. Restricted vehicle traffic | |
| Reduces likelihood of vehicle impact with bunkering equipment. | Reduces population in hazardous area near vessel and limits possible ignition sources in the case of an LNG release. |
| 10. Comprehensive bunkering procedures | |
| Addresses a broad array of prevention topics including: operating conditions, required equipment, safety, training, communications, mooring, connection, transfer, lifting, and disconnection. | Addresses a broad array of mitigation topics, including: safety, simultaneous operations, and emergency operations. |
| 11. Operator training | |
| Covers a broad array of prevention topics to ensure that operators are trained in safe work practices and understand all tasks for normal and non-routine operations. | Covers a broad array of mitigation topics to ensure that operators are aware of LNG hazards and are trained for emergency operations. |

| Prevention Safeguards | Mitigation Characteristics |
|---|---|
| 12. Accepted ship design and construction standards | |
| Safe ship arrangements, manufacture, workmanship, and testing to minimize probability of LNG leaks. | Ship design standards to mitigate impacts on people and property in case of an LNG release (e.g., fire safety equipment, electrical classification, ventilation). |
| 13. Regulated Navigation Areas | |
| Reduces likelihood of vessel impact with bunkering equipment. | Reduces population in hazardous area near vessel and limits possible ignition sources in the case of an LNG release. |
| 14. Warning signs | |
| Reduces likelihood of external impact with bunkering equipment. | Reduces population in hazardous area near vessel and limits ignition sources near bunkering operations to reduce likelihood of a fire if a release of LNG occurs. |

Table 17. Mitigation Safeguards

| Mitigation Safeguards | |
|-----------------------|---|
| 15 | Breakaway couplings on hose connections designed to minimize LNG releases in the case of excessive movement (e.g., truck drive-away, vessel drifting away). |
| 16 | Hazardous area classification near bunkering operations where accidental releases could occur to limit ignition sources. |
| 17 | Drip trays (aluminum or stainless steel) to collect and isolate LNG spills protecting ship areas from cryogenic hazards. |
| 18 | Personal protective equipment to protect operators from exposure to cryogenic and fire hazards. |
| 19 | Firefighting equipment, including dry chemical and water deluge systems, to mitigate fire damage if LNG release ignites. |
| 20 | Spark-proof tools to reduce likelihood of ignition if LNG is released. |
| 21 | Vessel emergency response plans with procedures to guide crew in addressing various LNG-related hazards. |
| 22 | Local emergency response plans with procedures to guide first responders in addressing various LNG-related hazards. |

Using a bow-tie model, Figure 11 illustrates how the safeguards listed in the previous tables provide multiple layers of defense that both reduce the likelihood that each initiating event will result in an LNG release and mitigate the impacts on people, property, and the environment.

Bow-Tie Diagram Illustrating Recommended Safeguards for LNG Bunkering Operations

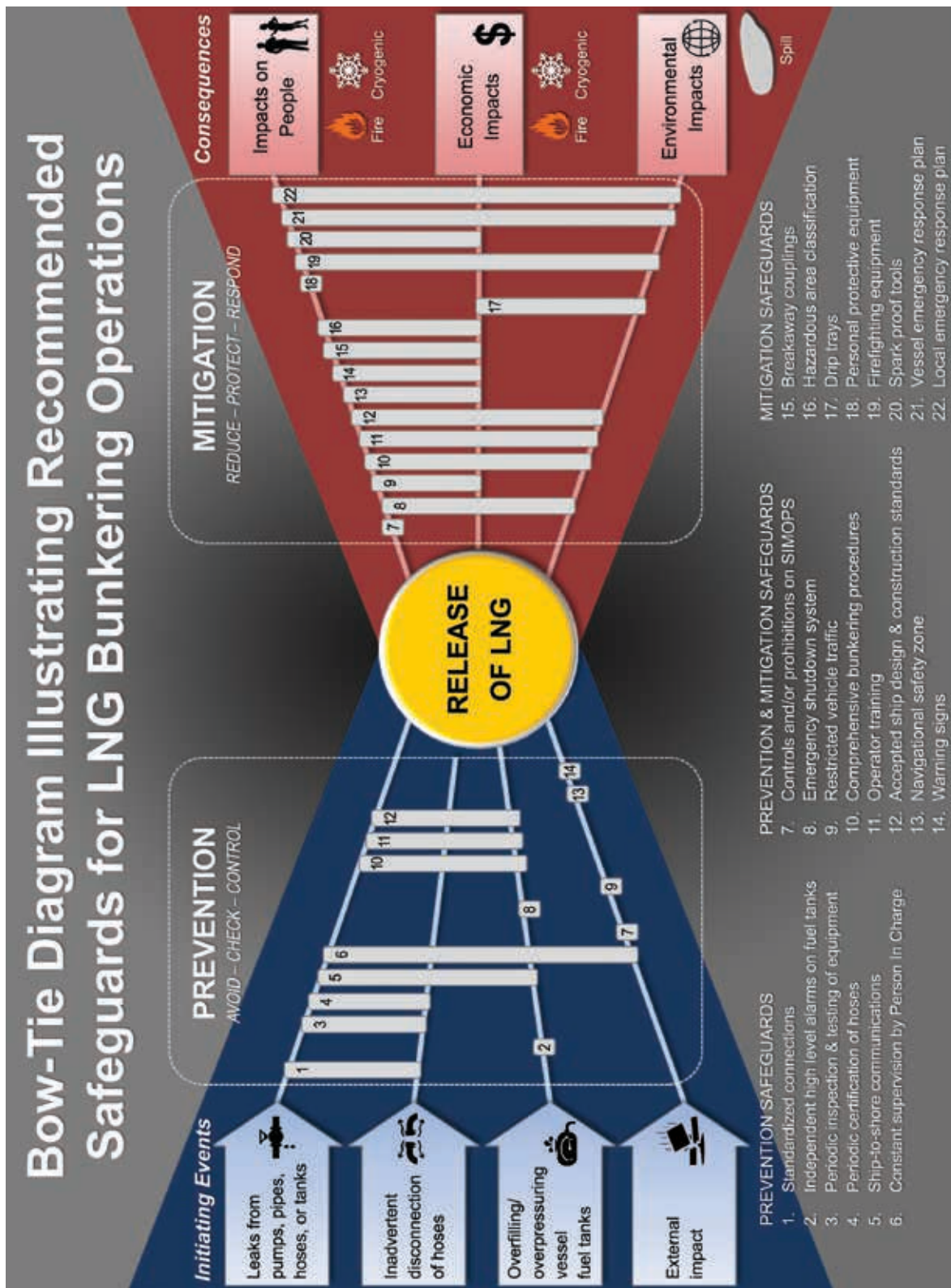


Figure 11. Bow-tie Diagram Illustrating Safeguards for LNG Bunkering Operations

6.2. Siting Study

The determinations of where to locate an LNG facility whether it is storage only or includes liquefaction are quite complex and will likely have a major impact on the ultimate cost of the project. Factors to consider include adequate land area, suitable land for construction, suitable marine access, potential environmental show stoppers, compatibility of adjacent facilities, and access to gas supply. NFPA 59A 5.2.1 requires a written site evaluation be available to the authorities, addressing potential incidents and mitigating measures, adjacent activities, severe weather patterns, other natural hazards, and security factors.

6.2.1. Potential Incidents and Minimum Land Area

LNG bunkering facilities store smaller volumes and generally require smaller land area as a buffer than LNG import and export facilities. In the US, the only codified siting criteria are NFPA 59A (Chapter 5) and DOT regulation 49 CFR 193 (Subpart B), which are used for those types of large LNG facilities. The objective for US standards is to ensure that an LNG facility controls a land area which might be affected by the consequences of a design spill. The consequences are the theoretical vapor dispersion distance of the unignited vapor or radiant heat from a fire if the vapor were ignited. The European standards use risk based criteria. European LNG import/export terminal risk criteria are located in EN-1473 for use where local risk standards do not exist. Criteria for small satellite plants, with storage capacities less than 200 tonne, are in EN-13645. NFPA 59A (2013) contains new performance based criteria (risk assessment Chapter 15) as an alternative to the Chapter 5 method for demonstrating adequate land area, bringing US and European LNG marine facilities standards closer philosophically, though US regulatory experience has been almost exclusively with the deterministic approach.

The site evaluation should demonstrate compliance with vapor dispersion and thermal radiation threshold requirements or provide quantification of vapor dispersion and thermal risks to populations outside the LNG terminal to ensure they do not exceed acceptable levels. If the project follows the Qualitative or Quantitative Risk Assessment (QRA) approach, the release scenarios for risk evaluation shall be developed through the use of Process Hazard Analyses (PHA), Hazard and Operability [HAZOP], or other systematic HazID studies (NFPA 59A 15.5.1). A spectrum of release behaviors including flashing, aerosol formation, jet fires, pool formation and flow, flash fire, explosions, and LNG with water interactions must be evaluated. There is not yet an extensive experience base in the application of Chapter 15 analyses, so a US bunkering facility may need to be prepared to educate the specific regulators to whom the results will be submitted (e.g., a state fire marshal's office).

6.2.2. Severe Weather

Emergency response personnel should be able to access the site during any weather condition for personnel safety and fire protection. The site elevation should be above the flood plain and allow for adequate storm water drainage.

6.2.3. Other Natural Hazards

LNG storage facilities should be designed to withstand seismic activity according to local building code criteria. Shop-built containers should comply with the ASME Boiler and Pressure Vessel Code and seismic accelerations given in NFPA 59A (2013) Section 13.3.14. Where tsunami risks are credible, the storage tank elevation may need to be raised.

6.2.4. Compatibility with Adjacent Activities

Types of products and operations on adjacent berths, including different safety philosophies and requirements should be considered. Unacceptable risks from the bunkering activity and storage should not be imposed on adjacent facilities. Residential development, sensitive development (schools, hospitals, retirement homes, or sports stadiums), transportation infrastructure, retail and leisure development, and buildings for incarceration should not be affected by unacceptable risks.

6.2.5. Security

A security assessment covering hazards, threats, vulnerabilities and consequences to the facility is required by NFPA 59A 12.9.1. The assessment should be available to the authority having jurisdiction, but not publicly. Major facility components such as storage tanks, control buildings, process equipment, and transfer facilities should be enclosed by a peripheral fence or natural barrier and lit at night.

6.2.6. Marine Topography

The waterfront facility must have adequate water depth alongside for the range of vessels which will be loaded. Allowance for tide, trim and underkeel clearance should be considered. Dredging may be required to facilitate access. Access during all states of tide is preferable, but if not practicable, then removal from the berth to a safe anchorage shall be provided. If dredging is required, beneficial use of the spoil and environmental implications should be considered. Permitting requirements for dredging should be consulted. Siltation and responsibility for maintenance dredging should be considered for any initial dredging.

Prevailing currents should be considered when determining the berth orientation to minimize strain on the mooring lines.

6.2.7. Meteorological Conditions

Strong winds and waves may impart a dynamic strain mooring lines, and the frequency of severe conditions should be considered by a weather related downtime assessment. Facility operators will have different downtime criteria, downtime tolerance, and standby tug cost acceptance.

6.2.8. Traffic Considerations

A bunkering facility will create additional traffic in the port area, which should be considered by port authorities. Passing traffic frequency, displacement and types of passing ships at the facility will have a dynamic effect on mooring lines, which should be considered by in a separate passing ship study.

6.2.9. Other Considerations

Many projects spend excess time trying to develop sites that are eventually determined to be unsuitable. The key is to make the determinations at the first possible opportunity. Other site suitability considerations include:

Shore-side Access issues to determine if the proposed site is suitable to accommodate the facility with specific regards to shore side accessibility. Issues to consider include:

- Road access
- Weight limitations
- Low bridges
- Possible restrictions on road traffic volume placed by local authorities

Distance between berths should be considered, to ensure adequate room for maneuvering vessels in and out of the bunkering facility while adjacent berths are occupied.

Visibility Assessment of delays to a vessel transiting to or from a berth caused by low visibility. There may be one criteria from pilots using local knowledge, and a different criteria by a vessel operator's safety management system. During final approach to a berth, the pilot must be able to judge the approach angle to the fenders.

Risk assessments, if required by the project or by authorities, should be undertaken by a team including personnel with marine expertise, LNG operational experience, and local knowledge.

6.2.10. Frequently Asked Questions

DOT has posted and updates frequently asked questions (FAQs) on LNG regulations, including their siting regulations pertaining to vapor dispersion and thermal radiation.³⁶ These FAQs are intended to clarify, explain, and promote better understanding of PHMSA's requirements concerning the siting application for installing LNG facilities. These FAQs are not substantive rules and do not create rights, assign duties, or impose new obligations not outlined in the existing regulations and standards.

6.3. Simultaneous Operations

The USCG Policy Letter 01-15³⁷ states the following:

The Coast Guard recognizes that simultaneous operations may be necessary in certain situations in order to allow for a non-disruptive flow of ship and port operations. Currently there is limited experience addressing the concept of conducting simultaneous shipboard operations (e.g., passenger, cargo, or ship store loading operations, etc.) while LNG fuel transfer operations are taking place. If simultaneous operations are to occur during LNG fuel transfer operations, a formal operational risk assessment may be conducted by the facility owner to address the added hazards and evaluate the potential risks.

The Policy Letter 01-15³⁸ further notes that vessel owners/operators considering the need to conduct SIMOPS should contact and discuss their intentions with the local COTP having jurisdiction over the area where the operation will be conducted.

36 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), "LNG Facility Siting Requirements," (<http://primis.phmsa.dot.gov/lng/faqs.htm>), revised 6 February 2015.

37 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

38 USCG Policy Letter, CG-OES Policy Letter No. 01-15, "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels using Natural Gas as Fuel," 25 February 2015.

Although not currently included in the US regulations, the USCG Policy Letter No. 01-15 makes reference to the recently issued ISO Technical Specification³⁹ on LNG bunkering, which lists a SIMOPS QRA study as an essential requirement. The elements of the QRA referenced in the ISO Guidelines are included in the appropriate studies described here and in the other studies in this Chapter 6.

For LNG bunkering, a SIMOPS assessment would focus on how other activities could increase the likelihood or consequences of an LNG release. For example, if cargo operations are located too close to bunkering locations, cargo could be dropped on LNG piping or hoses during lifting operations, resulting in an LNG release. Another example is the risk that might be posed by operation of equipment (e.g., a crane) that is not rated for hazardous area service in close proximity to a tank vent during bunkering. The SIMOPS study should serve both to (1) identify operations that potentially threaten bunkering and (2) decide whether those operations should be prohibited or can be allowed under specific, controlled conditions.

A SIMOPS assessment addresses the following items:

- Identification and description of modes of operation
- SIMOPS risk assessment
- Identification and development of risk mitigation measures

The specific mitigation measures identified in the SIMOPS assessment may be incorporated into the operations manual, standard operating procedures (SOPs), or may be managed as a separate process.

A SIMOPS assessment should be performed if the owner/operator wishes to conduct other activities, such as cargo (Figure 12) or passenger loading, while bunkering. The study should serve both to (1) identify operations that potentially threaten bunkering and (2) decide whether those operations should be prohibited or can be allowed under specific, controlled conditions.

39 International Organization for Standardization. "Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships, Technical Specification, ISO/TS 18683," 15 January 2015.

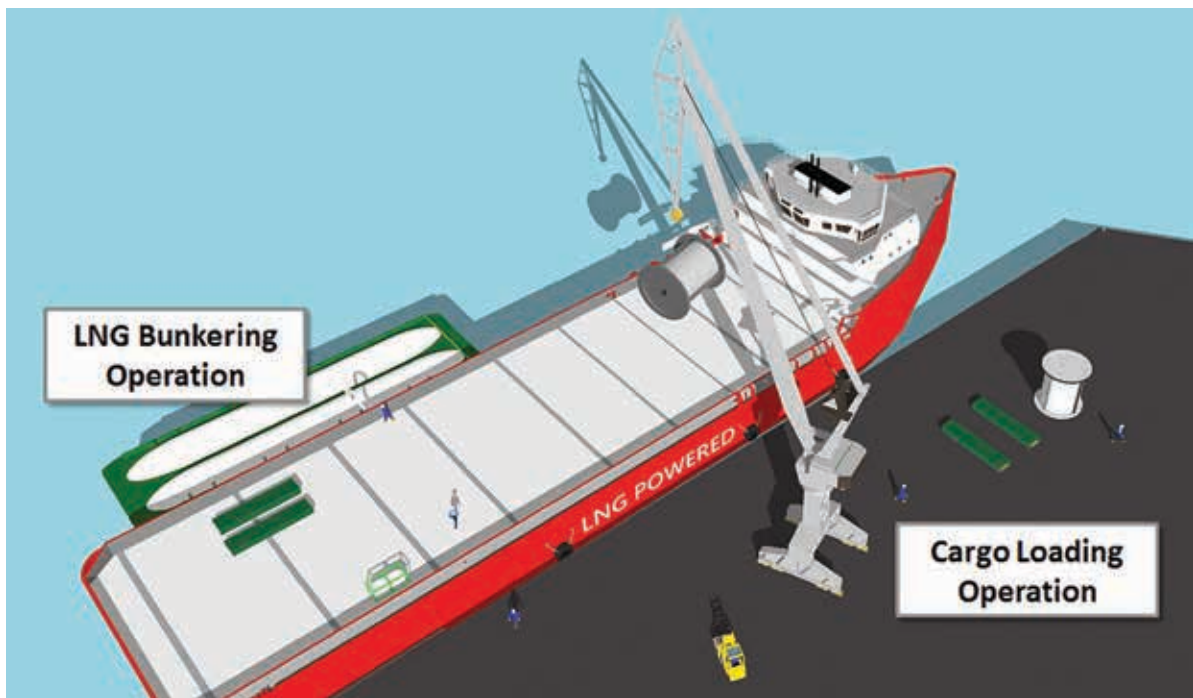


Figure 12. Example SIMOPS: LNG Bunkering and Cargo Loading

While a SIMOPS assessment is not currently required by US regulations related to LNG facilities, the USCG may require such an analysis as part of their review of bunkering procedures. The analysis should cover: (1) identification and assessment of unique hazards posed by SIMOPS, (2) engineered controls addressing SIMOPS hazards to be included in the design, (3) administrative controls addressing SIMOPS hazards documented in the operations manual or standard operating procedures, and (4) approved operating constraints (e.g., weather conditions) under which simultaneous operations are allowed.

SIMOPS could increase the risk of LNG bunkering in a variety of ways. Table 18 introduces some of the potential effects and provides examples of how SIMOPS may increase the risk.

Table 18. Example Effects of SIMOPS

| Potential Effects | Examples |
|--|--|
| Increased likelihood of LNG release | <ul style="list-style-type: none"> • Cargo loading during bunkering affecting a vessel's position relative to the bunkering station increasing likelihood of leaks and inadvertent disconnection of hoses • Dropping of cargo on LNG loading equipment • Personnel charged with overseeing LNG bunkering could become involved or distracted by other activity increasing the likelihood of fuel tank overfill |
| Increased likelihood of ignition, if LNG is released | <ul style="list-style-type: none"> • More vessel/vehicle traffic in the area related to cargo activities • Increased ignition source potential due from people in the surrounding area (e.g., smoking, using devices or equipment that is not rated as intrinsically safe.) |
| Increased consequence potential | <ul style="list-style-type: none"> • More people in the surrounding area (e.g., passenger, crew), including those who may be unaware of LNG hazards and emergency response measures • Increased congestion hindering egress in the case of a LNG release • Personnel charged with overseeing LNG bunkering could become involved or distracted by other activity resulting in delayed identification of and response to a LNG release |

The SIMOPS assessment should be tailored to the specific facility and scope of activities, but key steps in performing the assessment include:

1. **Identify SIMOPS.** Develop a detailed description of each operation addressing key elements, including:
 - Summary of the activity
 - Drawings identifying the work areas, including restricted areas (e.g., electrically classified areas)
 - Operational procedures (step-by-step)
 - Involved personnel
 - Identification of the safety and environmental hazards
 - Identify Potential Interference between SIMOPS
 - Identify potential scenarios where other operations could impact LNG bunkering and vice versa (see Table 18 for example)
2. **Assess Risk.** Choose an appropriate risk assessment technique (e.g., HAZOP, What-If) and conduct the assessment.
 - Assemble team of experts familiar with each activity (ship board and facility activities)
 - Provide an overview of each activity, including major steps of the operation
 - Brainstorm hazards that could arise from SIMOPS
 - Identify potential causes of the hazard
 - Identify safeguards potentially in place to prevent the likelihood of occurrence (prevention) or minimize the consequences (mitigation)
 - Describe the consequences, and if the hazard could result in a release of LNG
 - Score the risk of the hazard as a function of likelihood and consequence
3. **Develop SIMOPS Controls.** For risks above tolerance thresholds, identify additional controls necessary to mitigate the risks to acceptable levels. See Section 6.1.3 for examples of safeguards that could be employed to prevent and mitigate LNG release scenarios.
4. **Document the results of the SIMOPS Assessment.** Documentation can take a variety of forms, including developing a separate SIMOPS manual or incorporating SIMOPS into operations manual/SOPs. The documentation should address key areas such as:
 - Organizational roles and responsibilities
 - Description of the SIMOPS
 - SIMOPS SOPs
 - Operating conditions/limits for SIMOPS
 - Change control process
 - Communication plan
 - Contingency plan

6.4. Fire Risk Assessment

A FRA characterizes the fire risk at an LNG terminal by identifying fire scenarios of interest, their likelihood of occurrence, and their potential consequences. The purpose of an FRA for an LNG bunkering terminal is to estimate the level of risk present and, if necessary, identify measures (e.g., firefighting equipment) to reduce risk to an acceptable level. For example, if a bunkering facility does not believe that the fire protection requirements defined in NFPA 59A and 33 CFR 127 are appropriate or necessary for their operation, an FRA would allow them to define and document their approach for fire protection and submit it to the appropriate regulator (e.g., USCG, fire marshal, or other authority having jurisdiction).

If an FRA is required for a facility, the owner/operator should follow recommended guidelines, such as SIGTTO's *A Risk Based Approach for the Evaluation of Firefighting Equipment on Liquefied Gas Jetties or NFPA 551: Guide for the Evaluation of FRAs in the Development of the FRA*. FRAs may employ a variety of methods to characterize the likelihood and consequences of fire scenarios as described below. If an approach includes the effects of fire protection, both the effectiveness and reliability of such systems should be considered. Before using an approach, the facility should first confer with the appropriate regulators to ensure they are willing to consider the FRA outcome as a basis for defining required fire protection.

Qualitative Methods: Qualitative methods do not typically quantify the consequences or likelihood of fire events. Qualitative methods include what-if, risk matrices, risk indices, and fire safety concepts tree approaches. These methods are useful for generating fire scenarios used in other more quantitative approaches described below.

Semi-quantitative Methods: Semi-quantitative methods quantify either the likelihood or consequence of a fire event. Methods that calculate likelihood include actuarial/loss statistical analysis and stand-alone event tree analysis. Methods that calculate consequence include outdoor and enclosure fire models of various complexity.

For the commonly used event tree analysis approach, the likelihood of fire event outcomes will be based on the frequency of the originating event (i.e., a leak due to mechanical failure, human error, or intentional release) and the probabilities associated with the independent event tree branches. Branches may include actions which increase the consequences (i.e., ignition, wind direction, equipment congestion) as well as mitigate the consequences (i.e., firefighting resources, liquid containment). The termination of each branch leads to one or more outcomes for which the likelihood is the originating frequency multiplied by all the probabilities leading to the branch termination. Possible outcomes for LNG terminals include jet fires, pool fires, flash fires from flammable vapor clouds, boiling liquid expanding vapor explosions (BLEVE), rapid phase transitions (RPT), and cryogenic liquid injuries.

Semi-quantitative methods which calculate consequences typically use a fire model to determine the hazards. Many different fire models exist for various fire types including jet, pool, flash, and enclosure fires. Additionally, the fidelity of fire models range from simple analytical models to complex, numerical computational fluid dynamics (CFD) models. Fire models for LNG terminals typically include jet and pool fire models and flash fire (dispersion) models. Flash fire models rely on dispersion modeling to calculate the size of the flammable vapor cloud. Use of dispersion models for LNG should consider the material specific flashing and jetting behavior. Some Authorities Having Jurisdiction require specific modeling parameters when doing LNG dispersion modeling.

Simple jet and pool fire models will include discharge calculations which determine the leak rate and properties of LNG after the orifice followed by a model of the fire which depends on a geometric approximation of the fire shape. For jet fires, a cone shape or a series of frustums is used while for pool fires a tilted cylinder is typically used. The size of the assumed geometry is dependent on the discharge leak results combined with published analytical and semi-empirical relations (The Netherlands Organization yellow book, Center for Chemical Process Safety publications) for different fire orientations (i.e., horizontal jet, vertical jet, circular pool). Finally, using the assumed geometry and view factor calculations, thermal radiation values at targets can be determined. The models which implement the above features are typically included as part of a consequence modeling software package and they require moderate user experience and have runtimes measured in seconds to minutes.

More complex CFD models are appropriate when simple models have shown an unacceptable hazard and site specific features not captured in the simple models may influence the results. Features such as pool containment, drainage, local wind patterns, and structures/vessels can be more accurately included in CFD models which rely on a 3D model of the site. Multiple free and commercial CFD codes are capable of modeling fire hazards. These tools require a high degree of user experience and have runtimes of hours to days.

Quantitative Methods: Fully quantitative methods calculate both the likelihood and consequence of a fire event. Methods used should be validated and any numerical routines should undergo verification. Methods that can be used when performing a fully quantitative FRA include a rigorous calculation of risk from each fire scenario including all the possible outcomes indicated by the event tree and their likelihoods as well as simpler approaches which set a consequence limit and then sum the frequency from all events which exceed this limit and compare to the agreed upon criteria for frequency of unacceptable consequences. The rigorous approach is similar to a QRA where the risk of injury or death is calculated as the combination of likelihood and consequence. Total risk is the summation of the risk from each fire scenario outcome (i.e., jet fire, pool fire, etc.). The risk calculation may also require an estimate of the exposure time of personnel and the number of people exposed to accurately calculate maximum individual and aggregate risk measures, which can then be compared to agree upon criteria. Full QRA analysis can involve many fire scenarios of various magnitudes and involves a large amount of calculations. Such analyses are typically performed using specialized software to manage the complexity.

Cost-benefit Methods: Cost-benefit methods are computational models that incorporate probability, consequences, and cost data in an integrated manner. They include the risk of injury or death calculated in the full quantitative risk analysis approach above while adding an additional parameter, the cost of the fire in terms of both fire prevention costs and maintenance as well as the cost of damage associated with an event. This allows owners/operators to optimize the fire protection design while providing the necessary level of protection to reach life safety risk criteria.

6.5. Waterway Suitability Assessment

USCG Navigation and Vessel Inspection Circular (NVIC) No. 01-2011 requires owners/operators of LNG terminals to conduct a WSA to assess safety and security risks associated with LNG vessel operations within the port and, if necessary, recommend strategies to mitigate the identified risk. LNG bunkering facilities, while likely to store significantly less quantities of LNG when compared to import/export terminals, will likely be required to perform a WSA or at least a streamlined WSA, particularly if the bunkering will be supplied with LNG via bulk marine transport (e.g., LNG in bulk via LNG carriers or barges). Note: the WSA development is the responsibility of the LNG facility as per 33 CFR 127.

Full scope WSA's are risk-based assessments that address the following items:

Port characterization which includes: identification and descriptions of industrial areas, areas that are environmentally sensitive, populated areas, critical areas (military or otherwise areas of national significance) and overall port description including any regulated navigation areas; regulations specify that these areas are to be identified at a minimum, 15 miles (25 km) from the LNG facility along the transit route that the LNG vessel will be using.

Factors adjacent to the facility such as:

- Depths of the water
- Tidal range
- Protection from high seas
- Natural hazards, including reefs, rocks, and sandbars
- Underwater pipelines and cables
- Distances of berthed vessels from the channel
- Other safety and security issues identified

LNG Vessel: Vessel descriptions should include both the LNG cargo vessels and vessels using the facility to bunker. Most projects will not have a full understanding of these vessels since most are just now being developed. At a minimum, information should include the expected flag of vessels and vessel particulars (length, breadth, depth, capacity of cargo and or fuel) LNG tank description, firefighting capability, and vapor control capability. If some of the information is not known a statement that indicates as information is known will be furnished to the COTP. If the vessel is going to be US flagged it should be stated that the vessel will conform to all US design, construction, documentation and inspection regulations. If foreign flagged, it should be stated that the vessel will conform to Flag, Class and international requirements for a LNG carrier.

Characterization of the LNG bunkering facility and vessel routes: The facility description should include mode of arrival of the LNG (i.e., pipeline, truck, barge), description of storage, description of piping (i.e., Maximum Allowable Operating Pressure, length, diameter), description of transfer dock and transfer mode (i.e., loading arm, hose), firefighting capabilities and a statement that the facility will meet MTSA requirements. For vessel route (LNG bulk vessels only) information should include the populated areas (medium/high people per square mile areas as described in the NVIC), environmental sensitive areas, description of bridges and tunnels over and under the waterway,

Risk assessment for maritime safety and security: The NVIC has specific safety and security scenarios that should be included for all risk assessments. These scenarios are designed specifically for the LNG carrier's transit and while docked at the facility. The NVIC does not include specific scenarios for the transfer or storage of LNG on the facility. The COTP should be consulted for their specific requirements for those items.

Risk management strategies: The NVIC describes specific risk mitigation strategies in a USCG controlled attachment to the document, however, due to security reasons those strategies will not be discussed in this document.

Resource needs for maritime safety, security and response: These should include, fire, medical and law enforcement in the area and their capabilities to respond to an LNG incident, and a gap analysis of resources that are needed for an adequate response. These resources can include training, equipment, or public education/relations.

In current bunkering projects, requirements for what are being called WSAs are simpler reviews (i.e., streamlined WSAs) that are actually more like project HazID studies. It is recommended that discussions with the USCG staff in the port area be initiated well before a WSA is drafted for submission so expectations for the WSA can be defined (see policy letter 02-15⁴⁰).

WSAs are submitted to the local COTP for review. The COTP then passes the WSA and USCG recommendations regarding safety and security measures to the agency providing permits for the project. That agency may vary, depending on the nature of the facility and state and local requirements.

40 USCG Policy Letter, CG-OES Policy Letter No 02-15, "Guidance Related to Vessels and Waterfront Facilities Conducting Liquefied Natural Gas (LNG) Marine Fuel Transfer (Bunkering) Operations."

6.6. Process Hazards Analyses

PHAs are a class of study that industry very commonly uses for processes that handle hazardous materials and are required by the US regulations that mandate process safety management (OSHA 29 CFR 1910.119) and risk management (EPA 40 CFR 68). They are also addressed in Chapter 15 of NFPA 59A.

PHAs, which are sometimes referred to as HAZOP studies or HazID studies, involve a multidisciplinary team using detailed engineering information to consider the hazards of the "process," where process can be specific equipment or operations. Depending on the specific methodology used (e.g., what-if, failure modes and effects, HAZOP) the team will document what can go wrong, potential causes and consequences of that event, and what safety measures prevent or mitigate the event. Any recommendations from the PHA are then forwarded for consideration by project personnel completing the design, or planning the operations, maintenance, and emergency response activities for the facility to which the process belongs.

The typical project tasks for conducting a PHA consist of the following:

Collect data for the analysis. Prior to the analysis workshops, compile the following information:

- Process flow diagrams (these must indicate approximate process conditions)
- MSDSs (and other pertinent chemistry data) for chemicals involved in the process*
- Piping and instrumentation diagrams (P&IDs) *
- Design temperatures and pressures for major equipment (these data should be compiled if not shown on the P&IDs) *
- Pump/compressor curves and maximum (blocked) discharge pressures
- Materials of construction for equipment and interconnected piping (if not indicated on the P&IDs) *
- Plot plan (and/or equipment arrangement drawings) with general equipment layout and elevations
- Standard operating procedures (SOPs) for normal operations, as well as procedures for startup, shutdown, sampling, emergency shutdown, and any on line maintenance
- Safe work practices and permits/authorizations
- Emergency procedures (if they exist)
- Incident reports for the specific unit (or similar units if the unit is a new installation) filed in the past 5 years of process operations

** Indicates process safety information required by OSHA and EPA before beginning a PHA.*

In addition, the following information may be helpful as reference materials during the hazard evaluation meetings:

- Electrical classification drawings/information*
- Equipment testing/inspection plans
- Process alarm setpoint data, as well as logic/ladder diagrams or loop sheets for complex safety instrumented systems*
- Relief system design basis (including set pressures and relief capacity sizing basis for relief devices) *
- Ventilation system design data*

** Indicates process safety information required by OSHA and EPA before beginning a PHA*

Conduct the hazard evaluation meetings. The objectives of these meetings (1) provide an orientation for the PHA team members, explaining the technique to be used and the ground rules for team meetings, (2) perform a hazard evaluation of facility items (process sections, equipment failures, etc.), (3) perform a facility/stationary source siting and human factors review and (4) review incident reports that apply to the scope of the PHA.

Prepare a PHA report. Document the analysis including process descriptions, analysis protocol and methodology descriptions, and a detailed meeting summary table.

7. Sources of LNG and Project Implementation to Make LNG Available for Use as a Marine Fuel

7.1. Potential LNG Supply Sources

This section outlines the various types of LNG facilities for the bunkering of marine vessels in the US and Canada that are:

- Currently in operation or under construction
- Proposed and undergoing design review/approval
- Potential locations as a supplier of LNG

In addition to describing the various types of facilities, this section also lists known, proposed and potential sites currently announced for LNG supply to marine users. It should be noted that the market for supply of LNG to nontraditional users (e.g., fixed facilities, trucks, and marine shipping) is changing rapidly, so the examples provided in this study will change with many new suppliers expected to enter the market. The information on the companies and facilities described here represents ABS experience with ongoing LNG bunkering projects, long-term involvement in LNG activities, and consultation with leading companies in ongoing bunkering projects. The study also uses information drawn from media accounts, conference presentations, and discussions with a wide variety of people involved in the LNG business (including bunkering facility developers and gas-fueled ship operators). However, because of the rapid changes the LNG bunkering business is undergoing, this information will most definitely change.

The types of facilities that may provide LNG fuel include:

- Existing LNG import facilities
- Proposed LNG export facilities
- Existing LNG peakshaving/satellite facilities
- Existing and proposed liquefaction facilities supporting highway, heavy equipment, and rail markets
- Proposed bunkering facilities with liquefaction processes
- Proposed bunkering facilities supplied via trucks/transportation containers

FERC has indicated that it will not be licensing LNG bunkering facilities; however, licenses issued by FERC for facilities developed for other purposes (e.g., import and export terminals) may need to be amended to reflect bunkering or truck loading activities, if such operations are added after facility approval.

This section describes each of these types of facilities and how they may be pertinent to the growth of LNG bunkering. Also, Appendix C to this study provides a summary of information regarding interest in LNG bunkering and specific bunkering projects or activities in each maritime region of the US and Canada.

7.1.1. LNG Import Facilities

LNG import facilities generally receive LNG by vessel, transfer it to onshore storage tanks, and vaporize it into a natural gas pipeline for transmission to customers' distribution networks. These types of facilities were initially built in the US in the 1970s at the Everett (Boston, Massachusetts), Cove Point (Cove Point, Maryland), Elba Island (Savannah, Georgia), and Lake Charles (Louisiana) terminals. Table 19 lists all of the existing import/export terminals (as of January 6, 2015) in the US and Canada. The table also indicates which of them have been approved to re-export LNG that has been previously imported (see Section 7.1.2 for a discussion of export terminals). Most of these facilities have applied for, been approved or are constructing liquefaction and export facilities (see the Notes section of the table). This information and other useful lists/figures relating to existing and proposed LNG facilities are provided on the FERC website: <https://www.ferc.gov/industries/gas/indus-act/lng.asp>, and the Energy Information Administration natural gas website: <http://www.eia.gov/naturalgas>, or on the company website for each terminal.

Table 19. Currently Operating North American LNG Facilities with Maritime Access

| Terminal | Location | Owners and/or Operators | Year Service Began | Notes |
|------------------------|----------------------|--|--------------------|---|
| Atlantic Coast | | | | |
| Canaport LNG | St. John, NB | Repsol/Irving Oil | 2009 | 1.2 Bcfd Receiving and Regasification terminal. |
| Distrigas LNG Terminal | Everett (Boston), MA | Distrigas of Massachusetts, LLC | 1971 | Includes large LNG truck operation to satellite peakshavers and other customers. See Section 7.3.2 |
| Northeast Gateway LNG | Offshore, MA | Excelerate Energy | 2007 | Deepwater import facility 13 miles from shore can receive 0.6 Bcfd. Pipeline delivers to US markets. |
| Neptune LNG | Offshore, MA | GDF Suez | 2009 | Deepwater import facility 10 miles from shore can receive 0.4 Bcfd. Pipeline delivers to US markets. |
| Cove Point LNG | Cove Point, MD | Dominion CP LNG | 2003 | Suspended ops in 1970. Resumed ops in 2003. New facility construction begun October 2014. |
| Elba Island LNG | Savannah, GA | El Paso Energy | 2003 | Includes proposed liquefaction project and export facility. |
| Gulf Coast | | | | |
| Gulf LNG | Pascagoula, MS | El Paso (Kinder Morgan)/Crest/Sonangol | 2011 | Existing import capability. Liquefaction and export facility scheduled 2019/2020. |
| Lake Charles | Lake Charles, LA | Southern Union-Trunkline LNG | 1981 | Export facility scheduled 2019. |
| Cameron LNG | Hackberry, LA | Sempra | 2009 | Approved by DOE to re-export delivered LNG. DOE approved to export 1.7 Bcfd domestic LNG scheduled 2018. |
| Sabine Pass LNG | Cameron Parish, LA | Cheniere | 2008 | Approved by DOE to re-export delivered LNG. Export terminal with liquefaction process under construction. |

| Terminal | Location | Owners and/or Operators | Year Service Began | Notes |
|-------------------|-----------------|---|--------------------|--|
| Golden Pass LNG | Sabine Pass, TX | Qatar Petroleum/ ExxonMobil/ ConocoPhillips | 2010 | 2.0 Bcfd importing capability. Proposed to add exporting capability. |
| Freeport LNG | Freeport, TX | Cheniere | 2008 | Expanded import terminal approved, but not under construction. 2.0 Bcfd Liquefaction plant for LNG export approved by FERC July 2014, now under construction. |
| Alaska | | | | |
| Point Nikiski LNG | Kenai, AK | Conoco Phillips | 1969 | Operated as an export terminal for more than 40 years and was mothballed in 2012. In December 2013, the company applied to restart the facility to resume exports and support gas development in Alaska. That application was approved in February 2014. |

The interest in new LNG import facilities has decreased from 40 proposed facilities in 2008 to 2 listed by FERC as of January 6, 2015 that are still pursuing licenses and 2 additional potential sites. These locations are:

- Proposed sites
 - Downeast LNG (Robbinston, ME)
 - Oregon LNG (Astoria, OR)
- Potential sites
 - Kestrel Energy – Downeast LNG (Robbinston, ME)
 - Liberty Natural Gas (Port Ambrose, located off the NY coastline – LNG is not provided on shore)

As of January 6, 2015, there are no approved Import terminals currently under construction in the US Only two facilities, Downeast LNG and Port Ambrose are under consideration because they are located where they can supply natural gas to regions of the US that are not currently adequately served by natural gas pipelines (compared to the local or regional natural gas demand). Which of these facilities will be built will depend on successful approval and financing for further project development.

Although the amount of fuel needed for bunkering in most ports is relatively small compared to the capacity of most import terminals, such facilities are potentially pertinent to marine bunkering activities because they represent a potential source of LNG. From the table it is apparent that there is a move to liquefaction and export at existing import facilities which may provide additional marine fueling opportunities. In addition, some of the LNG import facilities already supply LNG to customers via LNG trucks (e.g., the Distrigas LNG Terminal in Massachusetts). Historically, truck transportation of LNG has been used extensively for supplying LNG satellite peakshaving facilities (see Section 7.1.3 for more details), but there is the potential for merchant sales of LNG from import terminals. See Section 7.3 for a discussion of such supply offers.

Bunkering project developers need to be aware that proposals for transportation of LNG by truck have not always been well received. It was opposed by a variety of local groups in Savannah in 2010 when the Elba Island LNG Terminal proposed distributing LNG by trucks that would pass through portions of the city of Savannah. The discussion of safety issues associated with that operation continued until 2012 when the terminal decided to abandon the proposal.

7.1.2. LNG Export Facilities

With the increase in domestic natural gas supplies, DOE is reviewing or has approved approximately 50 applications to export LNG. Following DOE approval they will be reviewed by FERC to approve the specific design from a safety, reliability, and environmental impact view point. If approved and built, these facilities will (1) be supplied with natural gas by pipeline and (2) include liquefaction systems to produce LNG and store it in onshore tanks or near shore floating facilities for some designs. Table 20 provides a list of proposed/potential US LNG export terminals and Table 21 provides a list of proposed/ potential Canadian export terminals.

Table 20. Current Summary of Proposed/Potential US LNG Export Terminals

| Company | Location | Export Quantity | Project Status | | | |
|-------------------------------------|------------------|-----------------------------------|--|-----------------------------------|------------------|--------------------|
| | | | Application Approved by DOE ⁺ | Under Review by FERC [‡] | Approved by FERC | Under Construction |
| Kestrel Energy – Downeast LNG | Robbinston, ME | 0.5 Bcfd | ✓ | ✓ | | |
| Liberty Natural – Port Ambrose | Offshore NY | 0.4 Bcfd | | | | |
| Dominion – Cove Point LNG | Cove Point, MD | 1.0 Bcfd FTA 0.77 Bcfd Non FTA | ✓ | ✓ | | ✓ |
| Southern LNG Company | Elba Island, GA | 0.35 Bcfd | ✓ | ✓ | | |
| Eagle LNG Partners | Jacksonville, FL | .075 Bcfd | ✓ | ✓ | | |
| Carib Energy (USA) LLC | Martin Cty, FL | .03 Bcfd FTA .04 Bcfd Non FTA | ✓ | | | |
| Advanced Energy Solutions, LLC | Martin Cty, FL | 0.02 Bcfd | ✓ | | | |
| Floridian Natural Gas Storage | Indiantown, FL | 0.02 Bcfd | ✓ | ✓ | | |
| Gulf LNG Liquefaction | Pascagoula, MS | 1.5 Bcfd | ✓ | ✓ | | |
| Freeport-McMoRan Energy LLC | Offshore LA | 3.22 Bcfd | ✓ | | | |
| Sabine Pass Liquefaction / Cheniere | Sabine Pass, LA | 2.2 Bcfd | ✓ | | ✓ | ✓ |
| Sabine Pass Liquefaction LLC | Sabine Pass, LA | 0.28 Bcfd | ✓ | | | |
| Sabine Pass Liquefaction LLC | Sabine Pass, LA | 0.24 Bcfd | ✓ | | | |

| Company | Location | Export Quantity | Project Status | | | |
|---|-------------------------------------|-------------------------------------|--|-----------------------------------|------------------|--------------------|
| | | | Application Approved by DOE ⁺ | Under Review by FERC [±] | Approved by FERC | Under Construction |
| Sabine Pass Liquefaction LLC | Sabine Pass, LA | 0.86 Bcfd | ✓ | ✓ | | |
| Sabine Pass Liquefaction LLC | Sabine Pass, LA | 0.54 Bcfd | ✓ | ✓ | | |
| Lake Charles Exports, LLC | Lake Charles, LA | 2.0 Bcfd | ✓ | ✓ | | |
| Cameron LNG, LLC | Hackberry, LA | 1.7 Bcfd | ✓ | | ✓ | ✓ |
| Cameron LNG, LLC | Hackberry, LA | .42 Bcfd | | | | |
| Louisiana LNG Energy LLC | Plaquemines Parish, LA | 0.30 Bcfd | ✓ | ✓ | | |
| SB Power Solutions | | 0.07 Bcfd | ✓ | | | |
| Main Pass Energy Hub, LLC | Gulf of Mexico | 3.22 Bcfd | ✓ | ✓ | | |
| CE FLNG, LLC | Plaquemines Parish, LA | 1.07 Bcfd | ✓ | ✓ | | |
| Magnolia LNG | Lake Charles, LA | 1.07 Bcfd | ✓ | ✓ | | |
| Southern Union-Trunkline LNG | Lake Charles, LA | 2.2 Bcfd | ✓ | ✓ | | |
| Delfin LNG LLC | Gulf of Mexico (off Cameron Parish) | 1.8 Bcfd | ✓ | | | |
| SCT&E LNG | Cameron Parish, LA | 1.60 Bcfd | ✓ | | | |
| Waller LNG Services, LLC | Cameron Parish, LA | 0.16 Bcfd 0.19 Bcfd Non FTA | ✓ | ✓ | | |
| Gasfin Development | Cameron Parish, LA | 0.20 Bcfd | ✓ | ✓ | | |
| Venture Global Calcasieu Pass, LLC (Former Venture Global LNG, LLC) | Cameron Parish, LA | 1.34 Bcfd | ✓ | ✓ | | |
| Freeport LNG Dev/ Freeport LNG Expansion/FLNG Liquefaction | Freeport, TX | 2.8 Bcfd FTA 0.4 Bcfd Non-FTA | ✓ | | ✓ | ✓ |
| ExxonMobil – Golden Pass | Sabine Pass, TX | 2.1 Bcfd | ✓ | ✓ | | |
| Excelerate Liquefaction | Lavaca Bay, TX | 1.38 Bcfd | ✓ | ✓ | | |

| Company | Location | Export Quantity | Project Status | | | |
|--|--------------------|----------------------------------|--|-----------------------------------|------------------|--------------------|
| | | | Application Approved by DOE ⁺ | Under Review by FERC [‡] | Approved by FERC | Under Construction |
| Cheniere – Corpus Christi LNG | Corpus Christi, TX | 2.1 Bcfd | ✓ | | ✓ | |
| Argent Marine Management Inc | Trussville, AL | 0.003 Bcfd | | | | |
| Eos LNG & Barca LNG | Brownsville, TX | 3.2 Bcfd | | ✓ | | |
| Gulf Coast LNG Export | Brownsville, TX | 2.8 Bcfd | ✓ | ✓ | | |
| Annova LNG LLC | Brownsville, TX | 0.94 Bcfd | ✓ | | | |
| Texas LNG LLC | Brownsville, TX | 0.27 Bcfd | ✓ | | | |
| WestPac/Gulfgate Terminal | Port Arthur, TX | 0.2 Bcfd | | | | |
| Next Decade | Galveston, TX | 0.77 Bcfd | | | | |
| Next Decade Partners, LLC, (former Pangea LNG (North America) Holdings, LLC) | Ingleside, TX | 1.09 Bcfd | ✓ | ✓ | | |
| Alturas LLC | Port Arthur, TX | 0.2 Bcfd | | | | |
| Strom Inc. | Starke, FL | 0.08 Bcfd | | | | |
| Strom Inc. | | 0.02 Bcfd | | | | |
| Strom Inc. | | 0.02 Bcfd | | | | |
| Air Flow North America Corp. | | .0002 Bcfd | | | | |
| American LNG Marketing, LLC | | 0.008 Bcfd | | | | |
| LNG Development Company LLC (d/b/a Oregon LNG) | Astoria, OR | 1.25 Bcfd | ✓ | ✓ | | |
| Jordan Cove Energy Project | Coos Bay, OR | 1.2 Bcfd FTA 0.8 Bcfd Non FTA | ✓ | ✓ | | |
| ExxonMobil, ConocoPhillips, BP, TransCanada and Alaska Gasline | Nikiski, AK | 2.55 Bcfd | ✓ | | | |

+ Based on Free Trade Agreement application status as of 31 December 2014

(<http://energy.gov/fe/downloads/summary-lng-export-applications>)

‡ Review and approval status as of 6 January 2015

(<http://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-potential-export.pdf>)

Table 21 Proposed/Potential Canadian LNG Export Terminals

| Project | Location | Approved by National Energy Board ⁺ |
|---|--|--|
| KM LNG Operating General Partnership – 0.7 Bcfd | Kitimat, BC | ✓ |
| BC LNG Export Co-operative LLC – 0.23 Bcfd | Kitimat, BC | ✓ |
| LNG Canada Development Inc – 3.23 Bcfd | Kitimat, BC | ✓ |
| Apache Canada Ltd – 1.28 Bcfd | Kitimat, BC | |
| Pacific NorthWest LNG Ltd.- 2.74 Bcfd | Prince Rupert Island, BC | ✓ |
| WCC LNG Ltd. | Kitimat or Prince Rupert, BC | ✓ |
| Prince Rupert LNG Exports Limited – 2.91 Bcfd | Prince Rupert Island, BC | ✓ |
| ExxonMobil – Imperial – 4.0 Bcfd | Prince Rupert Island, BC | |
| Woodfibre LNG Export Pte. Ltd.- 0.29 Bcfd | Squamish, BC | ✓ |
| Jordan Cove LNG L.P. | Kingsgate, BC - Eastport, ID Huntingdon, BC - Sumas, WA | ✓ |
| Triton LNG Limited Partnership – 0.32 Bcfd | Kitimat or Prince Rupert Island, BC | ✓ |
| Pieridae Energy Ltd(Goldboro LNG)- 1.4 Bcfd | Guysborough County, NS | |
| H-Energy – 1.8 Bcfd | Melford, NS | |
| Aurora Liquefied Natural Gas Ltd. – 3.12 Bcfd | Prince Rupert Island, BC | ✓ |
| Orca LNG – 3.2 Bcfd | Prince Rupert Island, BC | |
| Kitsault Energy Ltd. – 2.7 Bcfd | Kitsault, BC | |
| Canada Stewart Energy Group – 4.1 Bcfd | Stewart, BC | |
| WestPac Midstream Vancouver – 0.4 Bcfd | Delta, BC | |
| Steelhead LNG – 0.11 Bcfd | Vancouver Island, BC | |
| Woodside Energy Holdings Pty Ltd | Northwest Coast | |
| Quicksilver Resources Canada Inc. | Vancouver Island, BC | |
| Cedar 1, 2, 3, LNG Export Ltd | | |
| GNL Quebec Inc – 1.6 Bcfd | Saquenay, Quebec | |
| Bear Head LNG – 0.5 Bcfd | Port Hawkesbury, NS | |
| Oregon LNG Marketing Company LLC | Kingsgate, BC - Eastport, ID Huntingdon, BC - Sumas, WA | ✓ |

+ Based on National Energy Board's LNG Export License Application Schedule as of 27 November 2014, (<http://www.neb-one.gc.ca/clf-nsi/rthnb/pplctnsbfrthnb/Ingxprtlncncplctns/Ingxprtlncncplctns-eng>) and FERC North American LNG Export Terminals POTENTIAL as of 6 January 2015, (<http://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-potential-export>) and Article: "Alberta and British Columbia now have 19 LNG projects," (<http://www.pipelinenewsnorth.ca/news/industry-news/alberta-british-columbia-now-have-19-lng-projects-1.1306181>).

As shown in Table 20, most of the proposed US export facilities are on the Gulf Coast, so they will not contribute significantly to bunkering projects in the Northeast or on the West Coast. There is discussion of possible supply to the US northwest ports from Canadian export facilities, if market demand there is not met by US suppliers. Also, both DOE and energy industry analysts agree that not all of the export facilities will be built. However, facilities that are built may provide additional locations where LNG can be offered for marine vessel bunkering. Export facilities will always be located with marine access because they will be shipping LNG for export via LNG carriers and/or barges.

Some examples of LNG bunkering facilities are:

The **Magnolia LNG Export Terminal** proposed at Lake Charles, Louisiana, now under review by FERC, includes the loading of bunkering vessels (e.g., bunkering barges or ships) as part of its currently proposed design. Given the scale of a liquefaction and shipping facility required for large scale LNG export, addition of bunkering capability should be a relatively small increase in project scope and cost and may well be considered by other export projects.

Also, **Cheniere Energy** has an agreement in principle to supply LNG from its Sabine Pass LNG Export facility currently under construction in Cameron Parish, Louisiana, to LNG America. LNG America will distribute LNG in the greater Gulf Coast region and plans to expand to other regions as commercial agreements are completed. It recently signed a contract with Jensen Maritime, Crowley Maritime Corporation's Seattle-based naval architecture and marine engineering company, to design the initial bunker/shuttle barge for its Gulf Coast operations. The vessels have an initial planned capacity of up to 3,000 m³ of LNG. Once in operation, the bunker barges will serve the dual purpose of moving LNG from the supply source to coastal-based storage and distribution terminals, as well as directly bunkering large ships.

7.1.3. Peakshaving Facilities

Peakshaving facilities serve to collect and store LNG during times of low natural gas demand and then regasify the LNG to go into the local or regional natural gas network. There are about 100 LNG peakshaving facilities in the US. They are either: (1) facilities that have liquefaction systems to take natural gas off a pipeline and make LNG that can be stored, or (2) "satellite facilities" that are provided LNG by truck that is then stored. In either case, they have regasification equipment that allows them to supply natural gas to the network during subsequent periods of high demand (e.g., winter heating season).

There are about 100 of these facilities located across the US, often in locations where natural gas is not produced and the natural pipeline infrastructure is not adequate to bring natural gas into the region to meet peak demands.⁴² For example, there are a large number of peakshaving facilities in the Northeast because of limited access to natural gas pipeline capacity because of the distance from the primary gas supplies (primarily along the Gulf Coast). In Canada, there are also peakshaving facilities located in Quebec, Ontario, and British Columbia.⁴³

42 U.S. Energy Information Administration. "Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System," (http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/lngpeakshaving_map.html), December 2008.

43 National Energy Board of Canada. "Liquefied Natural Gas – A Canadian Perspective," (<http://www.neb-one.gc.ca/clf-nsi/mrgynfmrtn/hrgyrprt/ntrlgslqfdntrlgscndnprspctv2009/lqfdntrlgscndnprspctv2009qa-eng.html>), 17 May 2013.

Like import terminals, peakshaving facilities that have their own liquefaction equipment may be sources of LNG to support marine bunkering in their region. It is less likely that satellite facilities that only receive LNG by truck are potential suppliers of LNG. In that situation, it would generally make sense to ship LNG by truck only once, directly from the liquefaction location to the ultimate users.

As described in Section 7.3, AGL Resources is an example of a company with existing peakshaving facilities that intends to supply LNG to the marine fuel market. It has acquired a network of LNG storage facilities in the southeastern US (Alabama, Georgia, Tennessee and Virginia) and, through Pivotal LNG (a wholly owned subsidiary), is marketing LNG for delivery by truck to companies needing natural gas fuel. The AGL facility in Trussville, Alabama, has been mentioned as a potential supplier to LNG bunkering facilities along the US Gulf Coast.

7.1.4. LNG Fuel Distribution Facilities for Other Transportation Modes

There are numerous other applications for LNG as a fuel that are not marine-related. These include:

- Fueling of vehicle fleets operating out of fixed locations (e.g., buses, garbage trucks, mining vehicles)
- Fueling of trucks operating fixed routes of specific lengths (e.g., package delivery services)
- Long-haul trucking operations that fuel at truck stops

LNG usage by these industrial sectors is expanding rapidly, so participants are sponsoring liquefaction facilities regionally in order to serve cross-country needs. Three of the organizations that are planning LNG fuel growth for the trucking industry (and other users in selected areas) are:

- Clean Energy that currently plans 105 refueling stations
- Shell/Travel Centers of America that has proposed up to 100 refueling locations^{44,45}
- Gaz Métro LNG has a liquefaction, storage, and regasification plant in Montreal, Quebec currently servicing other transportation modes

Clean Energy. For its approach to the market, Clean Energy is participating in a consortium called Eagle LNG that includes Clean Energy Fuels Corp., Ferus Natural Gas Fuels, General Electric (GE) Ventures and GE Energy Financial Services. Their intent is to provide an end-to-end solution (i.e., gas supply, liquefaction, transport if required, and fuel transfer) for the markets they will serve. They believe their experience in introducing LNG to new customers and communities in the highway fuel market has prepared them for similar issues in the marine fuel business since both markets are immature and stakeholders (e.g., customers, regulators, and municipalities) need to be educated regarding LNG's values, characteristics, and hazards. One of the first maritime facilities they are examining is one proposed in Jacksonville, Florida to support gas-fueled cargo operations. As of December 15, 2014, FERC was reviewing the Jacksonville project proposal.

44 Texas Alternative Fuel Fleet Pilot Program: Railroad Commission of Texas Public Outreach & Education Blog. Smith, Fred. "Clean Energy LNG refueling facility in Baytown," (<http://blogs.rrc.state.tx.us/TPF/?p=8118>), 18 September 2013.

45 Fleet Owner. "Shell and TA to build national LNG fueling network," (<http://fleetowner.com/news/shell-and-ta-build-national-lng-fueling-network>), 15 April 2013.

Shell/Travel Centers of America. Shell and Travel Centers of America's plans for supplying LNG fuel to truck stops are about the same in scope as Clean Energy's plans. They involve liquefaction facilities, LNG distribution, and storing/dispensing of LNG at truck stops. They believe it is necessary for the fuel supplier to provide the entire delivery infrastructure so trucking companies have the confidence that the LNG fuel supply network will be reliable enough for it to make sense for companies to convert their truck fleets.

Gaz Métro LNG. Gaz Métro LNG has inaugurated their first commercial LNG fuel station in Canada. This station is on the "Blue Road," which is designed to be Canada's first LNG-fueled freight transportation corridor (located between the Quebec City and Toronto areas). In a statement released on December 11, 2014, Gaz Metro announced that it was tripling production capacity in Montreal to 9 billion cubic feet per year (.02 Bcf/d). In November 2013, Gaz Métro issued a nonbinding call for submissions for the purchase of LNG from its liquefaction plant in Montreal.⁴⁶ Gaz Métro LNG indicated to ABS that it is interested in expanding its supply of LNG to the marine market.

Because highway refueling locations are sited for supplying cross country trucking (i.e., primarily close to interstate exits), it is not likely that the refueling locations themselves will be pertinent for marine fuel bunkering. However, to support 200 LNG service stations, there will be numerous liquefaction facilities required. LNG from those facilities transported via truck or other containers to marine users as a fuel source may meet some of the marine vessel demand. In some cases, like that proposed by Clean Energy for Jacksonville, a liquefaction facility will be built with a clear plan for supplying both the trucking and marine fuel businesses.⁴⁷

7.2. Examples of Proposed Bunkering Facilities

This section provides examples of proposed projects that represent the various types of proposed bunkering facilities, based on how they obtain, store, and/or bunker LNG to vessels. Example projects are used in this study to illustrate how aspects of LNG infrastructure are expected to be satisfied. This information was collected by consulting with the developers of these projects and using other sources of available information. However, none of these projects are in operation and for some there is limited information that developers are able to share due to confidentiality requirements.

These bunkering facility types are:

- Bunkering facilities with onsite liquefaction
- Truck transportation of LNG to the storage at the bunkering facility location
- Truck transportation of LNG for truck to vessel bunkering

46 Gaz Metro. "Gaz Métro LNG Issues a Non-Binding Call for Submission for Liquefied Natural Gas," (http://www.corporatif.gazmetro.com/corporatif/communiqué/en/html/3906417_en.aspx?culture=en-ca), 20 November 2013.

47 Jacksonville Business Journal. Gibbons, Timothy. "Clean Energy to Build LNG Plant on Jacksonville's Northside," (<http://www.bizjournals.com/jacksonville/blog/morning-edition/2013/10/clean-energy-to-build-plant-on-zoo.html?page=all>), 30 October 2013.

7.2.1. Bunkering Facilities with Onsite Liquefaction

Of the three options listed above, bunkering facilities with an onsite liquefaction process generally require the greatest investment in terms of land and process equipment. They can also provide the largest capacity and throughput. This section describes examples of this approach that have been announced.

Shell LNG Bunkering Facilities in Geismar, Louisiana and Shell Sarnia, Ontario. In 2013, Shell announced plans to bring LNG fuel to its marine and heavy-duty on-road customers in North America by investing in two small-scale liquefaction units.^{48,49} These two units would form the basis of two new LNG transport corridors in the Great Lakes and Gulf Coast regions. This decision followed an investment decision in 2011 on a similar corridor in Alberta, Canada. In 2013, Shell indicated the facilities would take 3 years to come into operation. Once operational, the Geismar, LA facility would supply LNG along the Mississippi River, the Intra-Coastal Waterway, the offshore Gulf of Mexico, and the onshore oil and gas exploration areas of Texas and Louisiana. In the Great Lakes corridor, Shell planned to install a liquefaction unit at its Shell Sarnia Manufacturing Centre in Sarnia, Ontario, Canada. Once operational, this project would supply LNG fuel to all five Great Lakes, their bordering US states and Canadian provinces and the St. Lawrence Seaway. The liquefaction plants each have a planned capacity of 250-million kg (250,000 tonnes) of LNG per year. In March 2014, Shell announced that these facilities are on hold while conducting a review of market demand. A recent (January 2015) contact with Shell representatives indicated that this hold is still in effect.

Waller Marine/Tenaska Facilities in Baton Rouge and Cameron Parish, Louisiana. Waller Marine and Tenaska NG Guels, LLC have announced a project to provide an integrated LNG bunkering operation in Baton Rouge and Cameron Parrish, LA that includes liquefaction facilities and a family of LNG service vessels that can provide coastwise LNG transport, unloading to storage tanks, bunkering of vessels, and regasification into a natural gas piping network.⁵⁰ Construction is to begin in 2015 and the facility is scheduled to be operational in early 2017. Waller Marine designed bunker vessels, articulated tug barges, which will be used in conjunction with the new facilities, will be ABS classed.

48 The Global and Mail. Vanderklippe, Nathan. "Shell aims to fuel Great Lakes Freighters with Liquefied Natural Gas," (<http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/shell-aims-to-fuel-great-lakes-freighters-with-liquefied-natural-gas/article9282660/>), 5 March 2013.

49 Shell Media Centre. "Shell to Develop Two Additional Natural Gas for Transport Corridors in North America," (<http://www.shell.com/global/aboutshell/media/news-and-media-releases/2013/>), 5 March 2013.

50 ABS Surveyor. "Innovation Spotlight: Fueling the Fleet of the Future," Spring 2013.

Pivotal LNG/WesPac Facility in Jacksonville, Florida. Pivotal LNG, Inc. (Pivotal LNG), a wholly owned subsidiary of AGL Resources and WesPac Midstream, LLC (WesPac) announced on January 6, 2015 that they have signed a long term agreement with Totem Ocean Trailer Express (TOTE), Inc. to provide LNG to fuel TOTE's two new state-of-the-art 'Marlin-class' container ships in Jacksonville, Florida. These new dual fuel LNG container ships are expected to be delivered to the port in Jacksonville in late 2015 and early 2016.⁵¹

The new Jacksonville LNG facility is expected to be operational in mid-2016.

AGL Resources, the parent company of Pivotal LNG, has more than four decades of experience in providing LNG fuel. AGL Resources is one of the largest operators of liquefaction facilities in the nation primarily through its distribution utility operations that use the LNG facilities for peakshaving services for customers when demand is highest. In addition, Pivotal LNG owns and operates a merchant LNG facility and sells LNG wholesale to truck fleets and other high-horsepower engine operators.

WesPac is a private energy infrastructure company with several small LNG facilities under development in North America. WesPac's LNG projects are focused on high-horsepower engine applications, including oil-to-gas fuel switching in power plants, commercial ships, railroad locomotives, and trucking.

7.2.2. Truck Transportation of LNG to the Storage at the Bunkering Facility Location

Harvey Gulf Port Fourchon, Louisiana. On February 14, 2014, Harvey Gulf began building a bunkering and fueling (marine and over the road) facility at Port Fourchon, LA (Figure 13) to support OSVs.⁵² The facility will have two sites, each with a capacity of 270,000 gal of LNG storage.

These storage tanks will be of stainless steel, Type 'C' construction, featuring double-walled, vacuum-insulated construction that meets ASME Boiler and Pressure Vessel Code requirements. For LNG storage at vehicle fueling stations, the applicable requirements, detailed in Chapter 13 of NFPA 52, require that the storage containers be of 100,000 gal (378,000 liter [L]) capacities or less, with a maximum aggregate storage capacity at a single fueling facility of 280,000 gal (1060 m³). Note: NFPA 59A also provides requirements for such tanks. Initial plans call for the facility storage tanks to be filled with LNG brought to the facility by trucks, although transfer to and from barges is planned in later phases of the project. Aside from the primary role of supplying vessels that support the oil and gas industry, the facility will be capable of supporting over-the-road vehicles that operate on LNG.

51 TOTE Inc. News. "Pivotal LNG and WesPac Midstream LLC Selected to Serve TOTE's LNG Vessels in Jacksonville, Florida," (<http://toteinc.com/pivotal-lng-and-wespac-midstream-llc-selected-to-serve-totes-lng-vessels-in-jacksonville-florida/>), 6 February 2014.

52 Marine Link. "Harvey Gulf to Build America's First LNG Bunkering Facilities," (<http://www.marinelink.com/news/americas-harvey-build355478.aspx>), 10 June 2013.

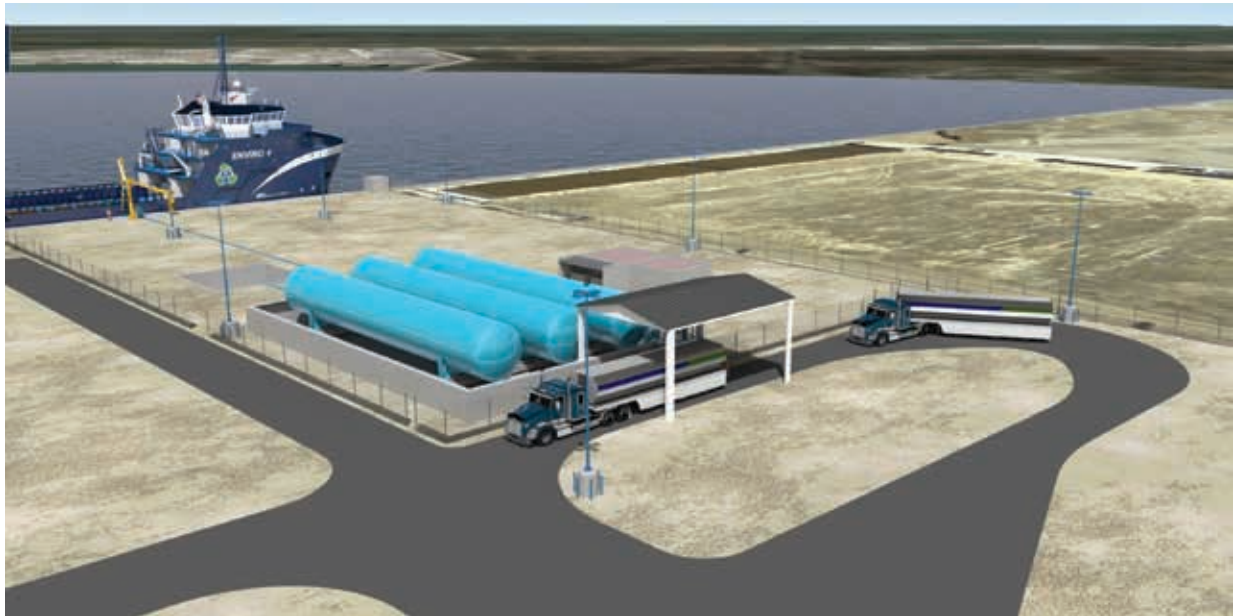


Figure 13. Artist's Rendering of Harvey Gulf International Marine's LNG facility at Port Fourchon, LA

7.2.3. Truck Transportation of LNG and Truck to Vessel Bunkering

A bunkering approach that does not require a "bunkering facility" is one in which the vessel is bunkered at a dock with LNG transferred directly from an LNG truck. Although there will not have to be infrastructure associated with a facility, USCG regulations for bunker transfers will still have to be met, and it is expected that the local COTP will want to review and approve the locations at which such transfers are planned. Initial LNG bunkering for two different passenger ferry operations is planned in this manner. In the long run, it is expected that bunkering facilities at ferry terminals will be developed so truck operations can be discontinued.

Washington State Ferry (WSF) LNG Conversions. WSF plans to convert its Issaquah class vessels to use LNG as fuel. The conversion would entail retrofitting LNG tanks on the top decks of vessels, situated between the exhaust stacks. The retrofit would also require installation of associated cryogenic piping. For initial operations of these ferries, the plan is to bunker the vessels by transferring LNG directly from trucks to the vessels. This approach will allow WSF to purchase LNG at existing LNG supply locations and fuel at one or more appropriate dock locations where the vessels call in the normal course of their operation. As of January 2015, the USCG is completing their review of WSF's safety, navigation and security risk assessment. An update of the WSF LNG conversions status is provided at the Washington State Department of Transportation website http://www.wsdot.wa.gov/NR/rdonlyres/FE0416C4-7127-460A-AAC5-8D880FFD636F/103394/WSF_LNG_Powerpoint_012115.pdf.

Pilot Project for Conversion of a Staten Island Ferry to Natural Gas Fuel Supplied as LNG. In a project funded in part by a Maritime Administration (MARAD) grant, the New York City Department of Transportation (NYCDOT) is going to convert one of its two Austen class small ferries to accept LNG as a fuel source. The original plan for the pilot project was to select a specific location at one of the ferry terminals (or another location if deemed a better choice) and bring an LNG truck to that dock to accomplish the bunker transfer. NYCDOT has now released two Requests for Proposal (RFP), one for the 499 ton 207 foot long Austen ferry conversion and another for the LNG storage and bunkering required to fuel the ferry. Bids were to be received November 20, 2014. The

conversion to LNG from ultra-low sulfur diesel is expected to halve the \$6 million annual fuel costs to about \$3 million. The plans are being coordinated with municipal, state, and federal agencies as part of a demonstration project for MARAD.

7.3. Example of LNG Offerings to the Marine Industry Using Existing LNG Facilities

In the last year, project plans have been proposed, approved and/or construction has begun on facilities built specifically for bunkering. Several of those projects are described in Section 7.2 of this study. This section outlines LNG offerings pertinent to the marine fuel market that are being made by companies planning new uses of existing LNG facilities. Also included in this are lessons learned and insights gained from securing LNG supply for marine bunkering. These include the full range from defining the requirements of the supply to soliciting industry and negotiating contract terms. These are included in Section 7.3.3

7.3.1. AGL Resources

AGL Resources (AGL) is one of the pioneers of downstream LNG fuel markets, is acquiring a network of liquefaction plants. AGL Resources plans to grow natural gas demand by pricing LNG on a cost-plus basis and using existing idle LNG capacity to seed nodes of demand.^{53,54} As part of this plan, AGL established Pivotal LNG to build, own, operate, and sell LNG.

AGL Resources and Pivotal LNG now operate six liquefaction facilities:

1. Riverdale LNG plant (Riverdale, GA) with a storage capacity of 31 million gal LNG in two storage tanks
2. Cherokee LNG plant (Ball Ground, GA) with a single storage tank capacity of 24.4 million gallons
3. AGL Resources LNG plant (Macon, GA) with a single storage tank capacity of 18 million gal
4. AGL Resources Chattanooga Gas (Chattanooga, TN) with total storage capacity of 1.2 billion cubic feet natural gas
5. AGL Resources LNG facility (Trussville, AL) with a capacity of 60,000 gal LNG per day
6. AGL Resources Virginia Natural Gas and Chesapeake LNG, LNG facilities (Chesapeake and James City County, VA)

Pivotal LNG has teamed with WestPac to provide LNG to TOTE, Inc.'s two new state of the art 'Marlin-class' container ships in Jacksonville, FL per an agreement signed January 6, 2015. The operational date for this liquefaction, storage and delivery project is scheduled for mid-2016.

Pivotal also owns and operates eight LNG tankers to facilitate deliveries, but it was set up primarily to build, own, and operate liquefaction and to sell out of its facilities.

53 Bulk Transporter, Weber, Rick. "AGL Resources V-P lays out a plan to price LNG on a cost-plus basis, use existing idle LNG processing, storage capacity," (<http://bulktransporter.com/tank-fleets/agl-resources-v-p-lays-out-plan-price-lng-cost-plus-basis-use-existing-idle-lng-processi>), 1 May 2012.

54 AGL Resources. "LNG and Propane," (<http://www.aglresources.com/about/lng.aspx>).

7.3.2. GDF Suez advance LNG Project

GDF SUEZ Gas NA announced in September 2013 the advance LNG Project, an initiative to provide attractively priced LNG to a wide array of customers in the US Northeast.⁵⁵ Through December 31, 2013, GDF SUEZ Gas NA accepted non-binding bids for LNG supply from the proposed project.

LNG from GDF SUEZ Gas NA's facility in Everett, Massachusetts, has supplied natural gas in New England, particularly during the coldest winter periods, over the last 40 years. However, GDF Suez Gas NA is now looking to expand its LNG offering to the market for use in a variety of applications, one of which is as marine fuel. By aggregating demand from many users, GDF SUEZ Gas NA believes they can offer more attractive pricing than would otherwise be achievable by individual consumers building a facility solely to meet their own needs. It is proposing to provide LNG deliveries by truck from its Everett Terminal or some of the peakshaving facilities it operates throughout the Northeast. The service area announced for this project includes states from Ohio all the way east and north to Maine.

7.3.3. Securing LNG Supply for Bunkering

In many respects, the single most important consideration in LNG supply for bunkering is lead time. There is currently no developed spot market for LNG for the volumes that most vessel operators/owners require. Additionally, unlike traditional bunker fuel supply, LNG supply and bunker decisions need to be made well in advance of the launch of the vessel particularly, if new build liquefaction and bunkering facilities are required to meet the need for LNG.

LNG Bunkering and Supply Requirements

In determining their LNG supply and bunkering requirements, vessel operators/owners need to carefully evaluate a number of factors. From an LNG bunkering perspective, consideration should be given to:

- The volume of LNG required at each bunkering event, the variability of LNG volumes from one bunkering event to another and any anticipated variability with respect to bunkering frequency.
- The need for SIMOPS – bunkering while loading/unloading of cargo or passengers.
- The required/preferred bunkering methodology (e.g., via tanker truck, direct cryogenic pipeline from a liquefaction or storage facility, or waterside bunkering from a bunker barge).
- For dual fuel (LNG and Low-sulfur Marine Gas Oil [LSMGO]) vessels, the implications and requirements of bunkering multiple fuels need to be addressed.
- Time in port required for bunkering LNG that may be different than bunkering traditional fuel.
- The current state of USCG and other agencies rules, regulations and guidance with respect to LNG bunkering.
- Capital and operating costs associated with bunkering, particularly if a bunker barge is required.

⁵⁵ GDF Suez North America. "GDF Suez Gas NA LLC Announces Non-Binding LNG Supply Offering," (<http://www.suezenergy-na.com/news/advanceLNG-press-release-sept-16-2013>), 16 September 2013.

Once a reasonable estimate of the required LNG volumes is established, vessel operators/owners can evaluate LNG supply in terms of:

- The availability, reliability and proximity of any existing sources of LNG (e.g., peak shaving facilities or existing merchant LNG liquefaction facilities) as primary and/or backup LNG supply options.
- Potential suppliers who are willing to develop, construct and operate a new build LNG liquefaction and storage facility that:
 - Will have the capacity to meet the bunkering volumes required by the vessel operator/owner, considering peak bunkering requirements and any variability in bunkering volumes and/or frequency. In most cases developers of new build facilities will look to have an “anchor” customer willing to take at least 50% of the new build facility’s planned volume.
 - Is in the optimal location considering the permits and approvals required, minimizes the impact on capital and operating costs and takes into account the preferred bunkering methodology. If bunkering is expected to be done by truck there is considerably more flexibility in terms of the location compared with bunkering via bunker barge.

Regardless of the source of the LNG, any potential supplier should:

- Have the supply chain that is consistent with the preferred bunkering methodology (e.g., bunkering via cryogenic pipe implies either a liquefaction and/or storage facility at the port where the vessel is docked, bunkering by bunker barge requires the ability to load the bunker barge at a port facility although not necessarily at the dock used by the vessel being bunkered).
- Be able to demonstrate they can produce LNG that meets the required specification, typically expressed by engine manufacturers in terms of a minimum methane number.
- Have LNG storage that provides for (i) the maximum volume to be bunkered, (ii) a safety margin to account for variability in required volumes/bunkering frequency and (iii) the necessary volumes to sustain bunkering in the event of a planned or unplanned interruption in the liquefaction process and resulting supply of LNG.
- Have in place back up fuel supply plans through which the LNG provider will either:
 - Provide LNG and the contract price from another supplier.
 - Provide ECA compliant fuel at the LNG contract price.

Financial and Economic Considerations

Most vessel operators/owners want to operate as they do today with respect to the purchase of fuel and bunkering services (“delivered to the flange of the vessel”) and, as such, are not likely to want to participate financially in the development of LNG production and bunkering infrastructure, but rather cover those costs in the price of LNG.

Particularly with respect to new build LNG liquefaction facilities where the vessel operator/owner would be considered the “anchor” customer, it is critical to:

- Receive and evaluate proposals from a number of potential suppliers
- Understand the capital and operating cost estimates of the facility and assign some confidence level to those estimates.
- Understand how the project will be funded and the source of the funding, particularly if project financing is involved since the developer will need a supply commitment in order to secure financing.
- The total delivered price of LNG and the pricing components that make up that price, including capital recovery.

The total delivered price of LNG to the flange of the vessel can be expressed in a number of ways (e.g., price per one million British Thermal Units, per LNG gallon, per cubic meter, per barrel of oil equivalent). There is currently no established “standard.” The metric for the exchange is typically determined by the buyer, and it is important for the buyer to define the preferred unit energy content and conversion factors to be used in the transaction. The total delivered cost of LNG typically takes into account all costs, including:

- The cost of natural gas, including transportation and distribution costs.
- The cost of the liquefaction.
- The cost of delivery based on the preferred/desired bunkering methodology.
- The cost of bunkering based on operating costs plus the amortization of the capital cost for the selected bunkering methodology; where a bunker barge will be utilized, it is important to note that early adopters will face bunker barge costs based on extremely low utilization.
- Profit

From a contractual perspective, most new build LNG liquefaction projects or significant upgrades to existing facilities that are focused on serving the marine industry are looking for a 10 year LNG supply agreement, to allow sufficient time for the recovery of capital in the price of LNG while keeping the price of LNG lower compared with other fuels, particularly LSMGO. These perspectives also include;

- Suppliers who are upgrading facilities may be in a position to offer a shorter contract term based on the amount of incremental capital required.
- Developers of new build liquefaction facilities may offer the anchor customer some form of price concession if they have excess capacity beyond the anchor customer’s requirement when it is sold to other customers.
- Developers of new build liquefaction facilities may offer the anchor customer right of first refusal on uncommitted capacity or on future production expansion.

7.4. Process for Gaining Approval of a Proposed Bunkering Facility

The LNG industry gained a great deal of experience in attempts to get import terminals licensed and approved in the last decade. LNG bunkering facilities are much smaller investments, smaller facilities, and present lower impacts on communities, both in normal operation and if accidents occur. However, some of the same lessons learned in the approval process for import terminals can be applied to bunkering facilities.

Early leaders in developing bunkering facilities are already sharing their recent experience in dealing with regulators and local communities. This section: (1) outlines some of those lessons learned, centering on the federal, state, tribal, and local agencies and organizations with whom coordination may be required (Section 7.4.1) and (2) provides suggestions on how to properly coordinate and communicate (Section 7.4.3). First, however, the following describes some of the unique aspects of bunkering facilities that help shape the approach a bunkering project developer needs to understand.

Regulatory Requirements. Considering regulatory requirements, LNG bunkering facilities have both an advantage and a disadvantage compared to large import or export facilities when it comes to obtaining approval to build and operate a facility. The FERC approval process for LNG import or export facilities can take 1 to 2 years to obtain construction license approval. The FERC approval process does not apply to bunkering facilities. That advantage comes at a price because

the regulatory process for the first wave of LNG bunkering facilities is not nearly as well defined as the FERC process. On balance, it seems the flexibility and shorter time frame is a positive for companies that want to develop bunkering facilities. Section 7.4.1 of this study documents the types of agencies and permits that will be required to gain formal approval of onshore LNG bunkering facilities. Section 7.4.2 outlines considerations for developers as they seek project approval, with the primary strategy being the consultation and coordination required by the project to replace the structured process that FERC uses for import and export facilities.

Lack of Federal Pre-emption. Earlier sections of this study outlined the current status of regulations that are “potentially applicable” to bunkering facilities. Some of them are in draft form and others have policy or guidance under which they will be developed and have not yet been drafted as regulations. This lack of maturity is compounded by the lack of an overall regulatory framework like FERC provides for import and export facilities. As described in the FERC docket for a facility under review, FERC reviews inputs and questions from other federal, state, tribal, and local agencies and organizations. Although somewhat cumbersome, under the Natural Gas Act (NGA), the FERC authority pre-empts the ability of states to disapprove LNG facilities except under specific circumstances defined in the NGA (e.g., if a facility does not adequately satisfy the Coastal Zone Management Act). That pre-emption policy does not apply to LNG bunkering facilities. Developers will have to identify all of the applicable regulations for the specific location, including federal, state, tribal, and local requirements and make sure they are satisfied. The resources in Chapters 3, 4, and 5 of this study help identify federal regulations that apply to gas-fueled vessels, LNG bunkering vessels, and LNG bunkering facilities, respectively. However, that information does not represent all of the requirements that are dependent on the specific location of the bunkering facility and the actual bunkering activities. Again, effective coordination and consultation with appropriate stakeholders are essential.

Risk Perceptions. It is clear that some earlier LNG facility development projects have faced increased costs and delays because of local opposition, some of which is based on perceptions of the risk from LNG that are not realistic. LNG bunkering facilities need to be prepared to address these issues as well, although arguments can be made that the smaller facilities involved in bunkering do not pose similar risks. The primary way to address misunderstanding of risks is to facilitate two-way communication with stakeholders that have concerns and with those that have not yet decided how they feel about an LNG facility in their community. Section 7.4.3 of this study addresses communications needs and approaches for LNG development activities.

Awareness of Jurisdictional Bans. The only known, specific ban of LNG activities by a North American city or state is the moratorium on LNG storage and transfer (other than interstate transportation) in New York City (NYC). In response to a 1973 explosion during construction activities at a Staten Island LNG facility, the state enacted a moratorium on siting of new LNG facilities and intrastate transport of LNG under a 1978 statute. On April 1, 1999, the state lifted the moratorium for all locations except NYC, where it has been extended every 2 years. However, new facilities and transportation cannot occur in other areas of the state until new state regulations are developed and certified transportation routes are defined.

Recent pressure by industry has caused the state to move on the need for regulations to facilitate use of LNG as a transportation fuel. On September 26, 2013, the New York State Department of Environmental Conservation (DEC) proposed regulations that would permit siting, construction, and operation of LNG truck fueling stations and storage facilities in the state. DEC emphasized

that recent interest from New York State businesses and utilities in LNG projects calls for new regulations conforming to the state Environmental Conservation Law. The proposed regulations would apply to LNG liquefaction and dispensing facilities and would not require permits for LNG-fueled vehicles or vessels. They would not affect the existing statutory moratorium that bans new LNG facilities in NYC. The proposed regulations specify permit requirements and application procedures, including requirements for site inspections, fire department personnel training, closure of out-of-service LNG tanks, spill reporting, financial guarantee, and permit fees.

It is expected that the new regulations will allow the development of marine bunkering facilities in New York State other than NYC. Until the regulation related to NYC is also changed, the opportunities for LNG bunkering in the city ports are limited to: (1) interstate supply of LNG by truck to an NYC location, (2) vessel-to-vessel bunkering using a supply vessel engaged in interstate transport of LNG, or (3) bunkering at a fixed facility located in another state (e.g., the New Jersey portion of the Port of New York/New Jersey).

7.4.1. State, Provincial, Local, and Port Issues for Bunkering Facility Development

Early bunkering projects have been driven by forward-thinking vessel companies and LNG suppliers. This section first provides insight into LNG facility approval efforts in various ports and then outlines the consultation and coordination process that has been successful for LNG-related projects in the US and Canada.

Port Survey. ABS 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. Questions from these visits and discussions centered on receptivity/plans for LNG development, state/local regulations, ongoing projects (exploratory/pre-production, current production and post-production phases), and local development processes for including LNG within their port.

Using World Port Source as a guide for varying sizes of ports,⁵⁶ categorized as Very Small, Small, Medium, Large and Very Large, as well as interest in LNG and LNG bunkering based on media reports and other sources, ABS leveraged a tiered system based on HIGH, MODERATE and LOW interest in LNG and LNG bunkering in a particular port. These contacts and visits provided a 'boots on the ground' perspective as to what is going on in North America based on stakeholder views, perspectives and, more broadly, what each particular region of the US and Canada feels and needs to consider when looking into LNG and LNG bunkering projects. In these stakeholder engagements it is important to note that these were opinions of those stakeholders and may not necessarily reflect federal, state, provincial and local regulations or public position. However, based on the bunkering projects that are being pursued, port organizations are supportive of LNG bunkering projects when the companies that operate vessels in their port and/or potential LNG suppliers propose such projects. LNG availability is expected to be a potential competitive advantage for ports working to attract new shipping operations in the near future.

56 World Port Source. "Map of United States Ports," (<http://www.worldportsource.com/ports/USA.php>).

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

Figure 14 shows the ports contacted and those where stakeholder discussions were conducted. Figure 15 summarizes responses about the general acceptance of LNG in the region and provides the location of potential LNG sources and proposed/ongoing LNG bunkering projects. Section 7.4.2 provides additional discussion of the port survey and stakeholder discussions.

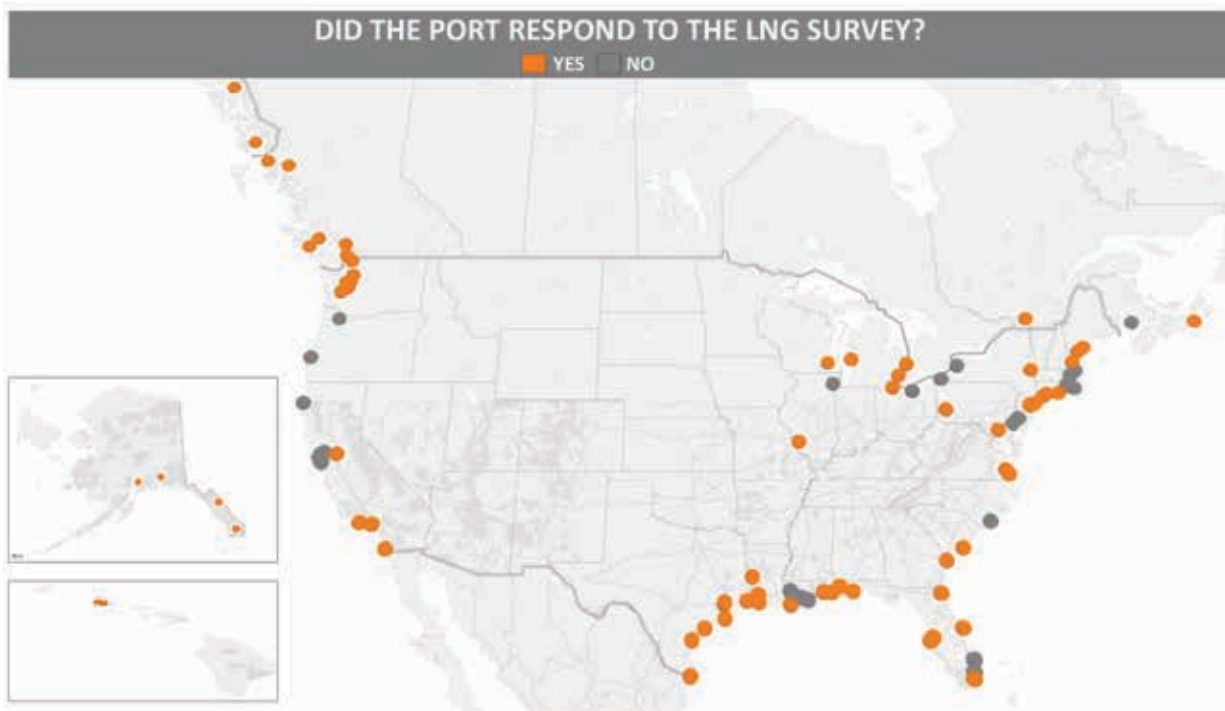


Figure 14. Ports Contacted in ABS Port Survey

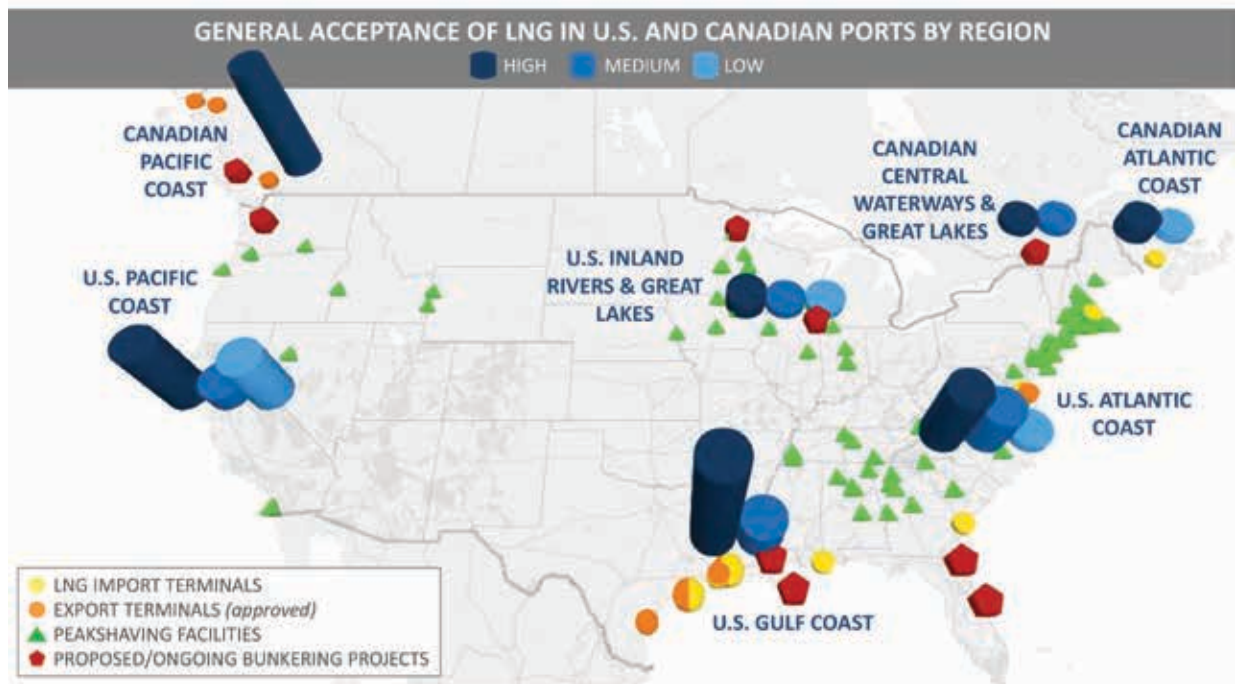


Figure 15. LNG General Acceptance by Regions vs. Potential LNG Sources and Proposed/Ongoing Bunkering Project Locations

In these discussions, the local representatives generally confirmed what ABS had learned from LNG bunkering project developers and what is conveyed in the port consultations. Port authorities are generally taking a wait-and-see approach, and projects in development have been driven by the developers themselves as opposed to port organizations. From a state/local regulatory standpoint, outside of the New York state moratorium on LNG facilities (referenced in Section 7.4), none of the representatives from the other states were aware of any state or local LNG-specific rules. The potential federal, state, and local regulatory agencies currently have some uncertainty as to which agencies will be responsible for permitting and authorizing facilities, but all see the USCG and the state and/or local fire marshal as playing key roles.

All of the representatives, including those from regulatory agencies, were supportive of potential LNG bunkering projects if developers propose projects for their port, and they clearly recognize the differences in the scale and regulatory authority between LNG bunkering facilities and LNG import/export terminals. In short, evidence the ABS team gathered suggests that developers should not be dissuaded from pursuing projects in maritime markets due to fear of regulatory impasses.

Table 22 provides a general list of potential regulatory agencies and organizations with whom a developer should consult and coordinate during a facility development process. The list will vary by location because of differences in state, provincial, county, municipal, and port/maritime organizations.

Table 22. Organizations for Consultation and Coordination Efforts

| Organization | Comments and Areas for Discussion |
|--|---|
| Potential Regulators | |
| USCG/Transport Canada <ul style="list-style-type: none"> • COTP/Transport Canada Regional Authority or designees (for facility locations and for bunkering vessel transit areas) • Headquarters (HQ) organizations (if recommended by sector/regional personnel) | <ul style="list-style-type: none"> ✓ Current USCG/Transport Canada HQ policies and regulatory status ✓ USCG/Transport Canada safety, security, and environmental requirements ✓ Local requirements ✓ Other local agencies and organizations to contact |
| DOT PHMSA/National Energy Board | <ul style="list-style-type: none"> ✓ DOT/National Energy Board regulations (if any) that apply to a bunkering facility connected to a natural gas pipeline ✓ Where the regulatory boundaries will occur ✓ Any hazardous materials transportation issues (when truck transportation of LNG is involved) |
| State/Provincial Pipeline Inspection Agency | Some states have been delegated selected federal regulatory authority for interstate pipelines (i.e., Arizona, Michigan, Ohio, Connecticut, Minnesota, Washington, Iowa, New York, West Virginia). ⁵⁷ Also, state pipeline inspection agencies are responsible for in-state pipelines <ul style="list-style-type: none"> ✓ Applicable state/provincial requirements and regulatory procedures |
| US Army Corps of Engineers (COE) | The COE has responsibilities in the area of waterfront facilities, wetlands protection, and other aspects of the shoreline that a bunkering facility may need to address <ul style="list-style-type: none"> ✓ Regulatory procedures, including: <ul style="list-style-type: none"> – Information that must be submitted – Permits/approvals that are required |
| State, Provincial and/or Local Fire Marshal Office | <ul style="list-style-type: none"> ✓ Codes and standards the fire marshal expects the facility will meet (e.g., NFPA 59A, NFPA 52, CSA Z276) should be discussed ✓ Local fire codes may also be relevant |
| State or Provincial Natural Gas Regulator | Some states have natural gas regulations that apply to “LNG facilities.” However, those regulations are typically designed to apply to companies supplying natural gas to utilities and distributors in the state. Massachusetts is an example of a state with an LNG facilities regulation that would apply to bunkering facilities that store LNG. ⁵⁸ <ul style="list-style-type: none"> ✓ Relevance of state/provincial natural gas regulations (if any) to bunkering facilities |

57 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), “State Pipeline Programs,” (<http://phmsa.dot.gov/pipeline/state-programs>).

58 Code of Massachusetts Regulations, 220 CMR 112.00. “Design, Operation, Maintenance and Safety of Liquefied Natural Gas (LNG) Plants and Facilities,” (<http://www.lawlib.state.ma.us/source/mass/cmr/220cmr.html>).

| Organization | Comments and Areas for Discussion |
|---|--|
| EPA/Environment Canada | <p>The EPA has a 2006 document that describes its involvement in “LNG facilities;” however, that document only addresses facilities subject to FERC or MARAD review processes (i.e., import and export facilities, either onshore or at deepwater ports). Some standard EPA requirements will apply based on legislation such as:</p> <ul style="list-style-type: none"> ✓ Clean Air Act ✓ Clean Water Act ✓ Resource Conservation and Recovery Act ✓ Other requirements depending on the technology involved <p>One reason to coordinate with EPA/Environment Canada is to determine whether they or a local agency has these responsibilities for the area in which the project is proposed.</p> |
| State, Provincial, and Local Environmental Regulators (e.g., Division of Environmental Quality, Department of Ecology, State EPA) | <p>Environmental regulations at the state, provincial, local level can vary greatly. Reaching out to the applicable organizations early is important</p> <ul style="list-style-type: none"> ✓ Applicable environmental agencies and regulations ✓ Extent of EPA/Environment Canada versus local permitting |
| Local planning/zoning commission | <ul style="list-style-type: none"> ✓ Discussion of local planning/zoning requirements |
| Local Maritime Community | |
| Port Authority | <p>Port authorities may have specific requirements regarding bunkering within the port</p> |
| Marine Exchange | <p>Marine exchanges can help identify issues and provide a conduit for communication to other maritime stakeholders (e.g., vessel and terminal companies that operate in the port area)</p> <ul style="list-style-type: none"> ✓ Experience with regulators ✓ Concerns from other users of the port |
| Marine Pilot Associations | <ul style="list-style-type: none"> ✓ Types of port entries and exits that currently require pilot involvement ✓ Input regarding appropriate locations/times for bunkering of vessels |
| Other Local Organizations | |
| Local Fire Department | <ul style="list-style-type: none"> ✓ Concerns/requirements for facility access and fire response planning ✓ Coordination of training regarding LNG hazards |
| Emergency Medical Services Agency | <ul style="list-style-type: none"> ✓ Concerns/requirements for facility access and medical response planning ✓ Coordination of training regarding LNG hazards |
| State/Provincial/Local/Port Law Enforcement Agencies | <p>Security assessments, plans, and coordination requirements</p> |

Appendix D includes two collections of information to assist a potential bunkering facility developer in a specific location. Table A8 is a compilation of state and provincial agencies that would potentially be involved in the review and approval of an LNG bunkering facility. To supplement that information, Table A9 provides information extracted from applications to FERC for LNG import/export facilities. It lists the agencies and organizations with which the applicant was working to obtain input and/or specific permits. Table A9 provides that information for an LNG project in nine different states, representing every state where an LNG import/export terminal has been proposed to FERC. As an example, Table 23 presents the state and local permitting agencies identified for the Long Beach LNG Import Project proposed for Long Beach, CA.

Table 23 Example of LNG Terminal Coordination Efforts for One State (California)

| Agency | Permit/Approval |
|--|--|
| Project: Long Beach LNG Import Project (Long Beach, CA) | |
| State | |
| California Coastal Commission | Federal Coastal Zone Management Consistency Determination |
| California Department of Transportation | Encroachment and Crossing permits |
| California State Historic Preservation Office | Consultation |
| Native American Heritage Commission | Consultation ⁵⁹ |
| Regional Water Quality Control Board, Los Angeles Region | National Pollutant Discharge Elimination System Storm Water Discharge Permit, Hydrostatic Testing, Water Quality Certification, Dredging Spoils (disposal) |
| Local | |
| City of Long Beach Engineering/Public Works | Encroachment Permit |
| City of Los Angeles Engineering/Public Works Department | Encroachment Permit |
| County of Los Angeles Health Hazardous Materials Division | Hazardous Materials Business Plan |
| | Risk Management Plan |
| Port of Long Beach | Harbor Development Permit |
| Port of Long Beach Development Services/Planning Department | Building Permit |
| Port of Los Angeles Engineering/Public Works Department | Encroachment Permit |
| South Coast Air Quality Management District | Permit to Construct/Permit to Operate |

Providing this information for LNG import/export terminals does not imply that bunkering facilities will have to meet the same requirements as those large, federally approved facilities. For example, coordination with historical preservation agencies and tribal organizations representing Native Americans is required for federally approved facilities as part of the environmental impact assessment process they undergo. Whether similar requirements (or recommendations) apply to smaller, bunkering facilities will depend on local regulations and conditions. By presenting all of the stakeholders, the tables provided here give a developer a starting point in identifying what coordination may be required.

7.4.2. Ports and Infrastructure

This section summarizes the findings of each region of the US and Canada. In the previous version of this study, ABS reviewed more than a dozen port regions in the United States and Canada in attempt to identify LNG bunkering interest, ongoing LNG bunkering projects, political climate as it related to potential LNG bunkering projects and public interest or concerns. In this updated revision of the study, ABS focused on similar LNG bunkering related issues and reached out to more than 100 federal, state and local regulators, port authorities, harbor safety committees, and industry representatives in the US and Canada. Of the 100 initial inquiries, ABS actually interviewed 73 respondents. Appendix E provides a comprehensive listing of the North American ports (including Canada), which includes key contact information and informative links.

59 Note: Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects on historic properties of any project carried out by them or that receives federal financial assistance, permits, or approvals, and provide the Advisory Council on Historic Preservation an opportunity to comment on these projects prior to making a final decision.

The information in this database provides the necessary groundwork for initial research and port-specific considerations when developing an LNG bunkering project.

7.4.2.1. The United States

ABS engaged with stakeholders within the USCG, including two of the USCG Centers of Expertise that can be contacted for assistance with LNG related issues; the Liquefied Gas Carrier National Center of Expertise (LGCNCOE) and the Towing Vessel National Center of Expertise (TVNCOE). These two organizations and their subject matter experts are available to assist interested parties in navigating the LNG process. The LGCNCOE maintains trained experts on the liquefied gas shipping industry to serve as in-house consultants to the USCG and as participants in technical forums and decision-making collaborations, provide technical advice to both the industry and the USCG, and increase and maintain the USCG's collective competency and capacity to professionally engage with the liquefied gas shipping industry.⁶⁰ While the LGCNCOE is not an approval authority, it can support industry in navigation of applicable requirements and approval procedures, as well as interact with and support Sector Prevention staffs and USCG Program offices for projects involving liquefied gas carriers, liquefied gas facilities, and use of liquefied gases as a fuel or bunkering operation. The TVNCOE maintains trained experts in the towing vessel industry to serve as in-house consultants to the USCG and as participants in technical forums and decision-making collaborations, provide technical advice to both the industry and the USCG, and increase and maintain the USCG's collective capacity, competence, and consistency to professionally engage with the towing vessel industry.⁶¹ While the TVNCOE is not an approval authority, it can support industry members in navigation of applicable requirements and approval procedures for towing vessels, as well as interact with and support Sector Prevention staffs and USCG Program offices for projects involving towing vessels.

The Pacific Coast, Alaska and Hawaii

The Pacific Coast of the US, including Alaska and Hawaii, is showing moderate interest in the use of LNG as a marine fuel. In particular, the Seattle/Tacoma region is where there is high interest in LNG. Representatives from ports that were contacted expressed interest in building an LNG bunkering infrastructure, but they highlighted a common dilemma that has stalled progress. Acknowledging that there are a couple of exceptions for those projects that are moving forward in North America, there is still the sense that vessel operators are waiting for LNG suppliers or bunkering operators to build the shore side or waterside infrastructure to ensure a reliable supply of LNG. Bunkering operators likewise are waiting for LNG suppliers and vessel operators to initiate development before making the financial commitments to build LNG bunkering vessels. The state and municipal governments are, in most areas, in favor of bringing LNG as a marine fuel to their ports, though there has been some in some areas. Port Authorities and local level governments play a critical role in the project approval process and in most ports; it is required to seek initial concept, interim and final approval for any LNG project and in most cases the primary approving authority will be at the state or local level. Most of the ports responding to the survey indicate that they have not been approached regarding LNG bunkering projects. The few that had been approached characterized the exchanges as preliminary.

60 USCG Liquefied Gas Carrier National Center of Expertise (LGCNCOE). "Vision, Mission and Values," (www.uscg.mil/lgcncoe).

61 USCG Towing Vessel National Center of of Expertise (TVNCOE). "What We Can Do," (www.uscg.mil/TVNCOE/).

In Alaska, Hawaii and Washington, the political climate is favorable to new LNG projects. Lower fuel costs, environmental advantages of a smaller carbon footprint and the potential availability of LNG are the primary driving factors for the high interest. All three states are currently in the initial research and planning phases of an LNG project for import/export, LNG as a fuel source for utility power generation, or LNG as a marine bunkering fuel.

Three notable projects in Washington are the Washington state ferries planned conversion of six of the Issaquah class ferries to LNG, Puget Sound Energy's (PSE) planned multi-model peakshaving and distribution facility in Tacoma and TOTE planned conversion of its two Orca Class Roll-on/Roll-off (RO/RO) cargo ships with service between Washington and Alaska. The WSF ferry conversion project is moving forward slowly while still awaiting funding for the project. PSE plans to break ground on construction of their peakshaving facility in 2015 with plans to supply LNG to the local economy during peak energy needs, supply LNG for trucking, buses and other vehicles, as well as supply LNG as a marine fuel.

In Alaska, there is a long standing history of success with LNG. This has led to strong government and public support for the use of LNG as an energy source and proposed LNG projects. There is a proposed Trans-Alaska gas pipeline being considered from the North Slope to the tide water in Cook Inlet that would link up with a proposed facility in Nikiski. The Alaska Marine Highways is looking into the use of LNG as a fuel for the ferry Tustumena replacement. There are design considerations to be evaluated such as; fuel tank placement, tank design in accordance with USCG regulations and capacity to carry fuel for one week. These issues are being evaluated during the ships design phase and will determine if LNG will be used as the fuel source. Due to the vast geographic expanse of Alaska and the remote locations of many of the small towns and villages and potential complications with safe navigation due to cold and icy conditions, LNG bunkering operations are less viable particularly in the Northern waterways. The South Eastern ports could potentially see LNG bunkering operations in the future but this potential will be driven by supply and demand. The USCG Sectors that had been approached about potential LNG bunkering project characterized the exchanges as preliminary.

Hawaii's interest in LNG centers on using LNG as a potential alternative power generation source. Hawaiian Electric Company, Inc. (HECO) is looking into the possible use of LNG as lower cost alternative for power generation and as a cleaner fuel source to comply with environmental standards. Jones Act requirements, finding suppliers willing to ship relatively small volumes and developing infrastructure to support LNG use are factors currently being addressed.

Hawaii Gas (HI Gas) is the Hawaiian Islands only franchised public gas utility. In 2014, HI Gas began shipping LNG in 40 foot specialized cryogenic tank containers transported out of Los Angeles via Matson, Inc. Ocean shipment. HI Gas uses this low volume LNG to supplement production of Synthetic Natural Gas (SNG) but expects LNG to replace SNG in the future which would require large LNG volumes. There is currently no LNG bunkering projects proposed in Hawaii. Jones Act restrictions and geographic location are significant challenges facing Hawaii and its availability to LNG sources. If LNG were to become available in Hawaii in large quantities, bunkering operations could become an option if demand required it. According to stakeholder interviews, LNG bunkering does not seem likely in the foreseeable future in Hawaii.

LNG project developers have shown interest in Oregon and California but the political climate, public acceptance and lack of LNG bunkering infrastructure or demand have forced potential projects to stall. As such there has been little movement beyond consultations. This finding is also supported by the observations from interviews with the USCG Sectors in California. Most contacted for this study indicated that they have not been approached regarding potential LNG bunkering operations. The few Sectors that had been approached about potential LNG bunkering projects characterized the exchanges as preliminary.

The Gulf Coast

The Gulf Coast region has numerous sources of LNG, and a receptive political and social climate that make it ideal for early adoption of LNG as a marine fuel. Yet interviews with stakeholders in the region reveal that there is limited activity that LNG bunkering projects are moving forward at this time.

The one notable exception is Harvey Gulf International Marine, who will soon have in operation the first of its two ABS classed dual fueled LNG-powered OSVs. The first of these vessels has been bunkered and will soon be in operation at the Port Fourchon facility (See Section 1). These vessels will be among the first to be classed under the ABS Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships. The vessels have received environmentally-friendly notations from ABS, including an ENVIRO+ notation which denotes vessels that adhere to enhanced environmental standards. In addition to providing LNG fueling for its own vessels, Harvey Gulf sees their facility as the first step to building an LNG supply infrastructure for other OSVs in the oil and gas industry. Harvey Gulf plans to make the facility capable of supporting over-the-road trucks that operate on LNG as well.

There have been some recent public announcements of potential LNG bunkering projects in the Gulf Coast region. In November 2014, Tenaska NG Fuels announced that they will construct a natural gas liquefaction and fueling facility along the New Orleans-Baton Rouge Mississippi River corridor with access to the Gulf of Mexico. In October 2014, LNG America announced they had reached an agreement with Buffalo Marine Service, Inc. to cooperate on the design of an LNG bunker fuel network for the U. S. Gulf Coast region. There are potential markets for LNG bunkering services in the Gulf Coast region, such as towing vessels and OSVs. According to US Army COE's report *Waterborne Transportation Lines of the United States, Volume 1, 2012*, there are approximately 3,500 towing vessels that operate on the Mississippi River and Gulf Intercostal Waterways. There are also approximately 1,600 OSVs operating in the US, of which the vast majority operates out of the Gulf Coast region. As a result of the increasing market, USCG Sector Mobile issued a Policy Letter, dated May 9, 2014, providing guidelines for the transfer of LNG as a marine fuel, largely drawing off of 33 CFR Parts 105, 127 and 156. The letter states that the recent need for a Policy Letter is a result of the COTP wanting to, "help owners, operators, and Coast Guard personnel understand the regulations that apply to specific types of LNG marine fuel transfer operations that are viable within the Mobile COTP Zone."⁶² In particular, the letter notes that waterfront facilities that handle LNG are regulated by 33 CFR 127 and that as a general policy for the Mobile COTP Zone, vessels transferring LNG fuel, to or from a fixed LNG facility will be regulated by this provision. As a result of this Policy Letter, in June of 2014 the COTP developed

62 USCG Sector Mobile, COTP Policy Letter, "Guidelines for the Transfer of Liquefied Natural Gas (LNG) as a marine fuel within the Sector Mobile Captain of the Port (COTP) Zone," 9 May 2014.

a Bunkering Checklist for USCG Sector Mobile using 33 CFR as its basis. However, there remain logistical and technical challenges with providing LNG to towing vessels and OSVs. Some of the challenges noted are unproven concepts and technology for midstream refueling, space restrictions for LNG fuel tanks in vessels, tight financial margins particularly for bulk agriculture commodities that do not support the return on investment, transient marine traffic patterns, and uncertainty about regulations or restrictions for LNG bunkering operations that may impede operational schedules.

The Atlantic Coast

The interest and activity associated with LNG bunkering on the Atlantic Coast can be roughly divided into three large geographic regions: North Atlantic, Middle Atlantic, and South Atlantic. The North Atlantic Region includes the coastal states of Maine, Massachusetts, New Jersey, New York, Pennsylvania, Connecticut and Rhode Island. The Middle Atlantic Region is comprised of the coastal states of Delaware, Maryland, Virginia and North Carolina. The South Atlantic Region is made up of South Carolina, Georgia and Florida.

The North Atlantic region can be characterized as having virtually no activity regarding LNG bunkering projects. Politically and socially LNG has not been generally accepted, even to potentially small scale bunkering operations. Most stakeholders expressed the opinion that LNG as a marine fuel will have to be proven elsewhere before it progresses in this region. The USCG Sectors in this region confirmed this sentiment. None of them have been approached by potential LNG bunkering projects for consultation. The one exception has been conversations between Staten Island Ferries and USCG Sector New York regarding the potential conversion of one of two Alice Austen Class ferries.

The activity and interest in LNG bunkering in the Middle Atlantic region can be characterized as a moderate level of interest but very limited activity. The public climate is rather neutral towards LNG bunkering operations. As long as the operations were located away from population densities or heavy marine traffic, LNG bunkering would probably not meet with much opposition. In some areas, DoD is a major port stakeholder. Consistent with the recommended approach for any port, consultation with DoD is advised for an LNG project. The most likely early adopters of LNG as a fuel in this region would be ferries, harbor tugs and coastal towing vessels on dedicated routes. Vessels that have dedicated routes of limited durations make it an ideal market for potential LNG bunkering operations because of their predictable schedules and short logistical lines. The United States Navy has a growing interest with a 'wait and see' approach for LNG as a maritime fuel. The Navy's interest in LNG is centered primarily on Secretary of the Navy, Ray Mabus, and his 'Green the Fleet' initiative to find cleaner energy alternatives across all commands. Currently exploring bio-fuels, the Navy's future interest in LNG could involve MSC vessels, but also as a conversion to electricity capability for all ships in the fleet. Although underway replenishment capabilities would be a concern, particularly for warships, the fact that LNG is being discussed within Department of Defense (DOD) circles demonstrates its future potential.

The South Atlantic region is the most promising East Coast region for the development of LNG bunkering, and both activity and interest in this area can be characterized as high. The political and social environment is accepting of LNG and actively seeking LNG bunkering infrastructure. The large ports of South Carolina, Georgia and Florida have long been engaged in a dynamic competition to attract and retain container and RO/RO cargoes. Some of the stakeholders expressed the sentiment that having a robust LNG bunkering infrastructure would provide a competitive advantage. The USCG Sectors in this region also indicated that there is active ongoing engagement from potential LNG bunkering projects.

By far the most advanced LNG bunkering project in the region is being jointly developed by WesPac Midstream, Pivotal LNG, and TOTE in the Port of Jacksonville. The first phase of the project is primarily focused on providing LNG to fuel TOTE's two new dual-fuel Marlin-class containerships. In October of 2014, WesPac Midstream purchased 36 acres of industrial waterfront near the Jacksonville Port Authority's Dames Point Marine Terminal. The plan is to have the facility operational in 2016. The facility will also supply other customers in Jacksonville and regional markets.

Though not directly related to LNG bunkering projects but indicative of the positive political and social climate toward LNG in the region, there are other projects related to the marine application of LNG that have been approved. Crowley Maritime was recently awarded two multi-year contracts to supply containerized LNG to major manufacturing facilities in Puerto Rico. The LNG will be transported in 10,000 gal, 40 foot intermodal containers to the Crowley's Jacksonville, FL, terminal, where they will be loaded onto Crowley vessels for shipment to Puerto Rico. Additionally, in September of 2014, Pivotal LNG announced a long-term agreement to sell LNG to Crowley Maritime.

In January 2015, Florida East Coast Industries announced that it proposes to build a \$250 million LNG facility near Titusville, which is 40 miles due east of Orlando, FL. Florida East Coast Industries states that it hopes to be operational by 2016. The facility will have a five million-gallon storage capacity and the capability to load to truck or rail. Florida East Coast Industries states that they plan to make their LNG available for trucking, maritime, electrical generation and space applications.

In-Land Rivers and Great Lakes

The Inland Rivers and Great Lakes regions can be characterized as having medium interest regarding LNG bunkering projects. Politically and socially there is no opposition to LNG and some of the utilities companies have shown interest in LNG as a potential energy source. Interviews revealed that there are numerous logistical and technical challenges with providing LNG to towing vessels. Some of the challenges highlighted were unproven concepts and technology for midstream refueling, space restrictions for LNG fuel tanks in vessels, tight financial margins that do not support the return on investment, and uncertainty about regulations or restrictions for LNG bunkering operations that may impede operational schedules. This sentiment was confirmed by the USCG. Most of the USCG Sectors in this region have not been approached by potential LNG bunkering project developers. The Towing Safety Advisory Committee (TSAC) organized an LNG working group to study LNG bunkering interest on the Western Rivers. A draft report (Recommendations for Mid-Stream Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG) Refueling of Towing Vessels) was posted for distribution on the USCG Homeport web site on September 16, 2014 to allow further subcommittee review and provide public access.

The intent of the study was to identify gaps in current USCG policy and regulations of LNG mid-stream fueling operations, and to identify operational requirements, procedures, and parameters necessary to support consideration for allowing these types of refueling operations to be conducted safely.⁶³ The final report will be published following official TSAC review and approval.

The Great Lakes region has expressed interest in LNG bunkering operations but there has been little discussions regarding development of LNG bunkering projects. Discussions with stakeholders identified key factors including the current state of the economy (depressed), age of the fleet in both the towing industry and the Lakers association, lack of LNG infrastructure and supply and the economic risks of retro-fitting the existing fleet or building new vessels. Most of the USCG Sectors in the region have not been approached regarding potential LNG bunkering operations. The Sectors or industry representatives that had been approached about potential LNG bunkering project characterized the exchanges as preliminary.

In regards to LNG and LNG bunkering options in the Great Lakes region of the US, the concept of LNG fueled ships has strong support, especially as Canada continues to progress in LNG export and LNG powered vessel operations. BLU LNG, which is making headway into its remote LNG refueling station operations in Central Canada, currently has two LNG bunkering permits under review for Duluth and South Lake Michigan. In anticipation of growing LNG fueled vessels operating in both US and Canadian waterways, industry stakeholders have identified three bunkering locations that could support Great Lakes traffic: Detroit, South Lake Michigan and Duluth.⁶⁴

7.4.2.2. Canada

LNG and LNG bunkering interest in Canada is positive due mostly in part to general Canadian public sentiment being receptive to LNG, as well as existing guidance and support from provinces and the Federal government. Provincial authorities and the Federal Canadian government are the lead points of contact and work together in regards to LNG projects, both existing and proposed. Currently, Canada has one existing import terminal at St. John in New Brunswick, Canaport LNG which is a facility run by Repsol/Irving. There is over a dozen other proposed LNG export terminals and one LNG bunkering opportunity being discussed as well. The Canadian Ministry of Transportation, Transport-Canada, oversees the 18 port authorities under its jurisdiction and through the Canadian Ministry of Natural Resources; the Canadian Government has been tracking existing, proposed and potential LNG import and export terminals around the country.⁶⁵ The main regulatory guidance/standard for proposed LNG project is through CSA, particularly through CSA-Z276⁶⁶, but Canadian LNG regulatory guidance is still in its development stages and the Canadian government is in the process of developing LNG bunkering specific regulations. Canadian stakeholders indicate that Canadian regulators are waiting on the international

63 USCG Towing Safety Advisory Committee (TSAC). Final Report, "Recommendations for Mid-Stream Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG) Refueling of Towing Vessels," 2014.

64 gCaptain, Editorial, "When Will Great Lakes Have LNG Bunkering?," 7 January 2015.

65 Natural Resources Canada, "Canadian LNG Projects," (<http://www.nrcan.gc.ca/energy/natural-gas/5683>), revised 23 September 2014.

66 Canadian Standards Association. "CSA Standard Z276, CAN/CSA-Z276-07 - Liquefied Natural Gas (LNG) - Production, Storage, and Handling," 2007.

community to develop regulatory guidance, through the IMO and the IGF Code. Aside from lack of strong regulatory guidance, other challenges include funding and supply issues in regards to LNG and facility construction.

Concerns within the provinces, if any, is in regards to the impact on rights such as the right to fish, the right to hunt, the right to gather, and other personal rights of Canadian "First Nation" citizens. A helpful tool that is currently being utilized by Transport-Canada, and could serve as a best practice for industry and local authorities, is a voluntary TERMPOL review. TERMPOL reviews are done with specific guidance in mind, which may include polling local sentiments, but also includes as part of its submission: Transit and Site Planning, Cargo Transport Assessment, Berth Procedures Assessment and an overall Risk Assessment Study. The details are filled out by project stakeholders through a TP-743 Guidance form that is available through Transport-Canada.⁶⁷ According to Transport-Canada, there are 7 TERMPOL's being performed for proposed LNG Facilities. These TERMPOL's help identify gaps and review local 'endorsements' with few regulatory impacts. However, in regards to mandatory reviews for an LNG project, there are two different Environmental Assessments: the Canadian Federal government performs one through the Canadian Environmental Assessment Agency (CEAA) and; the Provincial authority does one through its environmental agency, for instance, the British Columbia Environmental Assessment Agency.

Aside from Transport-Canada and provincial authorities, including port authorities, other notable regulatory agencies that organizations interested in developing LNG and LNG bunkering projects should consider engaging include: the Canadian Department of Fisheries, CEAA, the Canadian Coast Guard and the Canadian Marine Pilots Association. In regards to approving of LNG fueled vessels themselves, which is influencing the LNG export terminal and LNG bunkering discussions, the class societies in Canada would be the lead, in coordination with Transport-Canada.

Canada's Marine Liquefied Natural Gas Supply Chain Project is a joint industry project focused on the use of LNG. The project involves marine classification societies, technology and services providers, standards development groups, federal and provincial governments, and natural gas producers and suppliers. Stringent emissions regulations coming into force in 2015-2016 mean that vessel owners operating within 200 miles of the East and West Coast of Canada will need to use lower sulphur distillate fuel, install exhaust after treatment technologies, or switch to LNG in order to comply. The project focus is on technology readiness, training, safe operations and regulatory requirements, and environmental and economic benefits from a Canadian point of view. The project approach is to be conducted in 3 phases: Phase 1 – West Coast (Nov 2012 – Apr 2014), Phase 2 – Great Lakes and St. Lawrence, and Phase 3 – East Coast. Phase 2 and 3 final reports are expected September 2015. The Phase 1 report, Liquefied Natural Gas: A Marine Fuel for Canada's West Coast⁶⁸, summarizes project results related to identifying and addressing barriers to the establishment of a LNG marine fuel supply chain on Canada's West Coast. The project contributed to the development of a thorough understanding of key issues and how to design approaches that will encourage the use of LNG as a marine fuel in Canada.

67 Transport-Canada. "Termpol Review Process TP-743E," (<https://www.tc.gc.ca/publications/EN/TP743/PDF/HR/TP743E.pdf>), 2001.

68 Canadian Natural Gas Vehicle Alliance (CNGVA). "Liquefied Natural Gas: A Marine Fuel for Canada's West Coast," (http://stream1.newswire.ca/media/2014/04/02/20140402_C8173_DOC_EN_38721.pdf), April 2014.

The Pacific Coast

Many of the current LNG and LNG bunkering talks in Canada are occurring on the Pacific Coast (i.e., British Columbia [BC]). Numerous proposed or potential export terminals are being discussed and developed by stakeholders as well as monitored by Transport-Canada in many regions of the province (see Table 21). Most of these LNG projects are targeting large scale exportation.

Currently the WesPac Midstream – Vancouver, LLC (WPMV) project, which is a subsidiary of WesPac, is the only project that is proposing LNG bunkering operations. The terminal would be located on Tillbury Island, which is located south of Vancouver, BC, on the Fraser River.⁶⁹ There is an existing LNG storage facility on the island owned by FortisBC Energy, Inc., called the Tillbury LNG Plant. FortisBC currently uses this facility to provide gas supplies during periods of peak demand. However, the facility does not have a marine terminal. WPMV is planning a new marine terminal adjacent to the Tillbury LNG Plant to accommodate export of LNG by barges or ships. The Tillbury LNG Plant, which currently has only one LNG storage tank, will be expanded to meet the increased demand.

Despite only one of these projects explicitly showing interest in pursuing LNG bunkering, all of these proposed or potential terminals could have LNG bunkering in their future and have expressed interest. This is especially true as a result of many BC coastal ferries beginning to convert from diesel to LNG, thus having the potential need for future LNG bunkering terminals. There are two companies in BC currently building LNG fueled vessels, British Columbia Ferries and Seaspan Ferries Corporation. In particular, British Columbia Ferries is not only retrofitting its fleet for dual LNG and diesel oil, but will be the first domestic fleet to also be building vessels that will solely run on LNG. Both of these companies have structured phases of LNG conversion and implementation to occur between January 2015 and September 2015.

The Atlantic Coast

Although not as many as the Pacific Coast, there are LNG projects on the Atlantic Coast, primarily in Nova Scotia. These LNG projects, all being monitored by Transport-Canada, include proposed and potential LNG facilities at Guysborough, Nova Scotia, including Goldboro LNG and Melford LNG (see Table 21). A challenge with these East Coast projects is the marine supply chain and getting the gas/LNG to those ports and regions of the country. In particular, the Bear Head LNG project would be looking for a supply from the Scotian shelf, Western Canada and shale gas from the US. The Bear Head LNG has had discussions of its potential for LNG bunkering.

In Nova Scotia, public sentiment is favorable to LNG. Local authorities in Nova Scotia, when presented with an LNG project or proposal, poll its people to get their views or concerns. Working with industry proposing the project (such as Pieridae Energy Canada, H-Energy and Liquefied Natural Gas Limited representing the big three LNG projects), provincial authorities build consensus in advance and hold discussions on LNG planning with the local community way before a project gets underway, thus increasing its favorability with the public. The LNG facility regulatory process (typically taking 18 months and facilitated by Transport-Canada) includes the results of these public polls for all Project Study reports submitted for a public hearing before a panel of Canadian stakeholders/regulators. As a result of this advanced planning, local

69 WesPac Midstream. "NEB Application to Export LNG from Canada," (<http://wespac.com/irvine-ca-june-24-2014-wespac-midstream-vancouver-llc-wpmv-a-subsiary-of-wespac-midstream-llc-wespac-has-submitted-an-application/>), 24 June 2014.

municipalities have already performed 'pre-zoning' assessments of the coastline in their county for LNG use. Due to its unique location, the Halifax municipality requires a Coastal Pre-Zoning Assessment to be conducted before any proposed project gets off the ground.

Central Waterways and Great Lakes

Although there are a few notable projects and developments in the region with LNG, much like the East Coast, one of the main challenges is the supply chain of getting gas/LNG. In addition, one of the LNG projects being discussed in the region, which has LNG bunkering potential, recently announced a pause in further project development. In particular, the Great Lakes Corridor project being developed by Royal Dutch Shell and its liquefaction units in Sarnia, Ontario has been temporarily put on hold. The proposed terminal on the St. Clair River near Sarnia, Ontario and the shores of Lake Huron would have allowed Shell to supply LNG fuel to marine, rail and truck customers on both sides of the border along the Great Lakes and St. Lawrence Seaway. Royal Dutch Shell hoped to pump natural gas into Great Lakes freighters, as it was seeking new ways to lift demand for the fuel. LNG fuel was to be provided to marine traffic, as well as trucks and trains through Sarnia, Ontario since it is an important refueling hub on the Great Lakes, where some 65 US flagged and 80 Canadian flagged ships regularly make port calls. Most of the US vessels are too big to move through the St. Lawrence Seaway, meaning they are essentially a captive fleet on the lakes, which appeared as an ideal place for Shell to offer a new type of fuel as LNG. The St. Lawrence Seaway, has faced obstacles from the beginning such as lack of rules and regulations, as well as the need for detailed permits and standards. The need was identified as an Ohio based company, Interlake Steamship, was developing LNG fueled ships that they were converting fuel capability, which the Sarnia facility would have served. Royal Dutch Shell's announcement in Spring 2014 of the pausing of development of the Great Lakes Corridor project was described as a move to allow the company to review broader LNG-for-transport opportunities in North America and to ensure a more flexible and competitive portfolio. It is unclear whether this is just a pause in development, or leading towards a complete cancellation.

According to stakeholder input, in regards to Quebec, aside from the early stages for the GAZ Metro LNG project which is also supplying energy to remote areas of the province, there are no other LNG projects being proposed or discussed in this region. However, interest can be categorized as HIGH in the region, with strong public support, as GAZ Metro has been aggressively pursuing two LNG projects, one land based and one maritime. The land based project is called the Blue Highway Project (BLU LNG Project), overseen by Transport-Canada through their risk assessments, which involves a partnership with the largest trucking fleet in Canada, as well as the company BLU LNG, to provide gas fueling stations in remote areas of Quebec, as well as between Quebec and Ontario. The maritime project is based on an agreement between GAZ Metro and a Quebec ferry company called Société des Traversiers du Québec (STQ), which is currently building two LNG fueled ships. As a result, and possibly in anticipation of these LNG ship projects, GAZ Metro's actual LNG facility is located at Port of Montreal. Stakeholder's discussions with ABS have even gone so far as to state that Port of Montreal is very serious in exploring the option of LNG bunkering and is in discussions with potential industry clients, revealing that early conceptual phases are being explored (possibly 18-24 months out).

With the LNG market being so strong in Quebec, local stakeholders have turned and followed trends coming out of Europe for guidance. In fact, stakeholders in Quebec also have a Memorandum of Understanding with Antwerp, Belgium regarding LNG and energy best practices. In addition to STQ, European companies are also developing LNG fueled vessels that would

operate within the Great Lakes and St. Lawrence Seaway in Quebec. Hoegh Shipbuilding Company, based out of Norway, is developing a floating LNG platform project for maritime refueling within Quebec as well as a Belgium company, Anglo Belgian Corporation Container lines, that is making dual-retro-fitted tanks, both diesel and LNG, for their container ships. Finally, an Italian company, Fincantieri, is building a dual-fueled LNG ferry that is scheduled for delivery and cross the St. Lawrence Seaway in mid-2015, which will be the first LNG ferry in Canada. These dual-fueled vessels switch to diesel when doing their landing approach, however when they are underway, they will switch to LNG.

Due to the high demand, Port of Montreal as well as other Quebec and Central Canada stakeholders comprise a group, organized by the Canadian Natural Gas Vehicle Alliance, currently working on developing a study and report on LNG in the Great Lakes and St. Lawrence Seaway. In talking with Central and Eastern Canadian stakeholders, it was interesting that while LNG and LNG bunkering were so heavily considered, in regards to the US Great Lakes stakeholders, there was little interest expressed.

7.4.3. Consultation and Coordination Process for Bunkering Facility Development

The consultation and coordination process involved in developing a successful bunkering facility can vary based on the developer's experience in the local area where the bunkering facility is proposed. In this discussion, the "development process" is considered a coordinated effort, including any of the following project participants that exist at the time:

- Project sponsor/organization
- Engineering, procurement, and construction (EPC) firm(s)
- Law firms involved in local or federal (if any) licensing efforts
- Environmental compliance and services consultant
- Safety and security compliance consultant
- Other regulatory compliance consultants
- Media/communications consultants

In some cases, the project organization will have one or more people on staff that can provide some of the expertise listed above; however, the list does not imply that a contract firm has to be hired for each of the specialties listed. The specific participants supporting the project will depend on the scope of the project and the experience of the people on the project staff and its major contractors (e.g., EPC firm, lawyers, and environmental consultant).

Communication with affected parties is always an essential element in project management activities, but for LNG activities, it is even more critical. When a company is considering development of an LNG bunkering facility or using LNG as a fuel for its fleet of vessels, it has to be aware of, and deal with, public and some regulatory perceptions of LNG as higher risk than other fuels and other cargoes (even other liquefied gases). This calls for communication efforts beyond those for other types of project developments.

This need has been clearly demonstrated in ABS experience supporting LNG facility development projects and USCG safety and security analyses in all regions of the US and Canada. Those types of efforts have often required public meetings, workshops, and meetings with representatives from individual agencies and groups of agencies to explain the nature of LNG, its properties, hazards, benefits, and how the project is designed to provide safe, reliable, and secure handling of

LNG in the city, county, and state involved. Often, these communication activities required efforts that exceeded the level of public interaction required to obtain a specific federal agency approval or license. Because bunkering projects are smaller facilities, involving smaller LNG cargo vessels (if at all), and much lower inventories of LNG, the need for strong communication and the issue of public perception may be somewhat less of an issue, but companies proposing bunkering activities need to be prepared to address such issues throughout the development process.

The conclusion that early and continuous communication is a key element to LNG bunkering project success was re-emphasized at the second annual LNG as Fuel conference held in Seattle on January 27, 2015. The conference was attended by more than 200 representatives from every interest group in the LNG community. One of the strongest messages re-emphasized by each of the presenters related to the need for companies to communicate their project intentions early and often. This communications theme was echoed by conference attendees from:

- Federal regulators from the USCG in Washington, DC
- USCG COTP in Seattle
- USCG COTP MSU Houma, LA
- USCG Liquefied Gas Carrier National Center of Expertise
- Industry representatives from PSE, Washington State Ferries, Gas Technology Institute, GTT North America, Wärtsilä North America, ABS, DNV and Lloyd's Registry

PSE, WSF and other industry representatives in the development phases of various LNG projects continue to emphasize and acknowledge that communicating their intentions and seeking feedback from any and all regulatory, safety, environmental, tribal, or land owner entity are critical throughout the process.

Every region or port is different and the agencies and stakeholders in each state and port will vary. Communicating with the local USCG COTP regarding the intention to develop an LNG bunkering project is a key starting point. Appendix D provides a listing of potential state, provincial, and territorial stakeholders with whom LNG bunkering facility developers should potentially consult. The listing includes environmental regulators, natural gas/pipeline regulators, fire marshals, port authorities, pilot associations, and marine exchanges.

Communications efforts need to start with the discussions described in the previous section on coordination and consulting; however, that section largely focused on understanding requirements for getting a facility approved. This section is more concerned with getting a facility "accepted" which, depending on the locality, can have great influence on whether or not the facility will be approved.

Issues that need to be addressed in communications efforts regarding the project may include:

- Impacts on the community, including:
 - Disruption during construction
 - Pollution (air, water, noise, light)
 - Effects on fisheries
 - Maritime restrictions (if any) due to safety/security zones
- Risks to the community and users of the waterways
 - Potential for LNG accidents
 - Increased vessel traffic
 - Increased vehicle traffic
- Benefits to the community
 - Jobs (short term and long term)
 - Potentially attractive pay scales for facility jobs
 - Taxes the project will pay to the local municipality and state
 - Reduced pollution from ships that use natural gas fuel

This list will vary based on the nature of the community and to what portion of the public the communication effort is addressed. A few important concepts for communications efforts include:

Do Not Wait Until Controversial Issues Are Raised. When people know of the project, have met people involved in the project, and understand at least some information regarding the project plans, they are less likely to jump to unsupported conclusions. Good prior communication also gives them a chance to reach out to the developer representatives they have met to say, “I heard this. Is it true?”

Be Inclusive. Try to reach out to as many different organizations and segments of the population as practical.

Accept People’s Concerns as Valid. If people have concerns, do not dismiss them because they are not a concern you deem viable. Treat their concerns as valid and provide explanations to their concerns, explaining what the situation really is.

Good communications cannot guarantee a successful project, but effective communication has contributed to much wider acceptance and support for many of the LNG projects that have succeeded. Table 24 lists some of the kinds of communications efforts and organizations with whom a developer may want to communicate.

Table 24. Opportunities for Effective Communications Efforts

| Organizations/Locations | Considerations |
|---|---|
| Municipal organizations – city and county boards | This is a primary place to stress benefits to the community. |
| School staff and students | Providing educational sessions for schools and providing literature for students to take home to parents can reach a significant fraction of a community. |
| Police and fire departments | These organizations are trusted by their communities and their understanding of your project and involvement when appropriate carries a lot of weight with members of the public. |
| Public meetings sponsored by the project | Public meetings by the project may be required and can play an important role, but unless there is a large controversial issue, attendance tends to be light. Specific efforts to reach out to nearby property owners can be valuable. |
| Public meetings or areas of congregation for other reasons (i.e., not sponsored by the project) | Going to where people are for other reasons and making presentations or staffing a booth/display can often reach many more people than sponsored public meetings. Example of meetings sponsored by others include Chamber of Commerce, port authority, service clubs, economic development agency, marine exchange, etc. |
| Waterways user organizations | These can include fishing associations, boat/yacht clubs, marinas, etc. |

8. Conclusion

This 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 was retained in this revision for reference; however, additional information is also included that should be useful to interested LNG and LNG bunkering stakeholders.

Opportunities for LNG projects in North America have grown since the first publishing of this study. The port visits and discussions revealed not only progress with previously identified LNG and LNG bunkering projects, but also found preliminary stages of project exploration by ports and port authorities within the US and Canada. Nevertheless, there remains some level of a 'wait and see' attitude in some regions. Also of note is the growing interest by the United States Navy in LNG as a maritime fuel. The Navy's interest in LNG is centered primarily on the Navy's 'Green the Fleet' initiative to find cleaner energy alternatives across all commands. The Navy's position is also one of 'wait and see'.

The overall use of LNG as fuel for ships, other than those carrying LNG as cargo, is still a relatively new concept in North America. The US's regulations, including current USCG policy for vessels receiving LNG for use as fuel, as well as Canadian regulations, continue to be in the developmental stages to appropriately address the options for marine 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. However, engagement with stakeholders indicates some hesitancy to move forward on projects until Federal Regulations are in place. In addition, the timing of this report coinciding with the significant drop in crude oil prices has lessened the economic advantages of LNG.

Regardless of the hesitancy in some cases, several companies have initiated and are well under way in their development of gas-fueled vessels and the corresponding infrastructure for LNG bunkering. Planning and execution of these projects involved a number of key decisions and resolution of regulatory, commercial and technical issues. The lessons learned from North America's first adopters of gas-fueled vessels provide valuable insight for future project developers who are considering making an investment in LNG as an alternative marine fuel.

One of the common threads among North America's early adopters is having gained the awareness that making the switch to LNG requires patience and persistence navigating an uncharted course. When making the decision to build or convert vessels powered by gas, shipowners and operators must consider a number of regulatory factors and address technical challenges associated with applying new technology to their fleets for the first time. The process to develop the first wave of gas-fueled initiatives in North America has required close collaboration, open communication, and shared best practices among classification societies, regulatory bodies such as the USCG and port authorities, vessel designers, and shipyards to establish a baseline for these next-generation vessels. LNG fueled marine vessels and LNG bunkering will continue to be a part of discussions on energy efficiency and environmental stewardship in the maritime industry.

APPENDIX A – Risk Assessment Worksheet Templates

Introduction

Each LNG bunkering operation is unique and therefore, has a unique set of hazards and risks. This appendix introduces a risk assessment methodology, describes a process for performing a risk assessment, and provides example worksheet templates for a truck-to-vessel bunkering operation.

Risk Assessment Methodology

To characterize the risk of LNG bunkering operations, risk assessment teams must tailor a sound risk assessment methodology that can successfully answer the following questions:

- **What can go wrong?** Risk assessment methods are used to identify hazards that can create accidents. These can include equipment failures, human errors, and external events. Based on the quantity and types of hazards that may affect the bunkering option, analysts can gain a good understanding of the risk associated with the operation.
- **How likely is it?** Likelihood is usually expressed as the probability or frequency of an accident occurring. If the likelihood is low enough, analysts may conclude that a possible accident scenario is not credible, not of concern, or of extremely low risk. But, the criteria for making such judgments often change with the type and severity of the consequence related to the possible accident.
- **What are the impacts?** An accident can affect many areas of concern with different degrees of negative results. The type and severity of consequences related to an accident help an analyst understand and judge risk.

The following are key terms and definitions associated with the risk assessment process:

Hazards: Situations, conditions, characteristics, or properties that create the possibility of unwanted consequences.

Causes: Underlying reasons (e.g., equipment failure, human error) why the initial incident occurs and safeguards fail to interrupt the chain of events.

Safeguards: Planned protections that are intended to interrupt the progression of accident sequences at various points in accident chains of events. Safeguards can be applied to prevent the likelihood of occurrence or to minimize the consequences. These planned protections may be physical devices, human interventions, or administrative policies.

Likelihood: The likelihood of events is often expressed as a frequency, events per year. To assess the frequency of any event, analysts must consider (1) how often the hazard is present (e.g., how many times an operation is performed) and (2) the probability of experiencing the accident during any exposure to the hazard.

Table A1 is an example of likelihood categories.

Table A1. Likelihood Categories

| Category | Category Descriptions |
|--------------------|---|
| Almost Certain (E) | Occurs 1 or more times per year |
| Likely (D) | Occurs once every 1 to 10 years |
| Possible (C) | Occurs once every 10 to 100 years |
| Unlikely (B) | Occurs once every 100 to 1,000 years |
| Rare (A) | Occurs once every 1,000 to 10,000 years |

Consequences: Unwanted impacts that can negatively affect subjects of interest. These types of impacts can include: deaths/injuries to workers and the public, property damage, business interruption, environmental impacts, and impacts to company reputation. The severity of consequences can range from insignificant to catastrophic. Each owner/operator has unique considerations; therefore, impact and severity descriptions should be tailored to reflect organizational concerns. Table A2 provides an example of a consequence matrix containing representative impact and severity categories.

Table A2. Representative Consequence Categories

| Severity Categories | Impacts | | | |
|---------------------|---|--|--|---|
| | Death & Injury | Economic | Environmental | Reputation |
| Low (1) | Low level short-term subjective inconvenience or symptoms. No measurable physical effects. No medical treatment. | No shutdown, costs less than \$1,000 to repair. | No lasting effect. Low-level impacts on biological or physical environment. Limited damage to minimal area of low significance. | Public concern restricted to local complaints. Ongoing scrutiny/attention from regulator. |
| Minor (2) | Objective but reversible disability/impairment and/or medical treatment injuries requiring hospitalization. | No shutdown, costs less than \$10,000 to repair. | Minor effects on biological or physical environment. Minor short-term damage to small area of limited significance. | Minor, adverse local public or media attention and complaints. Significant hardship from regulator. Reputation is adversely affected with a small number of site-focused people. |
| Moderate (3) | Moderate irreversible disability or impairment (< 30%) to one or more persons. | Operations shutdown, loss of day rate for 1-7 days and/or repair costs of up to \$100,000. | Moderate effects on biological or physical environment but not affecting ecosystem function. Moderate short-medium term widespread impacts (e.g., oil spill causing impacts on shoreline). | Attention from media and/or heightened concern by local community. Criticism by Non-Governmental Organizations (NGO). Significant difficulties in gaining approvals. Environmental credentials moderately affected. |
| Major (4) | Single fatality and/or severe irreversible disability or impairment (> 30%) to one or more persons. | Operations shutdown, loss of day rate for 7-28 days and/or repair costs of up to \$1,000,000. | Serious environmental effects with some impairment of ecosystem function (e.g., displacement of species). Relatively widespread medium-long term impacts. | Significant adverse national media/public/NGO attention. May lose license to operate or not gain approval. Environment/management credentials are significantly tarnished. |
| Critical (5) | Short or long-term health effects leading to multiple fatalities, or significant irreversible health effects to > 50 persons. | Operations shutdown, loss of day rate for more than 28 days and/or repair costs more than \$1,000,000. | Very serious effects with impairment of ecosystem function. Long-term widespread effects on significant environment (e.g., unique habitat, National Park). | Serious public or media outcry (international coverage). Damaging NGO campaign. License to operate threatened. Reputation severely tarnished. Share price may be affected. |

Risk: The risk of a hazard is based on the combination of the likelihood and consequence assessment, allowing risks of different hazards, operations, and potential accidents to be compared using a common measuring stick. Table A3 presents examples of risk levels assigned for each combination of likelihood and severity combination. Each owner/operator has unique considerations and risk tolerances, thus risk levels should be tailored to reflect those individual organizational risk tolerances.

Table A3. Risk Levels

| Likelihood Categories | Consequence Severity | | | | |
|-----------------------|----------------------|----------|----------|--------|----------|
| | Low | Minor | Moderate | Major | Critical |
| | 1 | 2 | 3 | 4 | 5 |
| Almost Certain (E) | Medium | Medium | High | High | High |
| Likely (D) | Moderate | Medium | Medium | High | High |
| Possible (C) | Low | Moderate | Medium | High | High |
| Unlikely (B) | Low | Low | Moderate | Medium | High |
| Rare (A) | Low | Low | Moderate | Medium | Medium |

Risk Assessment Process

Accidents usually occur through a chain of events ending in one or more unwanted effects. This chain of events begins with hazards capable of causing consequences. If there are no hazards, there are no consequences. An equipment failure, human error, or external event is necessary for a hazard to cause consequences. Sometimes one or more equipment failures, human errors, or external events must take place after the initiating event for an accident to occur. An accident has at least one unwanted consequence with a measurable effect. This outcome is influenced throughout the chain of events by the presence of safeguards and their success or failure.

The risk assessment team should develop various accident chains for representative bunkering options by identifying potential hazards, causes, consequences, and safeguards by applying a sound methodology and structured assessment process (Figure A1). To do this, the team could employ the HazID methodology which leverages experts to brainstorm potential scenarios to facilitate in identification of health, safety, and environmental (HSE) hazards associated with various LNG bunkering options.

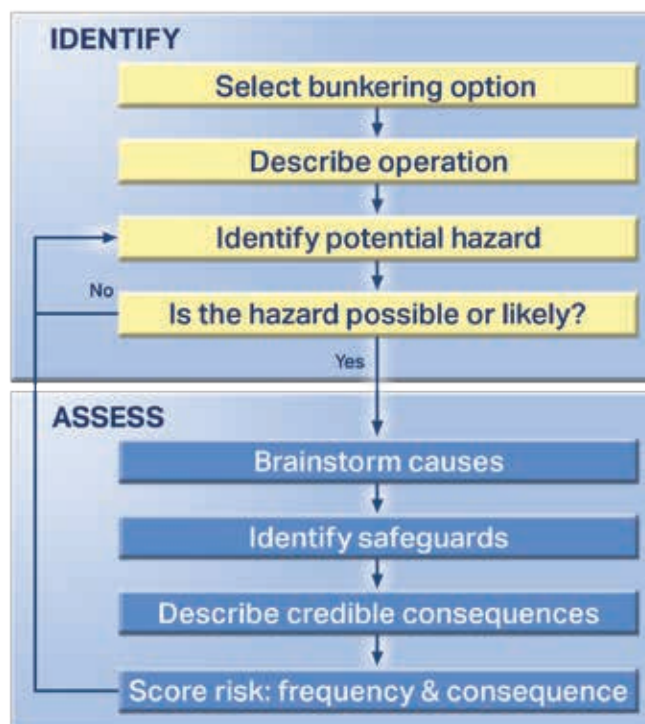


Figure A1. Risk Assessment Process

Key steps required to develop the risk profiles include:

- Assemble an appropriate team of experts familiar with LNG loading/unloading operations and LNG bunkering
- Provide an overview of each bunkering option, including major phases of the operations (e.g., connect, transfer, disconnect, lift) and types of vessels involved
- Brainstorm hazards that could potentially result in unwanted consequences
- Identify potential causes of the hazard
- Identify safeguards potentially in place to prevent the likelihood of occurrence (prevention) or minimize the consequences (mitigation)
- Describe the consequences and, if the hazard could result in a release of LNG, score the risk of the hazard as a function of likelihood and consequence considering all impact types: deaths/injuries, economic impacts, environmental impacts, and impacts to company reputation
- If applicable, document the linkage between hazards that could be causes of other hazards
- Record the team's discussions on HazID worksheets

LNG bunkering within North America is early in its development and there is relatively limited experience internationally. Therefore, at this time, there is a lack of historical accident data on which to base the risk assessment. To develop the risk profile, the team should consider hazards, causes, and consequences for historical accidents of analogous operations, including LNG import/export, traditional bunkering, and hazardous material transfers.

Table A4 provides an example worksheet template for a truck-to-vessel bunkering operation. Note: In the template, likelihood and consequences were not scored for LNG release scenarios. Similar worksheets provide useful templates for conducting hazards and risk analyses of other bunkering modes.

Table A4. Template Worksheet for Truck to Vessel Hazard Assessment

| No. 1 | | Truck to Vessel | | | | | Risk Level | | | Representative Safeguards | |
|-------|--|--|---|----------------|---|---|------------|--|--|---|---|
| Item | Hazard | Typical Causes | Typical Consequences | Impact | S | L | Risk Level | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Corrosion/erosion | Small release of LNG | Environmental | | | | | | Bunkering procedures | Communication between parties involved in bunkering (e.g., person in charge) |
| | | External impact | | | | | | | | | |
| | | Fatigue failure | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Gasket, packing failure | Small release of LNG, resulting in brittle fracture of ship deck, fire damage to ship/supply tank/ surrounding equipment potentially affecting a small area | Economic | | | | | | Controls and/or prohibitions of simultaneous passenger and bunkering operations | Designed breakaway coupling protects other equipment |
| | | Hose failure or disconnection | | | | | | | | | |
| | | Improper hose connection | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Improper maintenance | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | | | Equipment inspection/testing prior to bunkering | ESD system |
| | | Material defect (e.g., weld) | | | | | | | | | |
| | | Piping not properly cooled down prior to transfer | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Seal failure | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | | | ESD system tests | Flammable material detectors |
| | | Use of inappropriate piping/hoses (e.g., not LNG-rated) | | | | | | | | | |
| | | Valve leaking or misaligned to the atmosphere | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Vibration | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | | | Maintenance procedures | Personal protective equipment |
| | | Excessive movement of the loading arm (linked from 1.5) | | | | | | | | | |
| | | Supply truck drives/rolls away with hoses still connected (linked from 1.10) | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Another vessel collides with the receiving vessel (linked from 1.11) | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | | | Pressure testing | Supervision during transfer operations |
| | | Cargo dropped onto tank or loading lines (linked from 1.13) | | | | | | | | | |
| | | Fire aboard the receiving vessel (linked from 1.14) | | | | | | | | | |
| 1.1 | What if there is an LNG leak from pump/piping/hoses during transfer? | Extreme sea state (linked from 1.17) | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | | | Periodic certification of hoses | Vessel emergency response plans |
| | | Earthquake (linked from 1.18) | | | | | | | | | |
| | | Corrosion/erosion | | | | | | | | | |
| 1.2 | What if there is an LNG leak from the supply truck? | External impact | Small release of LNG | Environmental | | | | | | Bunkering procedures | Controls and/or prohibitions of simultaneous passenger and bunkering operations |
| | | Gasket/packing failure | | | | | | | | | |
| | | Improper maintenance | | | | | | | | | |
| 1.2 | What if there is an LNG leak from the supply truck? | Material defect | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Economic | | | | | | Equipment inspection/testing prior to bunkering | ESD system |
| | | Valve leaking or misaligned to the atmosphere | | | | | | | | | |
| | | ESD system tests | | | | | | | | | |

| Truck to Vessel | | Risk Level | | | | | Representative Safeguards | | |
|-----------------|------|---|--|---|---------------------------------|---|---------------------------|------------|--|
| No. 1 | Item | Hazard | Typical Causes | Typical Consequences | Impact | S | L | Risk Level | Representative Safeguards |
| | | | Vehicle collides with the supply truck (linked from 1.12) Cargo dropped onto tank or loading lines (linked from 1.13) Earthquake (linked from 1.18) | | | | | | Flammable material detectors Maintenance procedures Personal protective equipment Supervision during transfer operations Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Periodic certification of hoses Vessel emergency response plans Local emergency response plans |
| 1.3 | | What if there is a disconnect of piping/hoses during transfer (prior to stopping flow)? | Improper connection Excessive movement of the loading arm (linked from 1.5) Supply truck drives/rolls away with hoses still connected (linked from 1.10) Another vessel collides with the receiving vessel (linked from 1.11) Cargo is dropped onto loading lines (linked from 1.13) Extreme sea state (linked from 1.17) | Very small release of LNG Very small release of LNG, resulting in cryogenic hazards to personnel in the immediate area Very small release of LNG; no economic consequence | Environmental Death & Injury | | | | Bunkering procedures Communication between parties involved in bunkering (e.g., person in charge) Controls and/or prohibitions of simultaneous passenger and bunkering operations Designed breakaway coupling protects other equipment Drip tray Equipment inspection/testing prior to bunkering ESD system ESD system tests Flammable material detectors Maintenance procedures Personal protective equipment Supervision during transfer operations Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans |
| 1.4 | | What if the ESD system fails to stop LNG flow when leak or inadvertent disconnect occurs? | ESD instrumentation failure Icing on piping and/or valves interferes with ESD function No ESD system on supply truck Operator error/interference with ESD function Programming errors (e.g., | Large release of LNG Large release of LNG, resulting in brittle fracture of ship deck; fire damage to ship/supply tank/ surrounding equipment potentially affecting a large area | Environmental Economic | | | | Ability to manually initiate ESD system Bunkering equipment configuration control Bunkering procedures ESD system checkout and periodic testing Personal protective equipment Appropriate electrical classification in bunkering area |

| Truck to Vessel | | Typical Causes | Typical Consequences | Impact | S | L | Risk Level | Representative Safeguards |
|-----------------|---|---|--|---|---|---|------------|---|
| No. 1 Item | Hazard | | | | | | | |
| 1.5 | What if there is excessive movement of the hose/loading arm? | <p>improper logic) Use of nonstandard equipment</p> <p>External impact Improper maintenance Loading arm control system failure Operator error in placing and adjusting loading arm Structural failure Extreme wind (linked from 1.16) Earthquake (linked from 1.18)</p> | <p>personnel in the surrounding area Serious media attention and public outcry</p> <p>LNG leak from pump/piping/hoses during transfer (linked to 1.1) Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)</p> | Reputation | | | | <p>where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans</p> <p>Bunkering procedures ESD system Loading arm design standards and inspections Maintenance procedures</p> |
| 1.6 | What if the tank is overfilled? | <p>Level controller and operator fail to stop flow when tank is full</p> | <p>Small to medium release of LNG Small to medium release of LNG, resulting in brittle fracture of ship deck/fire damage to ship/supply tank/surrounding equipment potentially affecting a small area Small to medium release of LNG, resulting in fire/explosion/ cryogenic hazards to personnel in a small area</p> | <p>Environmental Economic</p> <p>Death & Injury</p> | | | | <p>Bunkering procedures High level alarm Independent level inputs to ESD system Personal protective equipment Tank instrumentation Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans</p> |
| 1.7 | What if the tank is overpressured? | <p>Continued transfer to liquid-full tank and relief valve fails to open Fire aboard the receiving vessel (linked from 1.14)</p> | <p>Large release of LNG Large release of LNG, resulting in brittle fracture of ship deck/ fire damage to ship/supply tank/ surrounding equipment potentially affecting a large area Large release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the surrounding area Serious media attention and public outcry</p> | <p>Environmental Economic</p> <p>Death & Injury</p> <p>Reputation</p> | | | | <p>Bunkering procedures, including emergency operations ESD system shut off on high level Personal protective equipment Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans</p> |
| 1.8 | What if the transfer lines are not de-inventoried and/or purged properly? | <p>Operator error</p> | <p>Small release of LNG Small release of LNG, resulting in brittle fracture of ship deck; fire damage to ship/supply tank/ surrounding equipment potentially affecting a small area</p> | <p>Environmental Economic</p> | | | | <p>Bunkering procedure, including; de-inventorying, purging, inerting, and disconnection steps Operator training</p> |

| Truck to Vessel | | Representative Safeguards | | | | | | | |
|-----------------|------|--|---|--|---|---|---|------------|---|
| No. 1 | Item | Hazard | Typical Causes | Typical Consequences | Impact | S | L | Risk Level | Representative Safeguards |
| | | | | Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area | Death & Injury | | | | Personal protective equipment Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans |
| 1.9 | | What if LNG (cryogenic liquid) is blocked in between two valves? | Improper purging | Damage to valve/piping Very small release of LNG Very small release of LNG, resulting in cryogenic hazards to personnel in the immediate area | Economic Environmental Death & Injury | | | | Bunkering procedure, including: de-inventorying, purging, inerting, and disconnection steps Personal protective equipment Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources |
| 1.10 | | What if the supply truck drives/rolls away with hoses still connected? | Failure to secure truck (brakes, wheel chocks) Truck driver error Vehicle collides with the supply truck (linked from 1.12) | LNG leak from pump/piping/hoses during transfer (linked to 1.1) Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3) | | | | | Bunkering procedures, including steps to secure supply truck Driver training Limit traffic in bunkering area |
| 1.11 | | What if another vessel collides with the receiving vessel? | Error in ship navigation by passing ship Poor visibility Steering or propulsion failure in passing ship | LNG leak from pump/piping/hoses during transfer (linked to 1.1) Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3) | | | | | Mariner training and credentials Piloted operations, where employed USCG safety zones and regulated navigational areas |
| 1.12 | | What if a vehicle collides with the supply truck? | Driver error | LNG leak from the supply truck (linked to 1.2) Truck drives/rolls away with hoses still connected (linked to 1.10) | | | | | Bunkering procedures Driver training Limited traffic in bunkering area Vehicle guards around fixed storage tank |
| 1.13 | | What if cargo is dropped onto supply truck or loading lines? | Crane operator error Crane structural failure Improper maintenance Use of equipment with insufficient lifting capacity Extreme wind (linked from 1.16) Earthquake (linked from 1.18) | LNG leak from pump/piping/hoses during transfer (linked to 1.1) LNG leak from the supply truck (linked to 1.2) Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3) | | | | | Bunkering procedures Controls and/or prohibitions of simultaneous cargo and bunkering operations Crane design standards and inspections Crane operator training and certification Maintenance procedures |
| 1.14 | | What if there is a fire aboard the receiving vessel? | Galley, engine room, passenger compartment fire | LNG leak from pump/piping/hoses during transfer (linked to 1.1) Tank is overpressured (linked to 1.7) | | | | | Bunkering procedures, including emergency operations ESD system Firefighting system Shipboard emergency response procedures |

| No. 1 Item | Truck to Vessel | | | | Typical Consequences | Impact | S | L | Risk Level | Representative Safeguards |
|---------------|---|--|--|---|----------------------|--------|---|---|---|---------------------------|
| | Hazard | Typical Causes | | | | | | | | |
| 1.15 | What if there is an external fire near the supply truck? | Onshore/dock fire Transportation equipment fire | Large release of LNG Large release of LNG, resulting in fire/explosion damage to ship/supply tank/surrounding equipment potentially affecting a large area Large release of LNG, resulting in fire/explosion/BLEVE/cryogenic hazards to personnel in the surrounding area Serious media attention and public outcry | Environmental Economic Death & Injury Reputation | | | | | Bunkering procedures, including emergency operations ESD system Facility emergency response procedures Facility firefighting system Personal protective equipment Appropriate electrical classification in bunkering area where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans | |
| 1.16 | What if there is extreme wind during the bunkering operation? | Weather | Excessive movement of the loading arm (linked to 1.5) Cargo is dropped onto tank or loading lines (linked to 1.13) | | | | | | Bunkering procedures, including weather limits | |
| 1.17 | What if there is an extreme sea state during the bunkering operation? | Weather | LNG leak from pump/piping/hoses during transfer (linked to 1.1) Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3) | | | | | | Bunkering procedures, including weather limits | |
| 1.18 | What if there is an earthquake during the bunkering operation? | Earthquake | LNG leak from pump/piping/hoses during transfer (linked to 1.1) LNG leak from the supply truck (linked to 1.2) Excessive movement of the loading arm (linked to 1.5) Cargo dropped onto tank or loading lines (linked to 1.13) | | | | | | Seismic qualifications of cranes Seismic qualifications of fixed onshore tanks | |

APPENDIX B – Basic and Advanced Training Competency Recommendations for Seafarers

This appendix contains detailed information on the specific knowledge, understanding and proficiencies being considered by the IMO Correspondence Group in *Development of the International Code of Safety for Ships using Gases or Log-Flashpoint Fuels, Development of Training and Certification Requirements for Seafarers for Ships Using Gases or Low-flashpoint Fuels* for each of the competencies listed in Section 3, section 3.2 and Table 2.

Basic Training. Table A5 below provides recommended specification of minimum standards of competence in the basic training of personnel aboard ships subject to the IGF Code. These standards are being recommended for all seafarers responsible for designated safety duties on board vessel subject to the IGF Code.

Table A5. Recommended Minimum Standards of Competence – Basic Training

| Competence | Knowledge, Understanding and Proficiency |
|---|---|
| <p>Contribute to the safe operation of a ship subject to the IGF Code</p> | <p>Design and operational characteristics of ships subject to the IGF Code</p> <p>Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems:</p> <ol style="list-style-type: none"> 1. Fuels addressed by the IGF Code 2. Types of fuel systems subject to the IGF Code 3. Atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code 4. General arrangement of fuel storage systems on board ships subject to the IGF Code 5. Hazard and Ex-zones and areas 6. Typical fire safety plan 7. Monitoring, control and safety systems aboard ships subject to the IGF Code. <p>Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code:</p> <ol style="list-style-type: none"> 1. Piping systems and valves 2. Atmospheric, compressed or cryogenic storage 3. Relief systems and protection screens 4. Bunkering systems 5. Protection against cryogenic accidents 6. Fuel leak monitoring and detection <p>Basic knowledge of the physical properties of fuels on board ship subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Properties and characteristics 2. Pressure and temperature, including vapour pressure/ temperature relationship <p>Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.</p> |

| Competence | Knowledge, Understanding and Proficiency |
|--|---|
| <p>Take precautions to prevent hazards on a ship subject to the IGF Code</p> | <p>Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Health hazards 2. Environmental hazards 3. Reactivity hazards 4. Corrosion hazards 5. Ignition, explosion and flammability hazards 6. Sources of ignition 7. Electrostatic hazards 8. Toxicity hazards 9. Vapour leaks and clouds 10. Extremely low temperatures 11. Pressure hazards 12. Fuel batch differences <p>Basics knowledge of hazard controls:</p> <ol style="list-style-type: none"> 1. Emptying, inerting, drying and monitoring techniques 2. Anti-static measures 3. Ventilation 4. Segregation 5. Inhibition 6. Measures to prevent ignition, fire and explosion 7. Atmospheric control 8. Gas testing 9. Protection against cryogenic damages (LNG) <p>Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS).</p> |
| <p>Apply occupational health and safety precautions and measures</p> | <p>Awareness of function of gas-measuring instruments and similar equipment</p> <ol style="list-style-type: none"> 1. Gas testing <p>Proper use of safety equipment and protective devices, including:</p> <ol style="list-style-type: none"> 1. Breathing apparatus 2. Protective clothing 3. Resuscitators and equipment <p>Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Precautions to be taken before entering hazardous spaces and Ex-zones 2. Precautions to be taken before and during repair and maintenance work 3. Safety measures for hot and cold work <p>Basic knowledge of first aid with reference to an SDS.</p> |

| Competence | Knowledge, Understanding and Proficiency |
|---|---|
| Carry out firefighting operations on a ship subject to the IGF Code | <p>Fire organization and action to be taken on ships subject to the IGF Code.</p> <p>Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code</p> <p>Firefighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code</p> <p>Firefighting system operations</p> |
| Respond to emergencies | Basic knowledge of emergency procedures, including emergency shutdown |
| Take precautions to prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code | <p>Basic knowledge of measures to be taken in the event of leakage/spillage of fuels from ships subject to the IGF Code, including the need to:</p> <ol style="list-style-type: none"> 1. Report relevant information to the responsible persons 2. Awareness of shipboard spill/leakage response procedures 3. Awareness of appropriate personal protection when responding to a spill/leakage of fuels addressed by the IGF Code |

Advanced Training. Table A6 provides recommended specifications of minimum standards of competence in the advanced training of personnel aboard ships subject to the IGF Code. These standards are being recommended for masters, engineers, officers, and all personnel with immediate responsibility for the care and use of fuels and fuel systems on board vessels subject to the IGF Code.

Table A6. Recommended Minimum Standards of Competence – Advanced Training

| Competence | Knowledge, Understanding and Proficiency |
|---|--|
| Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code | <p>Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to the safe bunkering and use fuels used on board ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. The chemical structure of different fuels used on board ships subject to the IGF Code 2. The properties and characteristics of fuels used on board ships subject to the IGF Code, including: <ol style="list-style-type: none"> 2.1. Simple physical laws 2.2. States of matter 2.3. Liquid and vapour densities 2.4. Boil off and weathering of cryogenic fuels 2.5. Compression and expansion of gases 2.6. Critical pressure and temperature of gases and pressure 2.7. Flashpoint, upper and lower flammable limits, auto-ignition temperature 2.8. Saturated vapour pressure/ reference temperature 2.9. Dewpoint and bubble point 2.10. Hydrate formation 2.11. Combustion properties: heating values 2.12. Methane number/knocking 2.13. Pollutant characteristics of fuels addressed by the IGF Code |

| Competence | Knowledge, Understanding and Proficiency |
|--|---|
| | <ol style="list-style-type: none"> 3. The properties of single liquids 4. The nature and properties of solutions 5. Thermodynamic units 6. Basic thermodynamic laws and diagrams 7. Properties of materials 8. Effect of low temperature, including brittle fracture, for liquid cryogenic fuels <p>Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code</p> |
| <p>Operate remote controls of fuel related to propulsion plant and engineering systems and services on ships subject to the IGF Code</p> | <p>Operating principles of marine power plants and ships' auxiliary machinery</p> <p>General knowledge of marine engineering terms</p> |
| <p>Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code</p> | <p>Design and characteristics of ships subject to the IGF Code</p> <p>Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Fuel systems for different propulsion engines 2. General arrangement and construction 3. Fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation 4. Fuel-handling equipment and instrumentations on board ships: <ol style="list-style-type: none"> 4.1. Fuel pumps and pumping arrangements. 4.2. Fuel pipelines and 4.3. Expansion devices 4.4. Flame screens 4.5. Temperature monitoring systems 4.6. Fuel tank level-gauging systems 4.7. Tank pressure monitoring and control systems 5. Cryogenic fuel tanks temperature and pressure maintenance 6. Fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution 7. Toxic and flammable gas-detecting systems 8. Fuel ESD system <p>Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code</p> <ol style="list-style-type: none"> 1. Low pressure pumps 2. High pressure pumps 3. Vaporizers 4. Heaters 5. Pressure Build-up Units |

| Competence | Knowledge, Understanding and Proficiency |
|--|--|
| | <p>Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including:</p> <ol style="list-style-type: none"> 1. Inerting 2. Cooling down 3. Initial loading 4. Pressure control 5. Heating of fuel 6. Emptying systems |
| <p>Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code</p> | <p>General knowledge of ships subject to the IGF Code</p> <p>Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code</p> <p>Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker- supply ship</p> <p>Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships subject to the IGF Code</p> <p>Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including:</p> <ol style="list-style-type: none"> 1. Bunkering procedures 2. Emergency procedures 3. Ship-shore/ship-ship interface 4. Prevention of rollover <p>Proficiency to perform fuel-system measurements and calculations, including:</p> <ol style="list-style-type: none"> 1. Maximum fill quantity 2. On board quantity (OBQ) 3. Minimum remain on board (ROB) 4. Fuel consumption calculations |
| <p>Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code</p> | <p>Knowledge of the effects of pollution on human and environment</p> |
| <p>Monitor and control compliance with legislative requirements</p> | <p>Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL) and other relevant IMO instruments, industry guidelines and port regulations as commonly applied.</p> <p>Proficiency in the use of the IGF Code and related documents.</p> |

| Competence | Knowledge, Understanding and Proficiency |
|--|--|
| <p>Take precautions to prevent hazards</p> | <p>Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Flammability 2. Explosion 3. Toxicity 4. Reactivity 5. Corrosivity 6. Health hazards 7. Inert gas composition 8. Electrostatic hazards 9. Pressurized gases <p>Proficiency to calibrate and use monitoring and fuel detection systems, instruments, and equipment on board ships subject to the IGF Code.</p> <p>Knowledge and understanding of dangers of noncompliance with relevant rules/ regulations.</p> <p>Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code.</p> <p>Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code.</p> <p>Ability to elaborate and develop safety plan and safety instructions for ships subject to the IGF Code.</p> |
| <p>Application of leadership and teamworking skills on board a ship subject to the IGF Code</p> | <p>Ability to apply task and workload management, including:</p> <ol style="list-style-type: none"> 1. Planning and coordination 2. Personnel assignment 3. Time and resource constraints 4. Prioritization 5. Allocation, assignment and prioritization of resources 6. Effective communication on board and ashore <p>Ability to ensure the safe management of bunkering and other IGF Code fuel-related operations concurrent with other on board operations, both in port and at sea.</p> |
| <p>Apply occupational health and safety precautions and measures on board a ship subject to the IGF Code</p> | <p>Proper use of safety equipment and protective devices, including:</p> <ol style="list-style-type: none"> 1. Breathing apparatus and evacuating equipment 2. Protective clothing and equipment 3. Resuscitators 4. Rescue and escape equipment <p>Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety, including:</p> <ol style="list-style-type: none"> 1. Precautions to be taken before, during, and after repair and maintenance work on fuel systems addressed in the IGF Code 2. Electrical safety (refer to IEC 600079-17) 3. Ship/shore safety checklist <p>Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code.</p> |

| Competence | Knowledge, Understanding and Proficiency |
|---|--|
| Prevent, control and fight fires on board ships subject to the IGF Code | Methods and firefighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code. |
| Develop emergency and damage control plans and handle emergency situations on board ships subject to the IGF Code | <p>Ship construction, including damage control</p> <p>Knowledge and understanding of shipboard emergency procedures for ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> 1. Ship emergency response plans 2. Emergency shutdown procedure 3. Actions to be taken in the event of failure of systems or services essential to fuel-related operations 4. Enclosed space rescue 5. Emergency fuel system operations <p>Action to be taken following collision, grounding or spillage and envelopment of the ship in toxic or flammable vapour including:</p> <ol style="list-style-type: none"> 1. Measures to keep tanks safe and emergency shutdown to avoid ignition of flammable mixtures and to avoid rapid phase transition (RPT) 2. Initial assessment of damage and damage control 3. Safe maneuverer of the ship 4. Precautions for the protection and safety of passengers and crew in emergency situations including evacuation to safe areas 5. Controlled jettisoning of fuel <p>Actions to be taken following envelopment of the ship in flammable fluid or vapour</p> <p>Knowledge of medical first-aid procedures and antidotes on board ships using fuels addressed by the IGF Code reference to the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG).</p> |

APPENDIX C – Summary of Regional Bunkering Infrastructure

Table A7. Summary of Regional Bunkering Infrastructure

| Region | LNG Availability | Existing Infrastructure | Market Interest | LNG Bunkering Projects in Process |
|---|--|--|--|--|
| United States, Pacific Coast, Alaska and Hawaii | Very Limited (because of proximity and accessibility to waterways) | According to PHMSA there are ten peak shaving facilities in the west coast states that are connected to natural gas pipe lines. According to FERC there is one export facility in Alaska. | High/Moderate The Pacific Coast of the United States, including Alaska and Hawaii, is showing relatively high to moderate interest in the use of LNG as a marine fuel. In particular, the Seattle/Tacoma region where there is high interest in LNG. | PSE's plans to break ground on a LNG facility summer of 2015. The facility will supply LNG to vessels as a marine fuel. The facility will also supply LNG to over-the-road vehicles. TOTE progressing with planned conversion of its two Orca Class RO/RO cargo ships with service between Washington and Alaska. Washington State Ferries recently submitted a WSA for the proposed conversion of six of the Issaquah class ferries to LNG. HECO is looking into the possible use of LNG as lower cost alternative for power generation and as a cleaner fuel source to comply with environmental standards. |
| United States, Gulf Coast | Very Good | According to FERC there are six approved LNG export terminals on the Gulf Coast. According to PHMSA there are 4 peak shaving facilities in Gulf Coast states. | High/Moderate The Gulf Coast region has numerous potential sources of LNG, and a receptive political and social climate that would make it ideal for early adoption of LNG as a marine fuel. | Harvey Gulf International Marine currently constructing an LNG bunkering facility in Port Fourchon, LA for OSVs in the oil and gas industry. Tenaska NG Fuels proposes to construct a LNG facility along the New Orleans-Baton Rouge Mississippi River corridor. LNG America has an agreement with Buffalo Marine Service, Inc. to design an LNG bunker fuel network for the Gulf Coast region. |
| United States, Atlantic Coast | Good | According to FERC there are three approved LNG export terminals on the Atlantic Coast. According to PHMSA there are 25 peak shaving facilities in the Atlantic Coast states. | Low/Moderate The North Atlantic region low interest. The Middle Atlantic region moderate level of interest. The South Atlantic region moderate level of interest (except Florida which is High). | WesPac Midstream, Pivotal LNG, and TOTE in the Port of Jacksonville jointly developing LNG bunkering project. TOTE is constructing two new LNG fueled ships for service between Jacksonville, FL and San Juan, PR. Crowley Maritime awarded two multi-year contracts to supply containerized LNG to major manufacturing facilities in Puerto Rico from the Port of Jacksonville. Florida East Coast Industries proposes to build a LNG facility near Titusville, FL that may in future have marine bunkering facilities. |
| United States, In-Land Rivers and Great Lakes | Very Limited (because of proximity and accessibility to waterways) | According to PHMSA there are 21 peak shaving facilities in the states that have access to the major inland rivers or the Great Lakes. | Moderate/Low The Great Lakes region is showing moderate to low interest in LNG bunkering operations. There appears to be little opposition to LNG in the region but most projects have not moved beyond consultation. | BLU LNG, currently has two LNG bunkering permits under review for Duluth and South Lake Michigan. |

| Region | LNG Availability | Existing Infrastructure | Market Interest | LNG Bunkering Projects in Process |
|---|------------------|--|--|--|
| Canada, Atlantic Coast | Very Limited | There is no existing LNG infrastructure. | <p>Moderate</p> <p>There are two proposed LNG facilities in Guysborough, Nova Scotia, and one in Port Hawkesbury, Nova Scotia.</p> <p>Discussions with local stakeholders and authorities in Nova Scotia indicate that public sentiment is very favorable to LNG.</p> | No LNG bunkering specific project in process. |
| Canada, Pacific Coast | Good | FortisBC Energy operates the Tillbury Island LNG facility near Vancouver BC. FortisBC currently uses this facility to provide gas supplies during periods of peak demand. However, the facility does not have a marine terminal. | <p>Moderate/High</p> <p>In British Columbia there are numerous proposed LNG export terminals being discussed. These include projects in Kitimat, BC; Douglas Channel LNG, LNG Canada, Kitimat LNG, WCC LNG, Triton LNG and Cedar LNG. Also in the Prince Rupert area; Orca LNG, Grassy Point LNG, Aurora LNG, Triton LNG, Pacific Northwest LNG, Prince Rupert LNG and WCC LNG. Other notable projects being discussed include Woodfibre LNG in Squamish, BC, the Kitsault Energy Project in Kitsault, BC.</p> | <p>WesPac Midstream – Vancouver LLC (WPMV), a subsidiary of WesPac Midstream LLC (WesPac), is partnering with FortisBC to use the Tillbury Island LNG facility which is located south of Vancouver, BC, on the Fraser River for LNG bunkering operations.</p> <p>BC Ferries is converting two Spirit Class vessels to LNG, and also building three dual fuel intermediate class vessels scheduled for delivery in 2016 and 2017.</p> <p>Seaspan Ferries Corporation, a unit of Vancouver-based Seaspan Marine Corporation, has awarded a contract for the construction of two LNG-powered ferries equipped with dual-fuel engines.</p> |
| Canada, Central Waterways and Great Lakes | Limited | Gaz Métro LNG has a liquefaction, storage and regasification plant in Montreal, QU. | <p>Moderate</p> <p>Mostly centering on Ontario and Quebec, overall LNG interest in the region can be moderate.</p> <p>Royal Dutch Shell proposed LNG facility in Sarnia, Ontario has been temporarily put on hold.</p> | GAZ Metro will be supplying Quebec ferry company Société des Traversiers du Québec (STQ), with LNG from trucks for three LNG fueled ferries to be operated by STQ. The first bunkering operation to happen spring of 2015. |

APPENDIX D – State, Provincial, Local, and Port Stakeholders

This appendix provides a summary of key state, provincial, and territorial stakeholders with whom LNG bunkering facility developers could potentially consult. Table A8 lists these stakeholders for Canadian maritime provinces and US maritime states and territories. The list includes potential environmental regulators, natural gas/pipeline regulators, fire marshals, port authorities, pilot associations, and marine exchanges.

Table A8. Key State, Provincial, and Territorial Stakeholders

| Type | Stakeholder (website) |
|------------------------|--|
| United States | |
| Alabama | |
| Environmental Agency | Alabama Department of Environmental Management (http://www.adem.state.al.us/default.cnt) |
| Fire Marshal | Alabama State Fire Marshal (http://www.firemarshal.alabama.gov/) |
| Pilot Association | Mobile Bar Pilots' Association (http://www.mobilebarpilots.com/) |
| Natural Gas/Pipeline | Administrator Gas Pipeline Safety Section - Alabama Public Service Commission (http://www.psc.state.al.us/Energy/gps/gas_pipeline_safety_section.htm) |
| Port Authority | Alabama State Port Authority (http://www.asdd.com) |
| Alaska | |
| Environmental Agency | Alaska Department of Environmental Conservation (https://dec.alaska.gov/) |
| Fire Marshal | Division of Fire and Life Safety (http://dps.alaska.gov/fire/) |
| Marine Exchange | Marine Exchange of Alaska (http://www.mxak.org/) |
| Pilot Associations | Alaska Marine Pilots & Dispatch Service (http://www.ampilots.com/pilots.html) |
| | Southeast Alaska Pilots' Association (http://www.seapa.com/) |
| | Southwest Alaska Pilots' Association (http://www.swpilots.com/) |
| Natural Gas/Pipeline | Federal Office of Pipeline Safety |
| American Samoa | |
| Environmental Agency | American Samoa Environmental Protection Agency (http://www.epa.as.gov/) |
| California | |
| Environmental Agencies | California Air Resources Board (http://www.arb.ca.gov/homepage.htm) |
| | California Department of Conservation (http://www.conservation.ca.gov/Index/Pages/Index.aspx) |
| | California Department of Toxic Substances Control (https://dtsc.ca.gov/) |
| | California Department of Water Resources (http://www.water.ca.gov/) |
| | California Environmental Protection Agency (http://www.calepa.ca.gov/) |
| Fire Marshal | Office of the State Fire Marshal - State of California (http://osfm.fire.ca.gov/) |
| Marine Exchanges | Marine Exchange of Southern California (http://www.mxsocial.org/) |
| | Marine Exchange of the San Francisco Bay Region (http://www.sfmex.org/information/misna.php) |
| Pilot Association | San Francisco Bar Pilots (http://www.sfbarpilots.com/) |
| Natural Gas/Pipeline | Utilities Safety and Reliability Branch - California Public Utilities Commission (http://www.cpuc.ca.gov/PUC/aboutus/Divisions/Consumer+Protection/Utilities+Safety+Branch/Natural+Gas+Safety/index.htm) |
| | Pipeline Safety Division - California State Fire Marshal (http://osfm.fire.ca.gov/pipeline/pipeline.php) |
| | California State Lands Commission (http://www.slc.ca.gov/) |
| | California Energy Commission (http://www.energy.ca.gov/) |

| Type | Stakeholder (website) |
|--|--|
| Port Authorities | Port of Hueneme/Oxnard Harbor District (http://www.portofhueneme.org) |
| | Port of Long Beach (http://www.polb.com) |
| | Port of Los Angeles (http://www.portoflosangeles.org) |
| | Port of Oakland (http://www.portofoakland.com) |
| | Port of Redwood City (http://www.redwoodcityport.com) |
| | Port of Richmond Commission - CA (http://www.ci.richmond.ca.us/index.asp?NID=102) |
| | Port of San Diego (http://www.portofsandiego.org) |
| | Port of San Francisco (http://www.sfport.com) |
| | Port of Stockton (http://www.portofstockton.com) |
| | Port of West Sacramento (http://www.portofwestsac.com) |
| Connecticut | |
| Environmental Agency | Connecticut Department of Environmental Protection (http://www.ct.gov/deep/site/default.asp) |
| Fire Marshal | Office of the State Fire Marshal - State of Connecticut (http://www.ct.gov/dcs/cwp/view.asp?a=4219&q=494802) |
| Pilot Association | Northeast Marine Pilots' Association (http://www.nemarinepilots.com/index.htm) |
| Natural Gas/Pipeline | Connecticut Department of Energy & Environmental Protection (http://www.ct.gov/deep/site/default.asp) |
| Delaware | |
| Environmental Agency | Delaware Dept. of Natural Resources and Environmental Control (http://www.dnrec.delaware.gov/Pages/Portal.aspx) |
| Fire Marshal | Office of the State Fire Marshal - State of Delaware (http://statefiremarshal.delaware.gov/) |
| Marine Exchange | Maritime Exchange for the Delaware River and Bay (http://www.maritimedelriv.com/) |
| Pilot Association | Pilots' Association for the Bay & River Delaware (http://www.delpilots.com/styles/blue/login.php) |
| Natural Gas/Pipeline | Delaware Public Service Commission (http://depssc.delaware.gov/naturalgas.shtml) |
| Port Authority | Port of Wilmington, Delaware - Diamond State Port Corporation (http://www.portofwilmington.com) |
| Florida | |
| Environmental Agency | Florida Department of Environmental Protection (http://www.dep.state.fl.us/) |
| Fire Marshal | Division of State Fire Marshal - State of Florida (http://www.myfloridacfo.com/division/sfm/#.Uw-g9uNdXdK) |
| Marine Exchange | Jacksonville Marine Transportation Exchange (http://jmtxweb.org/) |
| Pilot Associations | Biscayne Bay Pilots (http://www.bbpilots.com/) |
| | Canaveral Pilots' Association (http://www.canaveralpilots.com/) |
| | Cumberland Sound Pilots' Association |
| | Ft. Pierce Bar Pilots' Association |
| | Key West Bar Pilots |
| | Palm Beach Pilots (http://www.palmbeachpilots.com/) |
| | Port Everglades Pilots' Association (http://www.pepilots.com/) |
| | St. Andrew Bay Pilots' Association |
| | St. John's Bar Pilots' Association |
| Tampa Bay Pilots (http://www.tampabaypilots.com/) | |
| Natural Gas/Pipeline | Florida Public Service Commission - Safety (http://www.psc.state.fl.us/) |

| Type | Stakeholder (website) |
|------------------------|---|
| Port Authorities | Canaveral Port Authority (http://www.portcanaveral.org) |
| | Jacksonville Port Authority (JAXPORT) (http://www.jaxport.com) |
| | Panama City Port Authority (http://www.portpanamacityusa.com) |
| | Port Everglades (http://www.broward.org/port/) |
| | Port Manatee (http://www.portmanatee.com) |
| | Port of Palm Beach District (http://www.portofpalmbeach.com) |
| | Port of Pensacola (http://www.portofpensacola.com) |
| | Port Tampa Bay (http://www.porttb.com) |
| | Port Miami (http://www.miamidade.gov/portofmiami/) |
| Georgia | |
| Environmental Agencies | Georgia Department of Natural Resources (http://www.gadnr.org/) |
| | Georgia Environmental Protection Division (http://www.gaepd.org/) |
| Fire Marshal | Office of Insurance and Safety Fire Commission - State of Georgia (http://www.oci.ga.gov/FireMarshal/Home.aspx) |
| Pilot Associations | Brunswick Bar Pilots' Association (http://www.brunswickpilots.com/) |
| | Savannah Pilots' Association (http://www.savannahpilots.com/) |
| Natural Gas/Pipeline | Office of Pipeline Safety - Georgia Public Service Commission (http://www.psc.state.ga.us/facilitiesprotect/fp_pipesafe/fp_pipesafe.asp) |
| Port Authority | Georgia Ports Authority (http://www.gaports.com) |
| Great Lakes | |
| Pilot Associations | Lakes Pilots' Association, Inc. (http://www.lakespilots.com/) |
| | St. Lawrence Seaway Pilots' Association |
| | Western Great Lakes Pilots (http://www.wglpa.com/) |
| Guam | |
| Environmental Agency | Guam Environment Protection Agency (http://epa.guam.gov/) |
| Fire Marshal | Guam Fire Department (http://gfd.guam.gov/) |
| Port Authority | Port Authority of Guam (http://www.portguam.com) |
| Hawaii | |
| Environmental Agencies | Hawaii Department of Land and Natural Resources (http://www.state.hi.us/dlnr/docare/) |
| | Hawaii State Department of Health (http://health.hawaii.gov/) |
| Fire Marshal | State Fire Council - State of Hawaii (http://www1.honolulu.gov/hfd/statefirecouncil.htm) |
| Pilot Association | Hawaii Pilots' Association (http://www.hawaiipilots.net/) |
| Natural Gas/Pipeline | Federal Office of Pipeline Safety |
| Port Authority | Hawaii Department of Transportation (http://www.hawaii.gov/dot) |
| Illinois | |
| Environmental Agencies | Illinois Department of Natural Resources (http://www.dnr.illinois.gov/Pages/default.aspx) |
| | Illinois Environmental Protection Agency (http://www.epa.state.il.us/) |
| | Illinois Pollution Control Board (http://www.ipcb.state.il.us/) |
| Fire Marshal | Office of the Illinois State Fire Marshal (http://www.sfm.illinois.gov/) |
| Natural Gas/Pipeline | Illinois Commerce Commission - Pipeline Safety (http://www.icc.illinois.gov/pipelinesafety/) |
| Port Authority | Illinois Int'l Port District - The Port of Chicago (http://www.iipd.com) |

| Type | Stakeholder (website) |
|--|---|
| Indiana | |
| Environmental Agencies | Indiana Department of Environmental Management (http://www.in.gov/idem/) |
| | Indiana Department of Natural Resources (http://www.in.gov/dnr/) |
| Fire Marshal | Indiana State Fire Marshal (http://www.in.gov/dhs/3544.htm) |
| Natural Gas/Pipeline | Indiana Utility Regulatory Commission - Pipeline Safety Division (http://www.in.gov/iurc/2335.htm) |
| Port Authority | Ports of Indiana (http://www.portsofindiana.com) |
| Kentucky | |
| Environmental Agencies | Kentucky Department for Environmental Protection (http://dep.ky.gov/Pages/default.aspx) |
| | Kentucky Department for Natural Resources (http://dnr.ky.gov/Pages/default.aspx) |
| | Kentucky Environmental Quality Commission (http://eqc.ky.gov/Pages/default.aspx) |
| Fire Marshal | Kentucky State Fire Marshal (http://dhbc.ky.gov/sfm/Pages/default.aspx) |
| Natural Gas/Pipeline | Kentucky Public Service Commission - Gas Branch (https://psc.ky.gov/home/pipelinesafety) |
| Louisiana | |
| Environmental Agency | Louisiana Department of Environmental Quality (http://www.deq.louisiana.gov/portal/) |
| Fire Marshal | Office of the State Fire Marshal - State of Louisiana (http://sfm.dps.louisiana.gov/) |
| Pilot Associations | Associated Branch Pilots (http://www.barpilot.com/) |
| | Crescent River Port Pilots' Association (http://www.crppa.com/) |
| | Lake Charles Pilots (http://www.lakecharlespilots.com/) |
| | New Orleans Baton Rouge Steamship Pilots' Association (http://www.neworleansbatonrougepilots.com/) |
| Natural Gas/Pipeline | Louisiana Department of Natural Resources: Office of Conservation - Pipeline Division (http://dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=54) |
| Port Authorities | Caddo-Bossier Port Commission (http://www.portsb.com) |
| | Lake Charles Harbor and Terminal District (http://www.portlc.com) |
| | Plaquemines Port, Harbor and Terminal District (http://www.portofplaquemines.com/) |
| | Port Fourchon (http://www.portfourchon.com) |
| | Port of Greater Baton Rouge (http://www.portgbr.com) |
| | Port of Iberia District (http://www.portofiberia.com) |
| | Port of New Orleans (http://www.portno.com) |
| | Port of South Louisiana (http://www.portsl.com) |
| St. Bernard Port, Harbor & Terminal District (http://www.stbernardport.com/) | |
| Maine | |
| Environmental Agency | Maine Department of Environmental Protection (https://www.maine.gov/dep/) |
| Fire Marshal | Office of the State Fire Marshal - State of Maine (http://www.maine.gov/dps/fmo/index.htm) |
| Pilot Associations | Penobscot Bay & River Pilots Association (http://www.penbaypilots.com/) |
| | Portland Pilots, Inc. |
| Natural Gas/Pipeline | Maine Public Utilities Commission - Gas Safety (http://www.maine.gov/mpuc/natural_gas/natural_gas_safety/index.html) |
| Port Authority | Maine Port Authority (http://www.maineports.com) |

| Type | Stakeholder (website) |
|------------------------|---|
| Maryland | |
| Environmental Agencies | Maryland Department of Natural Resources (http://www.dnr.state.md.us/) |
| | Maryland Department of the Environment (http://www.mde.state.md.us/Pages/Home.aspx) |
| Fire Marshal | Department of Maryland State Police - State Fire Marshal (https://www.mdsp.org/Organization/StateFireMarshal.aspx) |
| Marine Exchange | Baltimore Maritime Exchange (http://www.balmx.org/) |
| Pilot Association | Association of Maryland Pilots (http://www.marylandpilots.com/) |
| Natural Gas/Pipeline | Public Service Commission of Maryland (http://webapp.psc.state.md.us/Intranet/home.cfm) |
| Port Authority | Maryland Port Administration (http://www.marylandports.com) |
| Massachusetts | |
| Environmental Agency | Massachusetts Department of Environmental Protection (http://www.mass.gov/eea/agencies/massdep/) |
| Fire Marshal | Office of the State Fire Marshal - State of Massachusetts (http://www.mass.gov/eopss/crime-prev-personal-sfty/fire/fire-marshal/) |
| Pilot Associations | Boston Pilots (http://www.bostonpilots.com/) |
| | Northeast Marine Pilots' Association (District 3) (http://www.nemarinepilots.com/index.htm) |
| Natural Gas/Pipeline | Massachusetts Department of Public Utilities - Pipeline Engineering & Safety Division (http://www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/agencies-and-divisions/dpu/dpu-divisions/pipeline-safety-division/) |
| Port Authority | Massachusetts Port Authority (http://www.massport.com/ports/) |
| | Port of New Bedford (http://www.portofnewbedford.org) |
| Michigan | |
| Environmental Agency | Michigan Department of Environmental Quality (http://www.michigan.gov/deq) |
| Fire Marshal | Fire Marshal - State of Michigan (http://www.michigan.gov/lara/0,4601,7-154-35299_42271_42321---,00.html) |
| Natural Gas/Pipeline | Michigan Public Service Commission – Gas Operations (https://www.michigan.gov/mpsc/0,4639,7-159-16385---,00.html) |
| Port Authorities | Detroit/Wayne County Port Authority (http://www.portdetroit.com) |
| | Port of Monroe (http://www.portofmonroe.com) |
| Minnesota | |
| Environmental Agencies | Minnesota Department of Natural Resources (http://www.dnr.state.mn.us/index.html) |
| | Minnesota Pollution Control Agency (http://www.pca.state.mn.us/) |
| Fire Marshal | Minnesota State Fire Marshal (https://dps.mn.gov/divisions/sfm/Pages/default.aspx) |
| Natural Gas/Pipeline | Minnesota Department of Public Safety - Office of Pipeline Safety (https://dps.mn.gov/divisions/ops/Pages/default.aspx) |
| Port Authority | Duluth Seaway Port Authority (http://www.duluthport.com) |

| Type | Stakeholder (website) |
|------------------------|--|
| Mississippi | |
| Environmental Agency | Mississippi Department of Environmental Quality (http://www.deq.state.ms.us/) |
| Fire Marshal | State Fire Marshal's Office - State of Mississippi (https://www.mid.ms.gov/state_fire_marshall/state_fire_marshall_office.aspx) |
| Pilot Association | Pascagoula Bar Pilots' Association (http://www.pascagoulabarpilots.com/) |
| Natural Gas/Pipeline | Mississippi Public Service Commission - Pipeline Safety Division (https://www.psc.state.ms.us/pipeline/pipeline.html) |
| Port Authorities | Mississippi State Port Authority at Gulfport (http://www.shipmspa.com) |
| | Port of Pascagoula (http://www.portofpascagoula.com) |
| Missouri | |
| Environmental Agencies | Missouri Department of Conservation (http://mdc.mo.gov/) |
| | Missouri Department of Natural Resources (https://www.dnr.mo.gov/) |
| Fire Marshal | Office of the State Fire Marshal - State of Missouri (http://www.dfs.dps.mo.gov/) |
| Natural Gas/Pipeline | Missouri Public Service Commission - Gas Safety/Engineering (http://psc.mo.gov/NaturalGas/) |
| New Hampshire | |
| Environmental Agency | New Hampshire Department of Environmental Services (http://des.nh.gov/) |
| Fire Marshal | Office of the State Fire Marshal - State of New Hampshire (https://www.nh.gov/safety/divisions/firesafety/) |
| Pilot Association | Portsmouth Pilots |
| Natural Gas/Pipeline | New Hampshire Public Utilities Commission - Safety Division (http://www.puc.state.nh.us/Safety/safety.htm) |
| Port Authority | Pease Development Authority Div. of Ports & Harbors (http://www.portofnh.org) |
| New Jersey | |
| Environmental Agency | New Jersey Department of Environmental Protection (http://www.state.nj.us/dep/) |
| Fire Marshal | Division of Fire Safety - State of New Jersey (http://www.state.nj.us/dca/divisions/dfs/) |
| Marine Exchange | Maritime Association of the Port of New York/New Jersey (http://www.nymaritime.org/) |
| Pilot Association | United New Jersey-Sandy Hook Pilots Benevolent Association (http://www.sandyhookpilots.com/) |
| Natural Gas/Pipeline | New Jersey Board of Public Utilities - Pipeline Safety (http://www.state.nj.us/bpu/about/divisions/reliability/) |
| Port Authorities | South Jersey Port Corporation (http://www.southjerseyport.com) |
| | The Port Authority of New York & New Jersey (http://www.panynj.gov) |

| Type | Stakeholder (website) |
|---|--|
| New York | |
| Environmental Agency | New York State Department of Environmental Conservation (http://www.dec.ny.gov/) |
| Fire Marshal | State Fire Administrator - State of New York (http://www.dhses.ny.gov/ofpc/) |
| Marine Exchange | Maritime Association of the Port of New York/New Jersey (http://www.nymaritime.org/) |
| Pilot Association | Hudson River Pilots' Association (http://www.hudsonriverpilots.com/) |
| | United New York-Sandy Hook Pilots Benevolent Association (http://www.sandyhookpilots.com/index.asp) |
| Natural Gas/Pipeline | New York State Department of Public Service - Safety Section (http://www.dps.ny.gov/) |
| Port Authorities | Albany Port District Commission (http://www.portofalbany.us/) |
| | New York City Economic Development Corp. (http://www.nycedc.com/Web) |
| | The Port Authority of New York & New Jersey (http://www.panynj.gov) |
| North Carolina | |
| Environmental Agencies | NC Department of Environment and Natural Resources (http://www.ncdenr.gov/web/guest) |
| | NC Division of Pollution Prevention and Environmental Assistance (http://www.p2pays.org/) |
| Fire Marshal | Office of the State Fire Marshal - State of North Carolina (http://www.ncdoi.com/osfm/) |
| Pilot Associations | Morehead City Pilots' Association, Inc. |
| | Wilmington-Cape Fear Pilots' Association (http://www.cfpilot.com/) |
| Natural Gas/Pipeline | North Carolina Utilities Commission - Pipeline Safety Section (http://www.ncuc.commerce.state.nc.us/industries/naturalgas/pipelinesafety.htm) |
| Port Authority | North Carolina State Ports Authority (http://www.ncports.com) |
| Northern Mariana Islands, Commonwealth of (CNMI) | |
| Environmental Agency | CNMI Division of Environmental Quality (http://www.deq.gov.mp/sec.asp?secID=18) |
| Fire Marshal | Commonwealth State Fire Division (http://www.dps.gov.mp/) |
| Ohio | |
| Environmental Agencies | Ohio Air Quality Development Authority (http://www.ohioairquality.org/) |
| | Ohio Department of Natural Resources (ODNR) (http://www2.ohiodnr.gov/) |
| | Ohio Environmental Protection Agency (http://www.epa.state.oh.us/) |
| Fire Marshal | Division of State Fire Marshal - State of Ohio (http://www.com.ohio.gov/fire/) |
| Natural Gas/Pipeline | Ohio Public Utilities Commission - Gas Pipeline Safety Section (http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/natural-gas-pipeline-safety-in-ohio/) |
| Port Authorities | Cleveland-Cuyahoga County Port Authority (http://www.portofcleveland.com) |
| | Toledo-Lucas County Port Authority (http://www.toledoseaport.org) |

| Type | Stakeholder (website) |
|------------------------|--|
| Oregon | |
| Environmental Agency | Oregon Department of Environmental Quality (http://www.oregon.gov/DEQ/Pages/index.aspx) |
| Fire Marshal | Oregon Office of State Fire Marshal (http://www.oregon.gov/OSP/SFM/Pages/index.aspx) |
| Marine Exchange | Merchants Exchange of Portland, Oregon (http://www.pdxmex.com/) |
| Pilot Associations | Columbia River Bar Pilots (http://www.columbiariverbarpilots.com/) |
| | Columbia River Pilots (http://www.colrip.com/) |
| | Coos Bay Pilots' Association |
| Natural Gas/Pipeline | Oregon Public Utility Commission - Pipeline Safety (http://www.puc.state.or.us/Pages/electric_gas/Natural_Gas.aspx) |
| Port Authority | Oregon International Port of Coos Bay (http://www.portofcoosbay.com) |
| | Port of Portland (http://www.portofportland.com) |
| Pennsylvania | |
| Environmental Agencies | Pennsylvania Department of Conservation and Natural Resources (http://www.dcnr.state.pa.us/) |
| | Pennsylvania Department of Environmental Protection (http://www.depweb.state.pa.us/) |
| Fire Marshal | Office of the State Fire Commissioner - State of Pennsylvania (http://www.osfc.state.pa.us/portal/server.pt/community/state_fire_commissioner_home/4462) |
| Marine Exchange | Maritime Exchange for the Delaware River and Bay (http://www.maritimedelriv.com/) |
| Pilot Association | Pilots' Association for the Bay & River Delaware (http://www.delpilots.com/) |
| Natural Gas/Pipeline | Pennsylvania Public Utility Commission - Gas Safety Division (http://www.puc.state.pa.us/consumer_info/transportation/pipeline_safety.aspx) |
| Port Authority | Philadelphia Regional Port Authority (http://www.philaport.com) |
| Puerto Rico | |
| Environmental Agencies | Autoridad de Desperdicios Sólidos (http://www.ads.pr.gov/) |
| | Departamento de Recursos Naturales y Ambientales (http://www.drna.gobierno.pr/) |
| Fire Marshal | Puerto Rico State Fire Marshal |
| Natural Gas/Pipeline | Puerto Rico Public Service Commission - Counsel on Legal and Federal Matters (Pipeline) |
| Rhode Island | |
| Environmental Agency | Rhode Island Department of Environmental Management (http://www.dem.ri.gov/) |
| Fire Marshal | Division of the State Fire Marshal - State of Rhode Island (http://www.fire-marshal.ri.gov/) |
| Pilot Association | Northeast Marine Pilots' Association (http://www.nemarinepilots.com/) |
| Natural Gas/Pipeline | Rhode Island Division of Public Utilities and Carriers (http://www.ripuc.org/) |
| Port Authority | Quonset Development Corp./Port of Davisville (http://www.quonset.com) |
| Saipan | |
| Port Authority | Port of Saipan-Commonwealth Ports Authority of CNMI (http://www.cpa.gov.mp) |

| Type | Stakeholder (website) |
|---|--|
| South Carolina | |
| Environmental Agencies | South Carolina Department of Health and Environmental Control (http://www.scdhec.gov/) |
| | South Carolina Department of Natural Resources (http://www.dnr.sc.gov/) |
| Fire Marshal | Office of the State Fire Marshal - State of South Carolina (http://scfiremarshal.llronline.com/) |
| Pilot Associations | Charleston Branch Pilots' Association (http://www.charlestonpilots.com/) |
| | Georgetown Bar & Harbor Pilots' Association |
| Natural Gas/Pipeline | Office of Regulatory Staff of South Carolina - Pipeline Safety (http://www.regulatorystaff.sc.gov/naturalgas/Pages/PipelineSafety.aspx) |
| Tennessee | |
| Environmental Agency | Tennessee Department of Environment and Conservation (http://www.tennessee.gov/environment/) |
| Fire Marshal | Fire Prevention Division - State of Tennessee (https://www.tn.gov/fire/) |
| Natural Gas/Pipeline | Tennessee Regulatory Authority - Gas Pipeline Safety Division (http://www.state.tn.us/tra/gassafety.shtml) |
| Texas | |
| Environmental Agency | Texas Commission on Environmental Quality (TCEQ) (http://www.tceq.state.tx.us/) |
| Fire Marshal | State Fire Marshal's Office - State of Texas (http://www.tdi.texas.gov/fire/Index.html) |
| Pilot Associations | Aransas-Corpus Christi Pilots (http://www.aransascorpuschristipilots.com/) |
| | Brazos Pilots' Association (http://www.brazospilots.com/) |
| | Brazos-Santiago Pilots |
| | Galveston-Texas City Pilots (http://galvestonpilots.com/galtexnew/) |
| | Houston Pilots (http://www.houston-pilots.com/) |
| | Matagorda Bay Pilots (http://www.matagordabaypilots.com/) |
| | Sabine Pilots (http://www.sabinepilots.com/) |
| Natural Gas/Pipeline | Railroad Commission of Texas - Safety Division (http://www.rrc.state.tx.us/safety/pipeline/index.php) |
| Port Authorities | Brownsville Navigation District - Port of Brownsville (http://www.portofbrownsville.com) |
| | Calhoun Port Authority (http://www.calhounport.com/) |
| | Port Corpus Christi (http://www.portofcorpuschristi.com) |
| | Port Freeport (http://www.portfreeport.com) |
| | Port of Beaumont (http://www.portofbeaumont.com) |
| | Port of Galveston (http://www.portofgalveston.com) |
| | Port of Harlingen Authority (http://www.portofharlingen.com) |
| | Port of Houston Authority (http://www.portofhouston.com) |
| | Port of Orange (http://www.portoforange.com) |
| Port of Port Arthur Navigation District (http://www.portofportarthur.com) | |
| Virgin Islands | |
| Port Authority | Virgin Islands Port Authority (http://www.viport.com) |
| Virginia | |
| Environmental Agency | Virginia Department of Environmental Quality (http://www.deq.virginia.gov/) |
| Fire Marshal | State Fire Marshal's Office - State of Virginia (http://vdfp.virginia.gov/state_fire_marshal/index.html) |
| Pilot Association | Virginia Pilot Association (http://www.vapilotassn.com/) |
| Natural Gas/Pipeline | Virginia State Corporation Commission - Division of Utility and Railroad Safety (http://www.scc.virginia.gov/urs/pipe/index.aspx) |
| Port Authority | Virginia Port Authority (http://www.portofvirginia.com) |

| Type | Stakeholder (website) |
|---|--|
| Washington | |
| Environmental Agencies | Washington Department of Transportation's Environmental Services (http://www.wsdot.wa.gov/localprograms/environment/) |
| | Washington State Department of Ecology (http://www.ecy.wa.gov/) |
| | Washington State Department of Natural Resources (http://www.dnr.wa.gov/Pages/default.aspx) |
| Fire Marshal | Office of the State Fire Marshal - State of Washington (http://www.wsp.wa.gov/fire/firemars.htm) |
| Marine Exchange | Marine Exchange of Puget Sound (http://marexps.com/) |
| Pilot Association | Puget Sound Pilots (http://www.pspilots.com/) |
| Natural Gas/Pipeline | Washington Utilities and Transportation Commission - Pipeline Safety (http://www.utc.wa.gov/publicSafety/pipelineSafety/Pages/default.aspx) |
| Port Authorities | Port of Bellingham (http://www.portofbellingham.com) |
| | Port of Everett (http://www.portofeverett.com) |
| | Port of Grays Harbor (http://www.portofgraysharbor.com) |
| | Port of Kalama (http://www.portofkalama.com) |
| | Port of Longview (http://www.portoflongview.com) |
| | Port of Port Angeles (http://www.portofpa.com) |
| | Port of Seattle (http://www.portseattle.org) |
| | Port of Tacoma (http://www.portoftacoma.com) |
| Port of Vancouver, U.S.A. (http://www.portvanusa.com) | |
| Wisconsin | |
| Environmental Agency | Wisconsin Department of Natural Resources (http://dnr.wi.gov/) |
| Fire Marshal | Office of the State Fire Marshal - State of Wisconsin (http://www.doj.state.wi.us/dci/state-fire-marshal) |
| Natural Gas/Pipeline | Wisconsin Public Service Commission: Natural Gas Division - Pipeline Safety (https://psc.wi.gov/utilityinfo/gas/pipelineSafety.htm) |
| Port Authorities | Brown County Port & Resource Recovery (http://www.portofgreenbay.com) |
| | Port of Milwaukee (http://www.milwaukee.gov/port) |
| Canada | |
| British Columbia | |
| Environmental Agency | British Columbia Ministry of Environment - Environmental Protection Division (http://www.env.gov.bc.ca/epd/) |
| Fire Marshal | British Columbia Office of the Fire Commissioner (http://www.embc.gov.bc.ca/ofc/) |
| Marine Exchange | Chamber of Shipping of British Columbia (http://www.cosbc.ca/) |
| Pilot Associations | British Columbia Coast Pilots (http://www.bccoastpilots.com/) |
| | Fraser River Pilots (http://members.shaw.ca/riverpilot35/pilot.htm) |
| Natural Gas/Pipeline | BC Oil and Gas Commission (https://www.bcogc.ca/about-us) |
| Port Authorities | Nanaimo Port Authority (http://www.npa.ca) |
| | Port Metro Vancouver (http://www.portmetrovancover.com) |
| | Prince Rupert Port Authority (http://www.rupertport.com) |

| Type | Stakeholder (website) |
|----------------------|--|
| New Brunswick | |
| Environmental Agency | New Brunswick Department of Environment and Local Government (http://www2.gnb.ca/content/gnb/en/departments/elg/environment.html) |
| Fire Marshal | New Brunswick Office of the Fire Marshal (http://www2.gnb.ca/content/gnb/en/departments/public_safety/safety_protection/content/police_fire_and_emergency/OfficeOfTheFireMarshal.html) |
| Natural Gas/Pipeline | New Brunswick Natural Gas (http://www.gnb.ca/0078/minerals/ONG_Menu-e.aspx) |
| Port Authorities | Belledune Port Authority (http://www.portofbelledune.ca) |
| | St. John's Port Authority (http://www.sjpa.com) |
| Newfoundland | |
| Environmental Agency | Newfoundland Labrador Department of Energy and Conservation (http://www.env.gov.nl.ca/env/) |
| Fire Marshal | Fire & Emergency Services NL - Fire Commissioner (http://www.gov.nl.ca/fes/) |
| Natural Gas/Pipeline | Newfoundland and Labrador Department of Natural Resources (http://www.nr.gov.nl.ca/nr/royalties/oil_gas.html) |
| Port Authority | Saint John Port Authority (http://www.sjport.com) |
| Nova Scotia | |
| Environmental Agency | Nova Scotia Environment (https://www.novascotia.ca/nse/) |
| Fire Marshal | Nova Scotia Office of the Fire Marshal (http://novascotia.ca/lae/publicsafety/ofm.asp) |
| Natural Gas/Pipeline | Nova Scotia Department of Energy (http://www.oilandgasinfo.ca/fracopedia/regulations-regulators/) |
| Port Authority | Halifax Port Authority (http://www.portofhalifax.ca) |
| Ontario | |
| Environmental Agency | Ontario Ministry of the Environment (http://www.ene.gov.on.ca/environment/en/) |
| Fire Marshal | Ontario Office of the Fire Marshal (http://www.mcscs.jus.gov.on.ca/english/firemarshal/ofmlanding/ofm_main.html) |
| Natural Gas/Pipeline | Ontario Ministry of Natural Resources (http://www.mnr.gov.on.ca/en/index.html) |
| Port Authorities | Hamilton Port Authority (http://www.hamiltonport.ca) |
| | Toronto Port Authority (http://www.torontoport.com) |
| | Windsor Port Authority (http://www.portwindsor.com) |
| Quebec | |
| Environmental Agency | Quebec Ministry of Sustainable Development, Environment and Parks (http://www.mddep.gouv.qc.ca/index_en.asp) |
| Fire Marshal | Quebec Ministry of Public Security (http://www.securitepublique.gouv.qc.ca/en/accueil/plan-du-site.html#c18888) |
| Pilot Associations | Corporation des Pilotes du Fleuve et de la Voie Maritime du Saint-Laurent (http://www.pilote-voie-maritime.ca/en/index.php) |
| | Corporation of Lower St Lawrence Pilots (http://www.pilotesbsl.qc.ca/en/index.php) |
| | Corporation of Mid St. Lawrence Pilots (http://www.cpslc.ca/en/home/) |
| Natural Gas/Pipeline | Québec Natural Resources (http://www.gouv.qc.ca/portail/quebec/pgs/commun/portrait/economie/ressources-naturelles/?lang=en) |
| Port Authorities | Montréal Port Authority (http://www.port-montreal.com) |
| | Québec Port Authority (http://www.portquebec.ca) |
| | Saguenay Port Authority (http://www.portsaguenay.ca/) |
| | Sept-Îles Port Authority (http://www.portsi.com) |
| | Trois-Rivières Port Authority (http://www.porttr.com/) |

Table A9 provides permitting agency information extracted from applications to FERC for LNG import/export facilities. Providing this information for LNG import/export terminals does not imply that bunkering facilities will have to meet the same requirements as those large, federally approved facilities. For example, coordination with historical preservation agencies and tribal organizations representing Native Americans is required for federally approved facilities as part of the environmental impact assessment process they undergo. Whether similar requirements (or recommendations) apply to smaller, bunkering facilities will depend on local regulations and conditions. By presenting all of the stakeholders, the tables provided here give a developer a starting point in identifying what coordination may be required.

Table A9. State and Local Agencies Involved and Permits Required for LNG Import/Export Terminals

| Agency | Permit/Approval |
|---|--|
| Project: Long Beach LNG Import Project (Long Beach, CA) | |
| State | |
| California Coastal Commission | Federal Coastal Zone Management (CZM) Consistency Determination |
| California Department of Transportation (CalTrans) | Encroachment and Crossing permits |
| California State Historic Preservation Office (SHPO) | Consultation |
| Native American Heritage Commission (NAHC) | Consultation |
| Regional Water Quality Control Board, Los Angeles Region (LAWQCB) | National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit, Hydrostatic Testing, Water Quality Certification, Dredging Spoils (disposal) |
| Local | |
| City of Long Beach Engineering/Public Works | Encroachment Permit |
| City of Los Angeles Engineering/Public Works Department | Encroachment Permit |
| County of Los Angeles Health Hazardous Materials Division | Hazardous Materials Business Plan |
| | Risk Management Plan (RMP) |
| Port of Long Beach | Harbor Development Permit |
| Port of Long Beach Development Services/Planning Department | Building Permit |
| Port of Los Angeles Engineering/Public Works Department | Encroachment Permit |
| South Coast Air Quality Management District (SCAQMD) | Permit to Construct/Permit to Operate |

| Agency | Permit/Approval |
|---|---|
| Project: Elba Liquefaction Project (Elba Island, GA) | |
| State | |
| Georgia Department of Natural Resources (GDNR), Wildlife Resources Division | Listed Species Consultation |
| GDNR | National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharges from Construction Activities (General Permit No. GAR 100002) |
| GDNR, Coastal Resources Division | Coastal Zone Management Act Coastal Zone Consistency |
| GDNR, Historic Preservation Division (HPD) | National Historic Preservation Act (NHPA), Section 106 Consultation |
| Georgia EPD | Clean Air Act, Prevention of Significant Deterioration (PSD) Review Title V |
| GDNR, Environmental Protection Division (GEPD) | Section 401 Water Quality Certification |
| South Carolina Department of Health and Environmental Conservation (SCDHEC) Ocean and Coastal Resource Management | South Carolina Coastal Zone Management Program |
| Tribal | |
| Catawba Indian Nation | NHPA, Section 106 Consultation |
| Cherokee of Georgia Tribal Council | NHPA, Section 106 Consultation |
| Creek Nation of Oklahoma | NHPA, Section 106 Consultation |
| Eastern Band of Cherokee Indians | NHPA, Section 106 Consultation |
| Georgia Tribe of Eastern Cherokee | NHPA, Section 106 Consultation |
| Lower Muskogee Creek Tribe | NHPA, Section 106 Consultation |
| Muskogee (Creek) Nation of Oklahoma | NHPA, Section 106 Consultation |
| Poarch Creek Indians | NHPA, Section 106 Consultation |
| Project: Sabine Pass Liquefaction Project (Sabine Pass, LA) | |
| State | |
| Louisiana Department of environmental Quality (LDEQ) | Air Permit |
| | Louisiana Pollutant Discharge Elimination System (LPDES) Construction Stormwater Permit |
| | Section 401-Clean Water Act, Water Quality Certification |
| Louisiana Department of Natural Resources, Coastal Management Division (LDNR) | Coastal Management Plan Consistency Determination |
| Louisiana Department of Wildlife and Fisheries (LDWF) | Sensitive Species/Habitats Consultation |
| Louisiana State Historic Preservation Office (SHPO) | Section 106 - National Historic Preservation Act |
| Local | |
| Cameron Parish | Building Permits |
| Cameron Parish Floodplain Administrator | Permit for Construction in a Zone "VE" or Variance as: functionally dependent use" |

| Agency | Permit/Approval |
|--|---|
| Project: Downeast LNG (Robbinston, ME) | |
| State | |
| Department of Marine Resources | Consultation/Review on Other Maine State Permits |
| Maine Atlantic Salmon Commission | Consultation/Review on Other Maine State Permits |
| Maine Department of Conservation | Consultation/Review on Other Maine State Permits. Maine Natural Areas Program |
| | Submerged Lands easement / lease |
| | Timber Harvest/Management Plans, Consultation/ Review on Other Maine State Permits, Maine Forest Service |
| Maine Department of Environmental Protection | 401 Water Quality Certificate |
| | Air Emission License (Minor Source), Bureau of Air Quality |
| | Bureau of Land & Water Quality and Bureau of Health |
| | Discharge License for Subsurface Waste Water Disposal System (septic tank leach field) |
| | Maine Construction General Permit (stormwater permit for construction), Bureau of Land & Water Quality |
| | Maine Mandatory Shoreline Zoning Act |
| | Multisector General Permit (industrial stormwater), Bureau of Land & Water Quality |
| | Natural Resources Protection Act Permit, Bureau of Land & Water Quality |
| | Site Location of Development Act (Site Law) Permit, Bureau of Land & Water Quality |
| | Solid Waste permit, Oil Terminal Chapter 600 and Review under Site Location Permit, Bureau of Remediation and Waste |
| | Sustainable Water Use, Bureau of Land & Water Quality |
| Waste Discharge Permit (MPDES industrial activity), Bureau of Land & Water Quality | |
| Maine Department of Inland Fisheries and Wildlife | Maine Endangered Species Act |
| Maine Historic Preservation Commission | Section 106 of the National Historic Preservation Act (NHPA) |
| Office of the State Fire Marshall | Blast Permit to Use |
| | Permit for Aboveground Storage of Flammable and Combustible Liquids |
| State Planning Office | Consistency with the Coastal Zone Management Act |
| Maine Department of Transportation | Railway Right-of-Way |
| | Site Access Driveway, Traffic Movement Permit, and Route 1 Improvements |
| | Utility Location Permit |

| Agency | Permit/Approval |
|--|---|
| Local | |
| City of Calais | Town Road Access - Pipeline ROW |
| Town of Baring Plantation | Town Road Access - Pipeline ROW |
| Town of Pembroke | Town Road Access - Pipeline ROW |
| Town of Perry | Town Road Access - Pipeline ROW |
| Town of Robbinston | Conditional Uses Permit |
| | Flood Hazard Development Permit |
| | Plumbing Permit |
| | Road Improvements |
| Town of Robbinston Planning Board | Maine Mandatory Shoreline Zoning Act (Delegated to Town via Town Zoning Regulation Adoption) |
| | Site Plan Approval |
| Tribal | |
| Aroostook Band of Micmacs | NHPA, Section 106 |
| Houlton Band of Maliseet Indians | NHPA, Section 106 |
| Passamaquoddy Tribe of Indians - Indian Township Reservation | NHPA, Section 106 |
| Passamaquoddy Tribe of Indians - Pleasant Point Reservation | NHPA, Section 106 |
| Penobscot Indian Nation | NHPA, Section 106 |
| Project: Dominion Cove Point LNG (Cove Point, MD) | |
| State | |
| Maryland Department of Natural Resources | Maryland Natural Heritage Program Consultation |
| Maryland Department of the Environment | 401 Water Quality Certification |
| | Air Permit |
| | Coastal Zone Management Consistency Certification |
| | General Discharge Permit for Hydrostatic Testing of Tanks, Pipes |
| | National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharge Associated with Construction Activities |
| | Nontidal Wetlands Permit |
| | NPDES Permit for Surface Water Discharge (Industrial) |
| Waterways Construction Permit | |
| Maryland Historical Trust | National Historic Preservation Act, Section 106 Consultation |
| Maryland Public Service Commission | Certificate of Public Convenience and Necessity |
| Maryland State Highway Administration | Commercial/Industrial/Residential Subdivision Access Permit |
| Virginia Department of Conservation and Recreation | Fish and Wildlife Coordination Act |
| | General Permit for Discharges of Stormwater for Construction Activities |
| | Virginia Stormwater Management Permit |
| Virginia Department of Environmental Quality | Air Permit |
| | Coastal Zone Management Consistency Certification |
| | Virginia Water Protection Permit |
| Virginia Department of Game and Inland Fisheries | Fish and Wildlife Coordination Act Review |
| Virginia Department of Historic Resources | National Historic Preservation Act, Section 106 Consultation |

| Agency | Permit/Approval |
|---|---|
| Project: Gulf LNG Liquefaction (Pascagoula, MS) | |
| State | |
| Mississippi Department of Archives and History | NHPA, Section 106 |
| Mississippi Department of Environmental Quality | Hydrostatic testing permit |
| | NPDES Construction Stormwater Permit |
| | NPDES Discharge Permit |
| | Section 401 Water Quality Certification |
| | State Operating Permit |
| Mississippi Department of Marine Resources | State Permit to Construct |
| | Coastal Zone Consistency Determination |
| Mississippi Department of Marine Resources | Joint Permit with COE |
| | State Dredge and Fill Permit |
| Mississippi Department of Transportation | Permit for Activities in State Road ROW |
| Mississippi Museum of Natural Science-Natural Heritage Program | Threatened and Endangered Species Consultation |
| Local | |
| Jackson County Planning Department | Building Permit |
| | Zoning Variance - Building Height |
| Project: Broadwater LNG Receiving Terminal (Long Island Sound, NY) | |
| State | |
| New York State Department of Environmental Conservation | Bulk Storage Permit |
| | Certificate to operate air contamination sources |
| | Section 401 - State certification of water quality |
| | State Pollution Discharge Elimination System (SPDES) permit - Section 401 State certification of water quality - Certificate to operate air contamination sources |
| New York State Department of Public Service | Requirement to certify that Broadwater will design, install, inspect, test, construct, operate, replace, and maintain a gas pipeline facility under the standards and plans for inspection and maintenance under section 60108 of 49 U.S.C. 60108 |
| New York State Department of State | Coastal Zone Consistency Determination |
| New York State Office of General Services | Submerged Lands easement / lease |
| New York State Parks recreation and Historic Preservation | Review of project effects on cultural resources |

| Agency | Permit/Approval |
|---|---|
| Project: Jordan Cove LNG Terminal Project (Coos Bay, OR) | |
| State | |
| Oregon Department of Energy (DOE) | Lead Coordinating State Agency for FERC Pre-filing Process |
| Oregon Department of Environmental Quality (DEQ) Air Quality Division | Air Permit |
| Oregon Department of Environmental Quality (DEQ) Water Quality Division | Construction Storm Water Discharge Permit |
| | Hydrostatic Test Water Disposal Permit |
| | Industrial Discharge Permit |
| | Operation Storm Water Discharge Permit |
| | Water Quality Certification |
| Oregon Department of Fish and Wildlife (DFW) | Threatened and Endangered Species Consultation |
| Oregon Department of Land Conservation and Development | Coastal Zone Management Compliance |
| Oregon Division of State Lands (DSL) | Joint Permit with the USACE |
| Oregon State Historic Preservation Office (SHPO) | NHPA, Section 106 |
| Local | |
| Coos County Planning Department | Building Permit |
| | Notice of Planning Directors Decision – Administrative Boundary Interpretation for 6-WD and Administrative Conditional Use Request for Fill in 6-WD |
| | Notice of Planning Directors Decision - Site Plan Review for Integrated Power Generation and Process Facility |
| | Notice of Planning Directors Decision – To Allow Fill in IND Zone, To Allow Fill in CBEMP 7-D Zone, Vegetative shoreline Stabilization in CBEMP 7-D |
| | Notice of Planning Directors Withdrawal and Reissuance of Administrative Conditional Use and Boundary Interpretation ABI for CBEMP/To allow Fill |

| Agency | Permit/Approval |
|---|---|
| Project: Golden Pass LNG Terminal (Sabine Pass, TX) | |
| State | |
| Texas Coastal Coordination Council | Coastal Zone Management Consistency Determination |
| Texas Commission on Environmental Quality | 401 Certification |
| | Air Quality Pre-Construction Permit |
| | Solid Waste Registration |
| | Temporary Water Use Permit (hydrostatic testing) |
| | Texas Pollutant Discharge Elimination (TPDES) Wastewater Discharge Permit |
| | Title V Operating Permit |
| Texas Department of Transportation | Road Opening / Access Permits |
| Texas Historic Commission - State Historic Preservation Officer | Section 106 Cultural Resources Clearance |
| Texas Parks and Wildlife Department | Listed Threatened and Endangered Species Clearance |
| Texas Railroad Commission | Hydrostatic Test Water Permit |
| | NPDES Stormwater Construction Permit (copy of USEPA application) |
| | Section 401 Water Quality Certification |
| Local | |
| City of Port Arthur | Development Permit |
| | Fire Marshall Permit |
| | Food Service Permit |
| | Specific Use Permit |
| Jefferson County | Building Permits |
| | Flood Plan Management Permit |

APPENDIX E – Port Stakeholder Contact Information

Table A10. Port Stakeholders for Medium to Very Large Ports

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|-------------------------------|------------------------------|---------------|--------------------------|--|---|---|--|--------------------------|-------------------------------------|----------------------------------|
| ALABAMA | | | | | | | | | | |
| Port of Mobile | Sector Mobile/ Mobile, AL | Gulf Coast | LARGE | City of Mobile Department of Safety and Performance 251-208-7892 | http://www.cityofmobile.org/departments_full.php?view=73index.php | n/a | Alabama State Port Authority 251-441-7200 | 251-441-5960 | 251-441-5999 | 251-441-5685 |
| ALASKA | | | | | | | | | | |
| Port of Anchorage/ Alaska LNG | Sector Anchorage/ Kenai AK | Pacific Coast | MEDIUM | Kenai Cook Inlet Harbor Safety Committee 907-234-7821 | http://www.cookinletriskassessment.com/ | http://www.muni.org/Departments/port/Documents/Executive%20Summary%20of%20Port%20Master%20Plan.pdf | Port of Anchorage Authority 907-343-6201 | 907-428-4144 | 907-428-4149 | 907-271-6771 |
| Port of Juneau | Sector Juneau/ Juneau, AK | Pacific Coast | SMALL (but LNG interest) | Alaska Association of Harbormasters and Port Administrators (AAHPA) 907-586-0397 | https://sites.google.com/site/greaterketchikanarealepc/home | n/a | Juneau City and Borough Docks and Harbors 907-586-0292 | 907-463-2980 | 907-463-2469 | 907-463-2701 |
| Port of Ketchikan | Sector Juneau/ Ketchikan, AK | Pacific Coast | MEDIUM | Greater Ketchikan Area Local Emergency Planning Committee (LEPC) 907-428-7024 | https://sites.google.com/site/greaterketchikanarealepc/home | n/a | City of Ketchikan Ports & Harbors 907-228-5632 | 907-463-2980 | 907-463-2469 | 907-463-2701 |
| Port of Valdez | MSU Valdez/ Valdez, AK | Pacific Coast | MEDIUM | Valdez Marine Safety Committee 907-834-5000 | http://www.pwsrcc.org/programs/maritime/valdez-marine-safety-committee/ | http://www.harboradvice.com/wp-content/uploads/2011/10/Valdez-Water-front-Master-Plan-Final.pdf | Port of Valdez 907-835-4564 | 907-835-7200 | 907-835-7223 | 907-835-7266 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|---|--|---------------|------------------|--|---|---|--|--------------------------|-------------------------------------|----------------------------------|
| CALIFORNIA | | | | | | | | | | |
| Port of Benicia | Sector San Francisco/ Benicia, CA | Pacific Coast | LARGE | Marine Exchange of the San Francisco Bay Region 415-441-5045 | http://www.sfmx.org/support/hsc/ | http://www.bcdc.ca.gov/laws_plans/plans/benicia_waterfront.shtml | Port of Benicia Authority 707-246-4138 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| Humboldt Bay Harbor | Sector San Francisco/ Eureka, CA | Pacific Coast | MEDIUM | Humboldt Bay Area Harbor Safety Committee 707-834-4938 | http://humboldt harborsafety.org/ | http://humboldt bay.org/sites/humboldt bay.org/files/documents/rev_plan_2003/ execsum.pdf | Humboldt Bay Harbor District 707-443-0801 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| Port Hueneme | Sector LA-LB/ Hueneme, CA | Pacific Coast | MEDIUM | Port Hueneme Harbor Safety Committee 805-488-3677 | http://www.portofhueneme.org/safety_and_security/harbor_safety_comm ittee.php | n/a | Port Hueneme Authority 805-488-3677 | 310-521-3601 | 310-521-3701 | 310-521-3848 |
| Port of Los Angeles/ Long Beach (LA-LB) | Sector LA-LB/ Los Angeles, CA | Pacific Coast | VERY LARGE | Marine Exchange Southern California- Harbor Safety Committee 562-435-5435 | http://www.mxsocial.org/hscmembers.aspx | http://www.portoflosangeles.org/planning/pmp/Amendment%2028.pdf | Port of Los Angeles 310-732-7678 | 310-521-3601 | 310-521-3701 | 310-521-3848 |
| Port of Oakland | Sector San Francisco/ Oakland, CA | Pacific Coast | VERY LARGE | Marine Exchange of San Francisco Bay Region 415-441-5045 | http://www.sfmx.org/support/hsc/ | n/a | Port of Oakland Authority 510-627-1210 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| Port of Richmond | Sector San Francisco/ Richmond, CA | Pacific Coast | LARGE | Marine Exchange of San Francisco Bay Region 415-441-5045 | http://www.sfmx.org/support/hsc/ | n/a | Port of Richmond Authority 510-215-4600 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| Port of Redwood | Sector San Francisco/ Redwood City, CA | Pacific Coast | MEDIUM | Marine Exchange of San Francisco Bay Region 415-441-5045 | http://www.sfmx.org/support/hsc/ | http://www.redwoodcityport.com/Reports/Tran Systems_Report _02_01_08.pdf | Port of Redwood Authority 650-306-4150 | 415-399-3547 | 510-816-1240 | 415-399-7327 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| Port of San Diego | Sector San Diego/ San Diego, CA | Pacific Coast | VERY LARGE | San Diego Harbor Safety Committee 619-686-6526 | https://www.portofsan-diego.org/maritime/safety-and-emergencies/1648-san-diego-harbor-safety-committee-get-involved.html | https://www.portofsandiego.org/environment/land-use/port-master-plan.html | San Diego Port Authority 619-686-6200 | 619-278-7005 | 619-278-7230 | 619-278-7086 |
| Port of San Francisco | Sector San Francisco/ San Francisco, CA | Pacific Coast | VERY LARGE | Marine Exchange of San Francisco Bay Region 415-441-5045 | http://www.sfmex.org/support/hsc/ | http://www.sfcountroller.org/Modules/ShowDocument.aspx?documentid=1390 | Port of San Francisco Authority 415-274-0400 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| Port of Stockton | Sector San Francisco/ Stockton, CA | Pacific Coast | MEDIUM | Marine Exchange of San Francisco Bay Region 415-441-5045 | http://www.sfmex.org/support/hsc/ | n/a | Port of Stockton Authority 415-982-5666 | 415-399-3547 | 510-816-1240 | 415-399-7327 |
| CONNECTICUT | | | | | | | | | | |
| Port of Bridgeport | Sector Long Island Sound/ Bridgeport, CT | Atlantic Coast | LARGE | Thames Maritime Coalition- SE CT Region 860-437-4659 | http://www.secater.org/Home/Programs/ThamesMaritimeCoalition/tabid/79/Default.aspx | https://www.bridgeportct.gov/files/storage/89013/89319/MasterPlanofConservationandDevelopment.pdf | Bridgeport Port Authority 203-576-7179 | 203-468-4401 | 203-468-4504 | 203-468-4429 |
| Port of New Haven | Sector Long Island Sound/ New Haven, CT | Atlantic Coast | LARGE | Thames Maritime Coalition- SE CT Region 860-437-4659 | http://www.secater.org/Home/Programs/ThamesMaritimeCoalition/tabid/79/Default.aspx | http://www.cityofnewhaven.com/uploads/LandUsePlan(1).pdf | New Haven Port Authority 203-946-6778 | 203-468-4401 | 203-468-4504 | 203-468-4429 |
| Port of New London | Sector Long Island Sound/ New London, CT | Atlantic Coast | MEDIUM | Thames Maritime Coalition- SE CT Region 860-437-4659 | http://www.secater.org/Home/Programs/ThamesMaritimeCoalition/tabid/79/Default.aspx | n/a | New London Port Authority 860-447-5201 | 203-468-4401 | 203-468-4504 | 203-468-4429 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| DELAWARE | | | | | | | | | | |
| Port of Delaware River and Bay | Sector Delaware Bay/ New Castle, DE | Atlantic Coast | MEDIUM | Mariners' Advisory Committee for the Bay & River Delaware 215-925-2615 | http://www.macedriv.org/ | n/a | Delaware River Port Authority 856-968-2277 | 215-271-4990 | 215-271-4850 | 215-271-4908 |
| FLORIDA | | | | | | | | | | |
| Port Canaveral | Sector Jacksonville/ Cape Canaveral, FL | Gulf Coast | MEDIUM | Jacksonville Marine Transportation Exchange 904-608-1122 | http://jmtxweb.org/Harbor_Safety.htm | http://www.portcanaveral.com/general/images/masterplan.pdf | Canaveral Port Authority 321-783-7831 | 904-564-7501 | 904-564-7549 | 904-564-7627 |
| Port Everglades | Sector Miami/ Fort Lauderdale, FL | Atlantic Coast | MEDIUM | Broward County Government 954-357-7362 | http://www.broward.org/Administrator/Pages/Default.aspx | http://www.broward.org/Port/MasterPlan/Documents/porteverglades_masterplan_execsummary_draft.pdf | Port Everglades Authority 954-523-3404 | 305-535-4304 | 305-535-8709 | 305-535-8757 |
| Port of Jacksonville | Sector Jacksonville/ Jacksonville, FL | East Coast | LARGE | Jacksonville Marine Transportation Exchange 904-608-1122 | http://jmtxweb.org/Harbor_Safety.htm | http://www.jaxport.com/strategicplan | Port of Jacksonville Authority 904-357-3036 | 904-564-7501 | 904-564-7549 | 904-564-7627 |
| Port of Miami | Sector Miami/ Miami, FL | Atlantic Coast | MEDIUM | Economic Development & Port Miami Committee 305-375-4835 | http://www.miamidade.gov/gov/action.asp?Action=Agendas&Oper=DisplayAgenda&Agenda=EDP&AgendaName=Economic+Dev elopment+%26 +Port+Miami+ Committee | http://www.miamidade.gov/portmiami/library/2035-master-plan/complete-master-plan.pdf | Port Miami Administration 305-371-7678 | 305-535-4304 | 305-535-8709 | 305-535-8757 |
| Port of Palm Beach | Sector Miami/ Riviera Beach, FL | Atlantic Coast | MEDIUM | Palm Beach Harbor Pilots Association 561-845-2628 | http://floridapilots.com/wordpress/?page_id=45 | http://www.portofpalmbeach.com/DocumentCenter/View/102 | Port of Palm Beach 561-383-4121 | 305-535-4304 | 305-535-8709 | 305-535-8757 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| Port of Pensacola | Sector Mobile/ Pensacola, FL | Gulf Coast | MEDIUM | Pensacola Bay Pilots Association 850-434-8163 | http://floridapilots.com/wordpress/?page_id=45 | http://portofpensacola.com/port-information/port-development-strategy/ | Port of Pensacola 850-436-5070 | 251-441-5960 | 251-441-5999 | 251-441-5685 |
| Port of St. Petersburg | Sector St. Petersburg/ St. Petersburg, FL | Gulf Coast | SMALL | Tampa Bay Harbor Safety and Security Committee 813-500-6681 | https://www.pellerclubtampa.com/index.asp?pageid=86 | n/a | Port St. Petersburg 727-893-7053 | 727-824-7574 | 813-228-2191 | 813-228-2191 (Ext. 8108) |
| Port of Tampa | Sector St. Petersburg/ Tampa, FL | Gulf Coast | LARGE | Tampa Bay Harbor Safety and Security Committee 813-500-6681 | https://www.pellerclubtampa.com/index.asp?pageid=86 | https://www.tampaport.com/userfiles/files/TPA%202008%20Master%20Plan.pdf | Port Tampa Bay 813-905-7678 | 727-824-7574 | 813-228-2191 | 813-228-2191 (Ext. 8108) |
| GEORGIA | | | | | | | | | | |
| Port of Savannah | Sector Charleston-MSU Savannah/ Savannah, GA | Atlantic Coast | MEDIUM | Savannah Maritime Association 912-233-0415 | http://www.savannahmaritime.com/ | n/a | Georgia Ports Authority 912-964-3874 | 843-724-7600 | 843-740-3180 | 912-652-4353 |
| GUAM (US Territory) | | | | | | | | | | |
| Port Guam | Sector Guam/ Santa Rita, Guam | Pacific Coast | MEDIUM | Port of Guam 671-477-5931 | http://www.portofguam.com/ | http://www.portofguam.com/docs/modernization/master-plan-2013.pdf | Port Guam Authority 671-477-5931 | 671-355-4900 | 671-355-4835 | 671-355-4892 |
| HAWAII | | | | | | | | | | |
| Honolulu Harbor, Oahu | Sector Honolulu/ Honolulu, HI | Pacific Coast | LARGE | Hawaii Ocean Safety Team (HOST) 808-224-5522 | http://hoshawaii.org/ | http://hidot.hawaii.gov/harbors/files/2013/01/Oahu-2020-Master-Plan.pdf | Hawaii Division of Harbors 808-587-1928 | 808-842-2640 | 808-522-8264 | 808-842-2694 |
| Pearl Harbor | Sector Honolulu/ Pearl Harbor, HI | Pacific Coast | VERY LARGE | Hawaii Ocean Safety Team (HOST) 808-224-5522 | http://hoshawaii.org/ | http://hidot.hawaii.gov/harbors/files/2013/01/Oahu-2020-Master-Plan.pdf | Commander, Joint Base Pearl Harbor-Hickam 808-473-1168 | 808-842-2640 | 808-522-8264 | 808-842-2694 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| ILLINOIS | | | | | | | | | | |
| Port of Chicago | Sector Lake Michigan-MSU Chicago/Chicago, IL | In-Land Rivers & Great Lakes | LARGE | Chicago Harbor Safety Committee 312-458-0810 | http://coastguardnews.com/chicago-harbor-safety-committee-convenes-elects-first-board-members/2013/07/15/ | n/a | Port of Chicago: Illinois International Port District iipd@iipd.com 773-646-4400 | 414-747-7100 | 414-747-7157 | MSU- Chicago 630-986-2157 |
| KENTUCKY | | | | | | | | | | |
| Paducah Riverport | MSU Paducah-Sector Ohio Valley/Paducah-McCracken County, KY | In-Land Rivers & Great Lakes | SMALL (but LNG interest) | Ohio River Valley Water Sanitation Commission (ORSANCO) 513-231-7719 | http://www.orsanco.org/about-us | n/a | Paducah-McCracken County Riverport Authority 270-442-9326 | 502-779-5411 | 502-779-5448 | MSU Paducah Commander 270-442-1621 MSU Paducah AMSC 270-442-1621 (Ext. 2111) |
| LOUISIANA | | | | | | | | | | |
| Port of Baton Rouge | Sector New Orleans-MSU Baton Rouge/Baton Rouge, LA | Gulf Coast | SMALL (but LNG interest) | Maritime Navigation Safety Association 225-562-5050 | http://www.mnsa.org/default.htm | n/a | Port of Baton Rouge 225-342-1660 | 504-365-2211 | 504-365-2291 | 225-298-5400 |
| Port of Cameron Parish | MSU Port Arthur-Lake Charles/Cameron Parish, LA | Gulf Coast | SMALL (but LNG interest) | Calcasieu River Waterway Harbor Safety Committee 337-480-6571 | http://onlinepubs.trb.org/onlinepubs/conferences/2012/HSCAMSC/Presentations/4-More.pdf | n/a | West Cameron Port and Harbor 337-775-5206 | 409-723-6515 | 409-723-6564 | 409-723-6523 |
| Port Fourchon | MSU Morgan City/Morgan City, LA | Gulf Coast | MEDIUM | Calcasieu River Waterway Harbor Safety Committee 337-480-6571 | http://onlinepubs.trb.org/onlinepubs/conferences/2012/HSCAMSC/Presentations/4-More.pdf | n/a | Port of Baton Rouge Authority 225-342-1660 | 985-380-5320 | 985-380-5352 | 985-380-5313 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| Port of Lake Charles | MSU Port Arthur- Lake Charles/ Lake Charles, LA | Gulf Coast | SMALL (but LNG interest) | Calcasieu River Waterway Harbor Safety Committee 337-480-6571 | http://onlinepubs.trb.org/onlinepubs/conferences/2012/HSCAMISC/Presentations/4-More.pdf | n/a | Port of Lake Charles Administration 337-493-3501 | 409-723-6515 | 409-723-6564 | 409-723-6523 |
| Port of New Orleans | Sector New Orleans/ New Orleans, LA | Gulf Coast | VERY LARGE | Greater New Orleans Port Safety Committee 504-833-4190 | http://gnopsc.org/ | http://senate.la.gov/Appel/topics/2010/2007ss/2020%20PoNO%20Master%20Plan.pdf | Port of New Orleans Authority 504-528-3262 | 504-365-2211 | 504-365-2291 | 504-589-6196 (ext. 240) |
| Port of South Louisiana | Sector New Orleans/ LaPlace, LA | Gulf Coast | SMALL (but LNG interest) | Greater New Orleans Port Safety Committee 504-833-4190 | http://gnopsc.org/ | n/a | Port of South Louisiana 985-652-9278 | 504-365-2211 | 504-365-2291 | 504-589-6196 (ext. 240) |
| MAINE | | | | | | | | | | |
| Bath Harbor | Sector Northern New England/ Bath, ME | Atlantic Coast | MEDIUM | Maine and New Hampshire Port Safety Forum 207-899-7123 | http://www.maineports.com/port-safety-forum | n/a | Maine Port Authority 207-624-3564 | 207-767-0320 | 207-767-0333 | 603-433-7324 (Ext. 265) |
| Port of Portland | Sector Northern New England/ Portland, ME | Atlantic Coast | MEDIUM | Maine and New Hampshire Port Safety Forum 207-899-7123 | http://www.maineports.com/port-safety-forum | n/a | Maine Port Authority 207-624-3564 | 207-767-0320 | 207-767-0333 | 603-433-7324 (Ext. 265) |
| MARYLAND | | | | | | | | | | |
| Port of Baltimore | Sector Baltimore/ Baltimore, MD | Atlantic Coast | VERY LARGE | Baltimore Harbor Safety & Coordination Committee mpasafepassage@marylandports.com 410-385-4438 | http://www.mpasafepassage.org/harbor.html | http://www.maryland.gov/media/client/planning/StrategicPlanFinal1208OS.pdf | Maryland Port Administration 410-385-4401 | 410-576-2561 | 410-576-2619 | 410-576-2568 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| MASSACHUSETTS | | | | | | | | | | |
| Port of New Bedford | Sector Southeastern New England/ New Bedford, MA | Atlantic Coast | MEDIUM | Harbor Development Commission (HDC) 508-961-3000 | http://www.portofnewbedford.org/hdc/about-the-hdc/ | http://www.portofnewbedford.org/documents/NB-FVN_Hbr_Plan_8-9-10.pdf | Port of New Bedford 508-961-3000 | 508-457-3219 | 401-435-2311 | 401-435-2380 |
| Gloucester Harbor | Sector Boston/ Gloucester, MA | Atlantic Coast | MEDIUM | Massachusetts Bay Harbor Safety Committee 781-337-6903 | http://www.massbaysafety.org/home-1.html | http://www.gloucester-ma.gov/DocumentCenter/View/2927 | Gloucester Harbor 978-282-3012 | 617-223-3005 | 617-223-3001 | 617-223-3008 |
| Port of Fall River | Sector Southeastern New England/ Fall River, MA | Atlantic Coast | MEDIUM | Harbor Development Commission (HDC) 508-961-3000 | http://www.portofnewbedford.org/hdc/about-the-hdc/ | n/a | Falls River Regulations Committee 508-678-3506 | 508-457-3219 | 401-435-2311 | 401-435-2380 |
| Port of Boston | Sector Boston/ Boston, MA | Atlantic Coast | VERY LARGE | Massachusetts Bay Harbor Safety Committee 781-337-6903 | http://www.massbaysafety.org/home-1.html | http://www.bostonredevelopmentauthority.org/planning/planning-initiatives/port-planning | Massachusetts Port Authority (MASSPORT) 617-946-4411 | 617-223-3005 | 617-223-3001 | 617-223-3008 |
| MICHIGAN | | | | | | | | | | |
| Port of Detroit | Sector Detroit/ Detroit, MI | In-Land Rivers & Great Lakes | MEDIUM | Detroit Seafarers International Union's Lakes & Inland Waters District 810-794-4988 | https://www.seafarers.org/index.asp | http://portdetroit.com/initiativespage1.php | Detroit/Wayne County Port Authority 313-259-5091 | 313-568-9552 | 313-568-9491 | 313-568-9497 |
| Muskegon Harbor | Sector Lake Michigan/ Muskegon, MI | In-Land Rivers & Great Lakes | MEDIUM | American Great Lakes Ports Association 202-625-2102 | http://www.greatlakesports.org | n/a | West Michigan Port Operators- Muskegon 216-536-2530 | 414-747-7100 | 414-747-7157 | 414-747-7194 |
| MISSISSIPPI | | | | | | | | | | |
| Port of Gulfport | Sector Mobile/ Gulfport, MS | Gulf Coast | SMALL (but LNG interest) | Mississippi Gulf Coast Safety Council 504-469-7787 | http://www.gulfcoastsafetycouncil.com/ | n/a | Port of Gulfport Authority 228-865-4300 | 251-441-5960 | 251-441-5999 | 251-441-5685 |

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| Port of Pascagoula | Sector Mobile/ Pascagoula, MS | Gulf Coast | MEDIUM | Mississippi Gulf Coast Safety Council 504-469-7787 | http://www.gulfcoastsafetycouncil.com/ | n/a | Port of Pascagoula Authority 228-762-4041 | 251-441-5960 | 251-441-5999 | 251-441-5685 |
| MISSOURI | | | | | | | | | | |
| Port of Metropolitan St. Louis | Sector Upper Mississippi River/ St. Louis, MO | In-Land Rivers & Great Lakes | SMALL (but LNG interest) | Missouri Department of Conservation 573-751-4115 | http://mdc.mo.gov/ | http://www.jeffersoncountyportauthority.com/Master_Plan_FINAL.pdf | St. Louis Port Authority Commission 314-657-3740 | 314-269-2500 | 314-269-2560 | 314-269-2595 |
| NEW HAMPSHIRE | | | | | | | | | | |
| Port of Portsmouth | Sector Northern New England/ Portsmouth, NH | Atlantic Coast | MEDIUM | Maine and New Hampshire Port Safety Forum 207-899-7123 | http://www.maineports.com/port-safety-forum | n/a | Port of New Hampshire Authority 603-436-8500 | 207-767-0320 | 207-767-0333 | 603-433-7324 |
| NEW JERSEY | | | | | | | | | | |
| Port of Bayonne | Sector New York/ Bayonne, NJ | Atlantic Coast | MEDIUM | Maritime Association of the Port of NY & NJ 212-425-5704 | http://www.panynj.gov/port/view-company-detail.cfm?cdetail=395 | n/a | Port Authority of New York and New Jersey 212 435-7000 | 718-354-4003 | 718-354-4075 | 718-354-4061 |
| Port of Camden | Sector Delaware Bay/ Camden, NJ | Atlantic Coast | MEDIUM | Mariners' Advisory Committee for the Bay & River Delaware 215-925-2615 | http://www.macedelriv.org/ | n/a | South Jersey Ports Authority 856-757-4927 | 215-271-4990 | 215-271-4850 | 215-271-4908 |
| Port Elizabeth | Sector New York/ Elizabeth, NJ | Atlantic Coast | LARGE | Maritime Association of the Port of NY & NJ 212-425-5704 | http://www.panynj.gov/port/view-company-detail.cfm?cdetail=395 | n/a | Port Authority of New York and New Jersey 212 435-7000 | 718-354-4003 | 718-354-4075 | 718-354-4061 |
| Port of Newark | Sector New York/ Newark, NJ | Atlantic Coast | VERY LARGE | Maritime Association of the Port of NY & NJ 212-425-5704 | http://www.panynj.gov/port/view-company-detail.cfm?cdetail=395 | n/a | Port Authority of New York and New Jersey 212 435-7000 | 718-354-4003 | 718-354-4075 | 718-354-4061 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| NEW YORK | | | | | | | | | | |
| Port of Albany | Sector New York/ Albany, NY | Atlantic Coast | MEDIUM | Maritime Association of the Port of NY & NJ 212-425-5704 | http://www.panynj.gov/port/view-company-detail.cfm?cdetail=395 | n/a | Port of Albany Authority 518-463-8763 | 718-354-4003 | 718-354-4075 | 718-354-4061 |
| Port of Buffalo | Sector Buffalo/ Buffalo, NY | In-Land Rivers & Great Lakes | MEDIUM | City of Buffalo- Administration, Finance and Urban Affairs 716-851-5922 | https://www.ci.buffalo.ny.us/Home/City_Deptments/Administration_Finance_Policy_and_Urban_Affairs | n/a | Port of Buffalo Authority 716-826-7310 | 716-843-9315 | 716-843-9324 | 716-843-9559 |
| Port of New York | Sector New York/ New York, NY | Atlantic Coast | VERY LARGE | Maritime Association of the Port of NY & NJ 212-425-5704 | http://www.panynj.gov/port/view-company-detail.cfm?cdetail=395 | http://www.panynj.gov/about/pdf/strategic-plan.pdf | Port Authority of New York & New Jersey 212 435-7000 | 718-354-4003 | 718-354-4075 | 718-354-4061 |
| NORTH CAROLINA | | | | | | | | | | |
| Port of Wilmington | Sector North Carolina/ Wilmington, NC | Atlantic Coast | MEDIUM | North Carolina Board of Transportation 910-239-5895 | http://www.ncdot.gov/about/board/bot/members/default.html | http://www.starnewsonline.com/assets/pdf/WM261401120.PDF | North Carolina Port Authority 910-763-162 | 910-772-2200 | 910-772-2225 | 252-247-4510 |
| OHIO | | | | | | | | | | |
| Port of Lorain | Sector Buffalo/ Lorain, OH | In-Land Rivers & Great Lakes | MEDIUM | Lorain County Port Authority 440-328-2324 | www.lcportauthority.org | n/a | Port of Lorain 440-204-2265 | 716-843-9315 | 716-843-9324 | 716-843-9559 |
| Port of Toledo | Sector Detroit- MSU Toledo/ Toledo, OH | In-Land Rivers & Great Lakes | MEDIUM | Toledo-Lucas County Port Authority 419-243-8251 | http://www.toledoportauthority.org/en-us/home.aspx | http://www.seaport.org/OverView/WelcomeToTheToledoSeaport.aspx | Port of Toledo 541-336-5207 | 313-568-9552 | 313-568-9491 | 419-418-6047 |
| OREGON | | | | | | | | | | |
| Port of Portland | Sector Columbia River/ Portland, OR | Pacific Coast | MEDIUM | Lower Columbia Region Harbor Safety Committee 503-234-5178 | http://www.lchrsc.org | http://www.portofportland.com/mtmp_t2_project.htm | Port of Portland Authority 503-415-6013 | 503-861-6200 | 503-861-6269 | 503-240-9313 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
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| Port of Coos Bay | Sector Columbia River/ Coos Bay, OR | Pacific Coast | MEDIUM | Lower Columbia Region Harbor Safety Committee 503-234-5178 | http://www.lcrhsc.org | portofcoosbay.com/crmplan.htm | Port of Coos Bay Authority 541-267-7678 | 503-861-6200 | 503-861-6269 | 503-240-9313 |
| PENNSYLVANIA | | | | | | | | | | |
| Port of Erie | Sector Buffalo/ Erie, PA | In-Land Rivers & Great Lakes | MEDIUM | Erie-Western Pennsylvania Ports 814-453-6721 (Ext. 227) | http://www.porterie.org | http://www.porterie.org/assets/021909_Erie%20Waterfront_Public%20Mtg%202.pdf | Port of Erie Authority 814-453-6721 (Ext. 224) | 716-843-9315 | 716-843-9324 | 716-843-9559 |
| Port of Pittsburgh | MSU Pittsburgh-Sector Ohio Valley/ Pittsburgh, PA | In-Land Rivers & Great Lakes | MEDIUM | Waterways Association of Pittsburgh 724-355-4101 | http://www.waterwaysassociation.org/about.htm | n/a | Port of Pittsburgh Commission 412-201.7335 | 502-779-5411 | 502-779-5448 | 502-779-5446 |
| Port of Philadelphia | Sector Delaware Bay/ Philadelphia, PA | Atlantic Coast | LARGE | Maritime Exchange for the Delaware River and Bay 215-925-2615 | http://www.maritimedeiv.com/ | n/a | Philadelphia Regional Port Authority 215-426-2600 | 215-271-4990 | 215-271-4850 | 215-271-4908 |
| PUERTO RICO | | | | | | | | | | |
| Port of San Juan | Sector San Juan/ San Juan, Puerto Rico (US Territory) | Gulf Coast | MEDIUM | Puerto Rico South Coast Harbor Safety & Security Committee (SCHS&SC) 787-899-2048 | http://cara.uprm.edu/?q=PRSCHS | n/a | Puerto Rico Port Authority 787-729-8715 | 787-729-6770 | 787-729-2378 | 787-289-2062 |
| RHODE ISLAND | | | | | | | | | | |
| ProvPort | Sector Southeastern New England/ Providence, RI | Atlantic Coast | MEDIUM | Providence Department of Public Safety 401-272-3121 | https://www.providenceri.com/public-safety | n/a | PROVPORT Authority 401-781-4717 | 508-457-3219 | 401-435-2311 | 401-435-2380 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|------------------------|---|----------------|------------------|--|---|---|--|--------------------------|-------------------------------------|----------------------------------|
| SOUTH CAROLINA | | | | | | | | | | |
| Port of Charleston | Sector Charleston/ Charleston, SC | Atlantic Coast | VERY LARGE | Maritime Association of the Port of Charleston 843-577-7678 | http://www.maritimesc.org/ | n/a | Port of Charleston Authority (South Carolina Ports) 843-577-8101 | 843-724-7600 | 843-740-3180 | 843-724-7762 |
| TEXAS | | | | | | | | | | |
| Port Arthur | MSU Port Arthur- Lake Charles/Port Arthur, TX | Gulf Coast | MEDIUM | Southeast Texas Waterways Advisory Council (SETWAC) 409-719-5086 | http://www.setwac.org/ | n/a | Port of Port Arthur Authority 409-983-2011 | 409-723-6515 | 409-723-6564 | 409-723-6523 |
| Port of Brownsville | Sector Corpus Christi/ Brownsville, TX | Gulf Coast | MEDIUM | Texas Marine Exchange/ Greater Houston Port Bureau 713-678-7711 | http://www.txgulf.org/index.php | n/a | Port of Brownsville Authority 956-831-4592 | 361-939-6227 | 361-888-3162 | 361-939-6393 |
| Point Comfort | Sector Corpus Christi/ Calhoun County, TX | Gulf Coast | MEDIUM | Texas Marine Exchange/ Greater Houston Port Bureau 713-678-7711 | http://www.txgulf.org/index.php | n/a | Point Comfort/ Calhoun Port Authority 361-987-2813 | 361-939-6227 | 361-888-3162 | 361-939-6393 |
| Port of Corpus Christi | Sector Corpus Christi/ Corpus Christi, TX | Gulf Coast | LARGE | Texas Marine Exchange/ Greater Houston Port Bureau 713-678-7711 | http://www.txgulf.org/index.php | n/a | Port of Corpus Christi Authority 361-882-5633 | 361-939-6227 | 361-888-3162 | 361-939-6393 |
| Port Freeport | Sector Houston- Galveston/ Freeport, TX | Gulf Coast | MEDIUM | Lone Star Harbor Safety Committee 713-670-2589 | http://www.lonestarhsc.org/index.php | http://www.portfreeport.com/about_files/StateofthePort4.23.13.pdf | Port Freeport Authority 979-233-2667 | 281-464-4801 | 281-464-4747 | 713-671-5118 |
| Port of Galveston | Sector Houston- Galveston/ Houston, TX | Gulf Coast | MEDIUM | Lone Star Harbor Safety Committee 713-670-2589 | http://www.lonestarhsc.org/index.php | n/a | Port of Galveston Authority 409-766-6112 | 281-464-4801 | 281-464-4747 | 713-671-5118 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|----------------------|---|----------------|-------------------------------|---|---|---|--|--------------------------|-------------------------------------|----------------------------------|
| Port of Houston | Sector Houston-Galveston/Houston, TX | Gulf Coast | VERY LARGE | Lone Star Harbor Safety Committee 713-670-2589 | http://www.lonestarhsc.org/index.php | http://www.portofhouston.com/static/gen/inside-the-port/Strategic%20Planning/2013_Strategic_Initiatives.pdf | Port of Houston Authority 713-670-2480 | 281-464-4801 | 281-464-4747 | 713-671-5118 |
| Jacintoport | Sector Houston-Galveston/Houston, TX | Gulf Coast | MEDIUM | Lone Star Harbor Safety Committee 713-670-2589 | http://www.lonestarhsc.org/index.php | n/a | JacintoPort Authority 713-821-7339 | 281-464-4801 | 281-464-4747 | 713-671-5118 |
| Port of Sabine Pass | MSU Port Arthur-Lake Charles/Sabine, TX | Gulf Coast | VERY SMALL (but LNG interest) | Southeast Texas Waterways Advisory Council (SETWAC) 409-719-5086 | http://www.setwac.org/ | n/a | Sabine Pass Port Authority 409-971-2411 | 409-723-6515 | 409-723-6564 | 409-723-6523 |
| VIRGINIA | | | | | | | | | | |
| Port of Newport News | Sector Hampton Roads/Newport News, VA | Atlantic Coast | LARGE | Virginia Maritime Association-Port of Hampton Roads 757-622-2639 | http://www.vamaritime.com/ | http://www.portofvirginia.com/pdfs/vpamasterplan052113.pdf | The Port of Virginia 757-683-2137 | 757-483-8565 | 757-668-5536 | 757-295-2030 |
| Port of Norfolk | Sector Hampton Roads/Norfolk, VA | Atlantic Coast | VERY LARGE | Virginia Maritime Association-Port of Hampton Roads 757-622-2639 2662 | http://www.vamaritime.com/ | http://www.portofvirginia.com/pdfs/about/vpamasterplan052113.pdf | The Port of Virginia 757-683-2137 | 757-483-8565 | 757-668-5536 | 757-295-2030 |
| Port of Portsmouth | Sector Hampton Roads/Portsmouth, VA | Atlantic Coast | LARGE | Virginia Maritime Association-Port of Hampton Roads 757-622-2639 | http://www.vamaritime.com/ | http://www.portofvirginia.com/pdfs/about/vpamasterplan052113.pdf | The Port of Virginia 757-683-2137 | 757-483-8565 | 757-668-5536 | 757-295-2030 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|--------------------|-------------------------------------|------------------------------|------------------|--|---|---|---|--------------------------|-------------------------------------|----------------------------------|
| WASHINGTON | | | | | | | | | | |
| Port of Bellingham | Sector Puget Sound/ Bellingham, WA | Pacific Coast | MEDIUM | Marine Exchange of Puget Sound 206-443-3830 | http://pshsc.org/ | http://www.cob.org/documents/planning/enviro nment/smp/2013-smp-final.pdf | Port of Bellingham Authority 360-676-2500 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| Port of Bremerton | Sector Puget Sound/ Bremerton, WA | Pacific Coast | LARGE | Marine Exchange of Puget Sound 206-443-3830 | http://pshsc.org/ | n/a | Port of Bremerton Authority 360-813-0821 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| Port of Everett | Sector Puget Sound/ Everett, WA | Pacific Coast | MEDIUM | Marine Exchange of Puget Sound 206-443-3830 | http://pshsc.org/ | http://www.portofeverett.com/your-completed-projects/completed-projects-2012/marine-terminals-master-plan | Port of Everett Authority 425-259-3164 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| Port of Olympia | Sector Puget Sound/ Olympia, WA | Pacific Coast | MEDIUM | Marine Exchange of Puget Sound 206-443-3830 | http://pshsc.org/ | http://www.portolympia.com/DocumentCenter/Home/View/545 | Port of Olympia Authority 360-528-8001 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| Port of Seattle | Sector Puget Sound/ Seattle, WA | Pacific Coast | VERY LARGE | Marine Exchange of Puget Sound 206-443-3830 | http://www.pshsc.org/ | http://www.portseattle.org/about/commission/pages/century-agenda.aspx | Port of Seattle Authority 206-787-3000 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| Port of Tacoma | Sector Puget Sound/ Tacoma, WA | Pacific Coast | VERY LARGE | Marine Exchange of Puget Sound 206-443-3830 | http://pshsc.org/ | http://portoftacoma.com/sites/default/files/StrategicPlan Brochure.pdf | Port of Tacoma Authority 253-383-5841 | 206-217-6205 | 206-217-6235 | 206-217-6694 |
| WISCONSIN | | | | | | | | | | |
| Port of Milwaukee | Sector Lake Michigan/ Milwaukee, WI | In-Land Rivers & Great Lakes | MEDIUM | Milwaukee City Council- Public Works and Transportation 414-286-2221 | http://city.milwaukee.gov/Council Committees/ Public-Works. htm#VJBwetL F87M | n/a | Port of Milwaukee 414-286-8130 | 414-747-7100 | 414-747-7157 | 414-747-7194 |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|-------------------------|----------------------------------|---------------|------------------|--|---|-----------------------------------|---|--------------------------|-------------------------------------|----------------------------------|
| CANADA | | | | | | | | | | |
| BRITISH COLUMBIA | | | | | | | | | | |
| Port of Kitimat | Kitimat, British Columbia | Pacific Coast | SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Port of Kitimat 1-250-632-8921 (Canada) | n/a | n/a | n/a |
| Port of Prince Rupert | Prince Rupert, British Columbia | Pacific Coast | MEDIUM | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Port of Prince Rupert Authority 1-250-627-8899(Canada) | n/a | n/a | n/a |
| Port of Squamish | Squamish, British Columbia | Pacific Coast | SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Port of Squamish Terminals 1-604-892 5623(Canada) | n/a | n/a | n/a |
| Port of Kitsault | Kitsault, British Columbia | Pacific Coast | VERY SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Town of Kitsault 1-613-591-2100 (Canada) | n/a | n/a | n/a |
| Port of Vancouver | Vancouver, British Columbia | Pacific Coast | LARGE | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Port of Vancouver Authority 1-604-665-9125 (Canada) | n/a | n/a | n/a |
| Campbell River Harbor | Campbell River, British Columbia | Pacific Coast | SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201)(Canada) | http://www.acpa-ports.net/ | n/a | Campbell River Harbour Authority 1-250-287-7931 (Canada) | n/a | n/a | n/a |

| Port | USCG Sector or Unit/ City | Region | Size Designation | Points of Contact (POC) | Website | Master Plan or Strategic Guidance | Port Authority POC | USCG Captain of the Port | USCG Chief of Prevention Department | Area Maritime Security Committee |
|----------------------|---------------------------|------------------------------------|------------------|---|---|-----------------------------------|---|--------------------------|-------------------------------------|----------------------------------|
| NEW BRUNSWICK | | | | | | | | | | |
| Port of St. John | St. John, New Brunswick | Atlantic Coast | MEDIUM | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201) (Canada) | http://www.acpa-ports.net/ | n/a | Port of Saint John Authority 1-506-636-4869 (Canada) | n/a | n/a | n/a |
| NOVA SCOTIA | | | | | | | | | | |
| Port of Goldboro | Goldboro, Nova Scotia | Atlantic Coast | VERY SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201) (Canada) | http://www.acpa-ports.net/ | n/a | Municipality of Guysborough, Nova Scotia 1-902-533-3705, Ext. 228 (Canada) | n/a | n/a | n/a |
| ONTARIO | | | | | | | | | | |
| Port of Sarnia | Sarnia, Ontario | Central Water-ways and Great Lakes | SMALL | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201) (Canada) | http://www.acpa-ports.net/ | n/a | Sarnia Harbor and City of Sarnia 1-519-332-0330, Ext. 3343 (Canada) | n/a | n/a | n/a |
| QUEBEC | | | | | | | | | | |
| Port of Montreal | Montreal, Quebec | Central Water-ways and Great Lakes | LARGE | Association of Canadian Port Authorities 1-613-232-2036 (Ext. 201) (Canada) | http://www.acpa-ports.net/ | n/a | Montreal Port Authority 1-514-283-7026 (Canada) | n/a | n/a | n/a |

Table A11 Primary Points of Contact for Small US Ports

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|----------------------------|------------------|------------|-------------------------------|--|
| ALABAMA | | | | |
| Port of Columbia | Columbia, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Eufaula | Eufaula, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Phoenix City | Phoenix City, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Clairborne | Clairborne, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Montgomery | Montgomery, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Selma | Selma, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Demopolis | Demopolis, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Port of Epes | Epes, AL | Gulf Coast | VERY SMALL | Industrial Board of Sumter County 877-588-7137 |
| Crossroads of America Port | Boligee, AL | Gulf Coast | VERY SMALL | Greene County Economic and Industrial Board 205-372-9769 |
| Port of Tuscaloosa | Tuscaloosa, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |
| Bevill-Hook Port | Aliceville, AL | Gulf Coast | VERY SMALL | Aliceville Industrial Development Board 205-373-6611 |
| Pickens County Port | Pickensville, AL | Gulf Coast | VERY SMALL | Pickens County Port Authority 205-373-8852 |
| Port of Guntersville | Guntersville, AL | Gulf Coast | SMALL | American Commercial Barge Line 256-582-3297 |
| Port of Decatur | Decatur, AL | Gulf Coast | SMALL | Decatur Transit, Inc. info@decatustransit.com 256-353-9601 |
| Port of Florence | Florence, AL | Gulf Coast | VERY SMALL | Florence - Lauderdale County Port Authority info@portofflorence.org 256-767-5388 |
| Port of Bridgeport | Bridgeport, AL | Gulf Coast | VERY SMALL | Alabama State Port Authority 334-441-7003 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|----------------------|-----------------|---------------|-------------------------------|---|
| ALASKA | | | | |
| Port of Adak | Adak Island, AK | Pacific Coast | VERY SMALL | Aleut Enterprise Corporation adak@adakisland.com 907-592-2325 |
| Port of Dutch Harbor | Unalaska, AK | Pacific Coast | SMALL | Port of Dutch Harbor prtldutch@arctic.net 907-581-1254 |
| Port of St. George | St. George, AK | Pacific Coast | SMALL | St. George Port Authority 907-859-2263 |
| Port of St. Paul | St. Paul, AK | Pacific Coast | SMALL | St. Paul Port Authority 907-546-3140 |
| Port of King Cove | King Cove, AK | Pacific Coast | SMALL | City of King Cove kcharbor@arctic.net 907-497-2237 |
| Port of Cold Bay | Cold Bay, AK | Pacific Coast | VERY SMALL | City of Cold Bay 907-532-2684 |
| Port of Sand Point | Sand Point, AK | Pacific Coast | SMALL | City of Sand Point 907-383-2696 |
| Port of Bristol Bay | Naknek, AK | Pacific Coast | SMALL | Bristol Bay Borough Port Authority portbb@bristolbay.com 907-246-6168 |
| Port of Dillingham | Dillingham, AK | Pacific Coast | SMALL | Dillingham Harbor Department 907-842-1069 |
| Port of Bethel | Bethel, AK | Pacific Coast | SMALL | City of Bethel Harbormaster 907-543-2310 |
| St. Michael Harbor | St. Michael, AK | Pacific Coast | VERY SMALL | n/a |
| Port of Nome | Nome, AK | Pacific Coast | SMALL | Port of Nome port@ci.nome.ak.us 907-443-6619 |
| Port of Kotzebue | Kotzebue, AK | Pacific Coast | SMALL | City of Kotzebue Harbormaster 907-442-3401 |
| Red Dog Harbor | Red Dog, AK | Pacific Coast | VERY SMALL | Red Dog Harbor 514-878-6500 |
| Port of Nenana | Nenana, AK | Pacific Coast | VERY SMALL | Port of Nenana Authority 907-832-5505 |
| Port of Kodiak | Kodiak, AK | Pacific Coast | SMALL | City of Kodiak Harbormaster harbormaster@city.kodiak.ak.us 907-486-8080 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-----------------------------|---------------------|---------------|-------------------------------|---|
| Port of Ouzinkie | Ouzinkie, AK | Pacific Coast | SMALL | Port of Ouzinkie cityofouzinkie@starband.net 907-680-2209 |
| Port of Seldovia | Seldovia, AK | Pacific Coast | SMALL | Seldovia Port Authority info@cityofseidovia.com 907-234-7886 |
| Port of Homer | Homer, AK | Pacific Coast | SMALL | City of Homer Port Authority 907-235-3160 |
| Drift River Marine Terminal | Drift River, AK | Pacific Coast | VERY SMALL | Cook Inlet Pipeline Company 907-243-1166 |
| Port of Nikiski | Nikiski, AK | Pacific Coast | SMALL | Port of Nikiski Authority 907-561-5111 |
| Port of Kenai | Kenai, AK | Pacific Coast | SMALL | Port of Kenai Authority 907-283-7535 |
| Seward Harbor | Seward, AK | Pacific Coast | SMALL | City of Seward Harbormaster harbormaster@cityofseward.net 907-224-3138 |
| Port of Whittier | Whittier, AK | Pacific Coast | SMALL | City of Whittier Harbormaster harbormaster@whittieralaska.gov 907-472-2327 (Ext. 115) |
| Port of Knik | Knik, AK | Pacific Coast | VERY SMALL | Knik Port Authority 907- 277-7611 |
| Port of Cordova | Cordova, AK | Pacific Coast | SMALL | Cordova Harbor and Port Department harbor@cityofcordova.net 907-424-6400 |
| Port of Yakutat | Yakutat, AK | Pacific Coast | VERY SMALL | City of Yakutat Port Authority 907-784-3323 |
| Port of Skagway | Skagway, AK | Pacific Coast | SMALL | City of Skagway Port Authority 907-983-2628 |
| Port of Haines | Haines Borough, AK | Pacific Coast | SMALL | Haines Ports and Harbors 907-766-2448 |
| Port of Excursion Inlet | Excursion Inlet, AK | Pacific Coast | SMALL | n/a |
| Gustavus Harbor | Gustavus, AK | Pacific Coast | VERY SMALL | Gustavus Harbormaster info@gustavusak.com 907-697-2454 |
| Port of Hoonah | Hoonah, AK | Pacific Coast | SMALL | City of Hoonah Harbormaster hoonah_harbor@hoonah.net 907-945-3670 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-------------------------|---------------------|---------------|-------------------------------|--|
| Port of Pelican | Pelican, AK | Pacific Coast | SMALL | City of Pelican Harbormaster 907-735-2202 |
| Port of Tenakee Springs | Tenakee Springs, AK | Pacific Coast | SMALL | n/a |
| Port of Angoon | Angoon, AK | Pacific Coast | SMALL | Angoon Port Authority 907-788-3653 |
| Port of Sitka | Sitka, AK | Pacific Coast | SMALL | City of Sitka Port Authority 907-747-3439 |
| Port of Kake | Kake, AK | Pacific Coast | SMALL | City of Kake Port Authority 907-785-3804 |
| Port of Petersburg | Petersburg, AK | Pacific Coast | SMALL | City of Petersburg Harbormaster harbor_master@ci.petersburg.ak.us 907-772-4688 |
| Port of Wrangell | Wrangell, AK | Pacific Coast | SMALL | Wrangell Harbor Department harbor@wrangell.com 907-874-3736 |
| Port of Thorne Bay | Thorne Bay, AK | Pacific Coast | SMALL | City of Thorne Bay Port Authority 907-755-2260 |
| Kasaan Harbor | Kasaan, AK | Pacific Coast | VERY SMALL | n/a |
| Hollis Harbor | Hollis, AK | Pacific Coast | VERY SMALL | Hollis Harbormaster 907-755-2260 |
| Port of Klawok | Klawok, AK | Pacific Coast | SMALL | City of Klawock Harbormaster 907-755-2260 |
| Port of Craig | Craig, AK | Pacific Coast | SMALL | City of Craig craighm@aptalaska.net 907-826-3404 |
| Port of Hydaburg | Hydaburg, AK | Pacific Coast | SMALL | Hydaburg Port Authority 907-285-3758 |
| Loring Harbor | Loring, AK | Pacific Coast | VERY SMALL | n/a |
| Knudson Cove Harbor | Knudson Cove, AK | Pacific Coast | VERY SMALL | Knudson Cove Harbormaster 907-247-8500 |
| Ward Cove Harbor | Ward Cove, AK | Pacific Coast | SMALL | n/a |
| Port of Saxman | Saxman, AK | Pacific Coast | SMALL | Saxman Port Authority 907-225-9040 |
| Port of Metlakatla | Metlakatla, AK | Pacific Coast | SMALL | Metlakatla Port Authority 907-886-4646 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-------------------------|---------------------|------------------------------|-------------------------------|---|
| ARKANSAS | | | | |
| Port of Little Rock | Little Rock, AR | In-Land Rivers & Great Lakes | SMALL | Little Rock Port Authority lport@dina.org 501-490-1468 |
| Port of Fort Smith | Fort Smith, AR | In-Land Rivers & Great Lakes | VERY SMALL | Fort Smith Port Authority 479-784-2201 |
| CALIFORNIA | | | | |
| Crescent City Harbor | Crescent City, CA | Pacific Coast | SMALL | Crescent City Harbor District 707-464-6174 |
| Trinidad Harbor | Trinidad, CA | Pacific Coast | VERY SMALL | Trinidad Harbormaster 707-677-0223 |
| Noyo Harbor | Fort Bragg, CA | Pacific Coast | VERY SMALL | Noyo Harbor District 707-964-4719 |
| Point Arena Cove | Point Arena, CA | Pacific Coast | VERY SMALL | Point Arena Cove 707-882-2100 |
| Porto Bodega Marina | Bodega Bay, CA | Pacific Coast | SMALL | Porto Bodega Marina Harbormaster info@portobodega.com 707-875-2354 |
| Port of West Sacramento | West Sacramento, CA | Pacific Coast | SMALL | Sacramento-Yolo Port Commission 916-371-8000 |
| Rio Vista Harbor | Rio Vista, CA | Pacific Coast | VERY SMALL | Rio Vista Harbormaster 707-374-6451 |
| San Joaquin Harbor | Antioch, CA | Pacific Coast | SMALL | n/a |
| Port of Pittsburg | Pittsburg, CA | Pacific Coast | SMALL | n/a |
| Port of Avon | Avon, CA | Pacific Coast | SMALL | n/a |
| Port of Crockett | Crockett, CA | Pacific Coast | SMALL | n/a |
| Pillar Point Harbor | Half Moon Bay, CA | Pacific Coast | SMALL | San Mateo County Harbor District harbormaster@smharbor.com 650-726-5727 |
| Santa Cruz Harbor | Santa Cruz, CA | Pacific Coast | SMALL | Santa Cruz Port District scpd@santacruzharbor.org 831-475-6161 |
| Moss Landing Harbor | Moss Landing, CA | Pacific Coast | SMALL | Moss Landing Harbor District 831-633-2461 |
| Monterey Harbor | Monterey, CA | Pacific Coast | SMALL | City of Monterey Harbormaster 831-646-3950 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|----------------------------------|-------------------|----------------|-------------------------------|--|
| Morro Bay Harbor | Morro Bay, CA | Pacific Coast | SMALL | City of Morro Bay, Harbor Department 805 772-6254 |
| Port San Luis Harbor | Port San Luis, CA | Pacific Coast | SMALL | Port San Luis Harbor District admin@portsanluis.com 805-595-5400 |
| Santa Barbara Harbor | Santa Barbara, CA | Pacific Coast | SMALL | City of Santa Barbara 805-564-5520 |
| El Segundo Offshore Oil Terminal | El Segundo, CA | Pacific Coast | VERY SMALL | Chevron Shipping Company 310-241-1389 |
| Two Harbors | Two Harbors, CA | Pacific Coast | SMALL | Two Harbors Enterprises 310-510-4253 |
| Avalon Harbor | Avalon, CA | Pacific Coast | SMALL | City of Avalon, Harbor Department harborpatrol@cityofavalon.com 310-510-0535 |
| Dana Point Harbor | Dana Point, CA | Pacific Coast | SMALL | City of Dana Point info@danapointharbor.com 949-923-2255 |
| Oceanside Harbor | Oceanside, CA | Pacific Coast | SMALL | City of Oceanside harborstaff@ci.oceanside.ca.us 760-435-4000 |
| CONNECTICUT | | | | |
| Norwich Harbor | Norwich, CT | Atlantic Coast | VERY SMALL | Norwich Harbormaster 860-823-3700 |
| Port of Hartford | Hartford, CT | Atlantic Coast | SMALL | Port of Hartford 860-275-8359 |
| Stonington Harbor | Stonington, CT | Atlantic Coast | SMALL | Stonington Harbor Management Commission harbormaster@ne.twcbc.com 207-367-5891 |
| Port of Mystic | Mystic, CT | Atlantic Coast | SMALL | Port of Mystic 860-572-8939 |
| Noank Harbor | Noank, CT | Atlantic Coast | SMALL | Noank Harbormaster harbormaster@cityofgroton.com 860-460-1802 |
| Port of New London | New London, CT | Atlantic Coast | SMALL | Port of New London Harbormaster 860-443-6304 |
| Black Rock Harbor | Black Rock, CT | Atlantic Coast | SMALL | Black Rock Harbormaster 203-576-8288 |
| Greenwich Harbor | Greenwich, CT | Atlantic Coast | SMALL | Greenwich Harbormaster info@thedelamar.com 203-661-9800 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-----------------------------|----------------------|----------------|-------------------------------|--|
| Stamford Harbor | Stamford, CT | Atlantic Coast | SMALL | Stamford Harbormaster 203-977-4444 |
| DELAWARE | | | | |
| Bowers Harbor | Bowers, DE | Atlantic Coast | VERY SMALL | n/a |
| DISTRICT OF COLUMBIA | | | | |
| Washington Navy Yard | Washington, D.C. | Atlantic Coast | SMALL | Naval District Washington 703-545-6700 |
| FLORIDA | | | | |
| Port of Fernandina | Fernandina Beach, FL | Atlantic Coast | SMALL | Ocean Highway and Port Authority of Nassau County info@portoffernandina.org 904-261-0098 |
| Port of Fort Pierce | Fort Pierce, FL | Atlantic Coast | SMALL | St. Lucie County Port Authority 772-462-2822 |
| Port of Key West | Key West, FL | Gulf Coast | SMALL | Key West Port Authority 305-293-6439 |
| Port of Boca Grande | Boca Grande, FL | Gulf Coast | VERY SMALL | Boca Grande Port Authority 941-964-0154 |
| Port Manatee | Port Manatee, FL | Gulf Coast | SMALL | Manatee County Port Authority portoffice@portmanatee.com 941-722-6621 |
| Port of Big Bend | Big Bend, FL | Gulf Coast | SMALL | Tampa Port Authority info@tampaport.com 813-905-7678 |
| Apalachicola Harbor | Apalachicola, FL | Gulf Coast | SMALL | n/a |
| Port of Port St. Joe | Port St. Joe, FL | Gulf Coast | SMALL | St. Joe Port Authority 850-229-5240 |
| Port of Panama City | Panama City, FL | Gulf Coast | SMALL | Panama City Port Authority 850-767-3220 |
| GEORGIA | | | | |
| Port of Wentworth | Savannah, GA | Atlantic Coast | SMALL | Port of Wentworth Authority 912-964-1271 |
| Port of Brunswick | Brunswick, GA | Atlantic Coast | SMALL | Georgia Ports Authority 912-264-7295 |
| Port of Bainbridge | Bainbridge, GA | Atlantic Coast | SMALL | Georgia Ports Authority info@gaports.com 229-248-2902 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-------------------------------|-------------------|------------------------------|-------------------------------|--|
| Port of Columbus | Columbus, GA | Atlantic Coast | VERY SMALL | Georgia Ports Authority 912-264-7295 |
| HAWAII | | | | |
| Hilo Harbor | Hilo, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-933-8850 |
| Port of Kailua Kona | Kailua Kona, HI | Pacific Coast | SMALL | n/a |
| Kawaihae Harbor | Kawaihae, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| Kahului Harbor | Kahului, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| Lahaina Harbor | Lahaina, HI | Pacific Coast | VERY SMALL | Hawaii Department of Transportation 808-882-7565 |
| Kaunakakai Harbor | Kaunakakai, HI | Pacific Coast | VERY SMALL | Hawaii Department of Transportation 808-882-7565 |
| Ala Wai Harbor | Honolulu, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| Kewalo Basin | Honolulu, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| Barbers Point Terminal | Barbers Point, HI | Pacific Coast | VERY SMALL | Chevron Texaco Shipping 808-527-2765 |
| Kalaeloa Barbers Point Harbor | Barbers Point, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-682-3989 |
| Nawiliwili Harbor | Nawiliwili, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| Port Allen Harbor | Port Allen, HI | Pacific Coast | SMALL | Hawaii Department of Transportation 808-882-7565 |
| IDAHO | | | | |
| Port of Lewiston | Lewiston, ID | Pacific Coast | SMALL | Lewiston Port Authority portinfo@lewiston.com 208-743-5531 |
| ILLINOIS | | | | |
| Port of Waukegan | Waukegan, IL | In-Land Rivers & Great Lakes | SMALL | Waukegan Port District 847-244-3133 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|--------------------------------|--------------------|------------------------------|-------------------------------|--|
| DuSable Harbor | Chicago, IL | In-Land Rivers & Great Lakes | SMALL | DuSable Harbormaster DUS@westrecchicago.com 312-742-3577 |
| Port of Lemont | Lemont, IL | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Joliet | Joliet, IL | In-Land Rivers & Great Lakes | SMALL | Port of Joliet Authority 815-838-9497 |
| Port of Channahon | Channahon, IL | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Quincy | Quincy, IL | In-Land Rivers & Great Lakes | SMALL | Mid-America Port Commission maiaport@adams.net 217-222-3111 |
| Port of Beardstown | Beardstown, IL | In-Land Rivers & Great Lakes | SMALL | Mid-America Port Commission maiaport@adams.net 217-222-3111 |
| Port of Peoria | Peoria, IL | In-Land Rivers & Great Lakes | SMALL | Port of Peoria Authority 309-634-0247 |
| INDIANA | | | | |
| Port of Indiana-Jeffersonville | Jeffersonville, IN | In-Land Rivers & Great Lakes | SMALL | Indiana Port Commission- Jeffersonville 812-283-9662 |
| Port of Evansville | Evansville, IN | In-Land Rivers & Great Lakes | SMALL | Evansville Port Authority 618-853-2370 |
| Port of Indiana-Mount Vernon | Mount Vernon, IN | In-Land Rivers & Great Lakes | VERY SMALL | Indiana Port Commission- Mount Vernon 812-838-4382 |
| Port of Indiana - Burns Harbor | Portage, IN | In-Land Rivers & Great Lakes | SMALL | Indiana Port Commission- Burns Harbor 219-787-8636 |
| IOWA | | | | |
| Port of Keokuk | Keokuk, IA | In-Land Rivers & Great Lakes | SMALL | Mid-America Port Commission maiaport@adams.net 217-222-3111 |
| Port of Burlington | Burlington, IA | In-Land Rivers & Great Lakes | SMALL | Mid-America Port Commission maiaport@adams.net 217-222-3111 |
| Port of Dubuque | Dubuque, IA | In-Land Rivers & Great Lakes | SMALL | City of Dubuque Port Planning Commission planning@cityofdubuque.org 563 589-4210 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|---|----------------|------------------------------|-------------------------------|---|
| KENTUCKY | | | | |
| Wurtland Riverport | Wurtland, KY | In-Land Rivers & Great Lakes | VERY SMALL | Greenup/Boyd County Riverport Authority 606-739-0010 |
| Jefferson Riverport | Louisville, KY | In-Land Rivers & Great Lakes | SMALL | Louisville-Jefferson County Riverport Authority 502-935-6024 |
| Owensboro Riverport | Owensboro, KY | In-Land Rivers & Great Lakes | SMALL | Owensboro Riverport Authority information@OwensboroRiverport.com 270-926-4238 |
| Henderson County Riverport | Henderson, KY | In-Land Rivers & Great Lakes | VERY SMALL | Henderson County Riverport 270-826-1636 |
| Eddyville Riverport | Eddyville, KY | In-Land Rivers & Great Lakes | VERY SMALL | Eddyville Riverport & Industrial Development Authority Riverport@bellsouth.net 270-388-9671 |
| Hickman Riverport | Hickman, KY | In-Land Rivers & Great Lakes | VERY SMALL | Hickman-Fulton County Riverport Authority 270-236-2563 |
| LOUISIANA | | | | |
| Port of Ostrica | Ostrica, LA | Gulf Coast | SMALL | n/a |
| Louisiana Offshore Oil Port (LOOP) Terminal | Metairie, LA | Gulf Coast | VERY SMALL | LOOP LLC 504-368-5667 |
| Port of Bellevue | Bellevue, LA | Gulf Coast | SMALL | n/a |
| Port of Alliance | Alliance, LA | Gulf Coast | SMALL | n/a |
| St. Bernard Port | Chalmette, LA | Gulf Coast | SMALL | St. Bernard Port, Harbor and Terminal District 504-277-8418 |
| Port of Gretna | Gretna, LA | Gulf Coast | SMALL | Board of Commissioners of the Port of New Orleans 504-522-2551 |
| Port of Gramercy | Gramercy, LA | Gulf Coast | SMALL | Johnston's Ports of Gramercy gramercy@johnstonports.com 225-869-9993 |
| Port of Burnside | Burnside, LA | Gulf Coast | SMALL | Greater Baton Rouge Port Commission 225-342-1660 |
| Port of Geismar | Geismar, LA | Gulf Coast | SMALL | Greater Baton Rouge Port Commission 225-342-1660 |
| Port of Terrebonne | Houma, LA | Gulf Coast | SMALL | Terrebonne Port Commission info@terrebonneport.com 985-873-6428 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|----------------------------|-------------------|----------------|-------------------------------|---|
| Port of Morgan City | Morgan City, LA | Gulf Coast | SMALL | Port of Morgan City Authority info@portofmc.com 985-384-0850 |
| Port of Iberia | New Iberia, LA | Gulf Coast | SMALL | Port of Iberia Authority info@portofiberia.com 337-364-1065 |
| Port of Krotz Springs | Krotz Springs, LA | Gulf Coast | SMALL | Greater Krotz Springs Port Commission 318-566-8867 |
| Port of Shreveport-Bossier | Shreveport, LA | Gulf Coast | SMALL | Port of Shreveport-Bossier Authority port@portsb.com 318-524-2272 |
| MAINE | | | | |
| Port of Eastport | Eastport, ME | Atlantic Coast | VERY SMALL | Eastport Port Authority 207-853-4614 |
| Lubec Harbor | Lubec, ME | Atlantic Coast | VERY SMALL | Lubec Harbormaster 207-733-2342 |
| Cutler Harbor | Cutler, ME | Atlantic Coast | VERY SMALL | Cutler Harbormaster 207-259-3693 |
| Machias Harbor | Machias, ME | Atlantic Coast | VERY SMALL | Machias Harbormaster machiasstownmanager@verizon.net 207-255-6621 |
| Machiasport Harbor | Machiasport, ME | Atlantic Coast | VERY SMALL | Machiasport Harbormaster 207-255-3680 |
| Jonesport Harbor | Jonesport, ME | Atlantic Coast | VERY SMALL | Jonesport Harbormaster 207-497-5926 |
| Wyman Harbor | Wyman, ME | Atlantic Coast | VERY SMALL | n/a |
| Milbridge Harbor | Milbridge, ME | Atlantic Coast | VERY SMALL | Milbridge Harbormaster 207-546-2967 |
| Corea Harbor | Corea, ME | Atlantic Coast | VERY SMALL | n/a |
| Winter Harbor | Winter Harbor, ME | Atlantic Coast | VERY SMALL | Winter Harbor Harbormaster 207-963-2235 |
| Sorrento Harbor | Sorrento, ME | Atlantic Coast | VERY SMALL | Sorrento Harbormaster 207-422-6727 |
| Bar Harbor Harbor | Bar Harbor, ME | Atlantic Coast | SMALL | City of Bar Harbor, Harbor Department bhhmaster@barharbormaine.gov 207-288-5571 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|--------------------|----------------------|----------------|-------------------------------|---|
| Northeast Harbor | Northeast Harbor, ME | Atlantic Coast | VERY SMALL | Northeast Harbor Harbormaster harbormaster@mtdesert.org 207-276-5737 |
| Southwest Harbor | Southwest Harbor, ME | Atlantic Coast | VERY SMALL | Southwest Harbor Harbormaster harbormasterswh@roadrunner.com 207-244-5404 |
| Bass Harbor | Bass Harbor, ME | Atlantic Coast | VERY SMALL | Bass Harbor Harbormaster 207-244-7204 |
| Bangor Harbor | Bangor, ME | Atlantic Coast | SMALL | City of Bangor Harbormaster harbor.master@bangormaine.gov 207-945-4400 |
| Winterport Harbor | Winterport, ME | Atlantic Coast | VERY SMALL | City of Bangor Harbormaster harbor.master@bangormaine.gov 207-945-4400 |
| Port of Bucksport | Bucksport, ME | Atlantic Coast | SMALL | Bucksport Harbormaster 207-469-7368 |
| Port of Searsport | Searsport, ME | Atlantic Coast | SMALL | Searsport Harbormaster 207-548-6372 |
| Belfast Harbor | Belfast, ME | Atlantic Coast | SMALL | City of Belfast, Harbor Department 207-338-1142 |
| Frenchboro Harbor | Frenchboro, ME | Atlantic Coast | VERY SMALL | Frenchboro Harbormaster 207-334-2957 |
| Minturn Harbor | Minturn, ME | Atlantic Coast | VERY SMALL | Minturn Harbormaster 207-244-7204 |
| North Haven Harbor | North Haven, ME | Atlantic Coast | SMALL | North Haven Harbormaster 207-867-4433 |
| Camden Harbor | Camden, ME | Atlantic Coast | VERY SMALL | Camden Harbormaster 207-236-7969 |
| Rockport Harbor | Rockport, ME | Atlantic Coast | VERY SMALL | Rockport Harbormaster harbormaster@town.rockport.me.us 207-236-0676 |
| Vinalhaven Harbor | Vinalhaven, ME | Atlantic Coast | VERY SMALL | Vinalhaven Harbormaster vhharbormaster@yahoo.com 207-836-2077 |
| Port of Rockland | Rockland, ME | Atlantic Coast | SMALL | City of Rockland Harbor Master 207-594-0312 |
| Thomaston Harbor | Thomaston, ME | Atlantic Coast | VERY SMALL | Thomaston Harbormaster 207-691-1315 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|------------------------|---------------------|----------------|-------------------------------|--|
| Matinicus Harbor | Matinicus, ME | Atlantic Coast | VERY SMALL | Matinicus Harbormaster bhhmaster@barharbormaine.gov 207-288-5571 |
| Criehaven Harbor | Criehaven, ME | Atlantic Coast | VERY SMALL | Criehaven Harbormaster bhhmaster@barharbormaine.gov 207-288-5571 |
| Friendship Harbor | Friendship, ME | Atlantic Coast | SMALL | Friendship Harbormaster 207-975-7107 or 207-832-6689 |
| Port Clyde | Port Clyde, ME | Atlantic Coast | SMALL | Port Clyde Harbormaster hbrmstr@stgeorgemaine.com 207-372-6363 |
| Monhegan Harbor | Monhegan, ME | Atlantic Coast | VERY SMALL | Monhegan Harbormaster 207-594-0806 |
| New Harbor | New Harbor, ME | Atlantic Coast | VERY SMALL | New Harbor Harbormaster 207-563-8001 |
| South Bristol Harbor | South Bristol, ME | Atlantic Coast | VERY SMALL | South Bristol Harbormaster 207-563-3977 |
| Boothbay Harbor | Boothbay Harbor, ME | Atlantic Coast | SMALL | City of Boothbay Harbor 207-633-7714 |
| Robinhood Harbor | Robinhood, ME | Atlantic Coast | VERY SMALL | Robinhood Harbormaster 207-371-2343 |
| Cundy Harbor | Cundy Harbor, ME | Atlantic Coast | VERY SMALL | n/a |
| South Harpswell Harbor | South Harpswell, ME | Atlantic Coast | VERY SMALL | South Harpswell Harbormaster harbormaster@harpswell.me.us 207-833-5771 |
| Freeport Harbor | Freeport, ME | Atlantic Coast | SMALL | Town of Freeport Harbormaster frprthmstr@gmail.com 207-865-4546 |
| Cape Porpoise Harbor | Cape Porpoise, ME | Atlantic Coast | VERY SMALL | Town of Kennebunkport Harbormaster harbormaster@kennebunkmaine.us 207-205-0991 |
| Kennebunkport Harbor | Kennebunkport, ME | Atlantic Coast | SMALL | Town of Kennebunkport Harbormaster harbormaster@kennebunkmaine.us 207-205-0991 |
| MARYLAND | | | | |
| Port Annapolis | Annapolis, MD | Atlantic Coast | SMALL | Port Annapolis Marina office@portannapolis.com 410-269-1990 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|--|---------------------|----------------|-------------------------------|---|
| Port of Cambridge | Cambridge, MD | Atlantic Coast | SMALL | City of Cambridge Dockmaster dockmaster@cic.cambridge.md.us 410-228-4031 |
| City Yacht Basin | Havre de Grace, MD | Atlantic Coast | SMALL | City of Havre de Grace 410-939-1800 |
| Solomons Island Harbor | Solomons Island, MD | Atlantic Coast | SMALL | Solomons Island Harbormaster 410-326-3441 |
| Naval Air Station Patuxent (PAX) River | Lexington Park, MD | Atlantic Coast | SMALL | Naval Air Station PAX River 301-342-3000 |
| Port of Piney Point | Piney Point, MD | Atlantic Coast | SMALL | n/a |
| Somers Cove Marina | Crisfield, MD | Atlantic Coast | SMALL | n/a |
| MASSACHUSETTS | | | | |
| Newburyport Harbor | Newburyport, MA | Atlantic Coast | SMALL | City of Newburyport Harbormaster 978-462-3746 |
| Rockport Harbor | Rockport, MA | Atlantic Coast | SMALL | Town of Rockport Harbormaster 978-546-9589 |
| Beverly Harbor | Beverly, MA | Atlantic Coast | SMALL | City of Beverly Harbormaster Dept. 978-921-6059 |
| Port of Salem | Salem, MA | Atlantic Coast | SMALL | Port of Salem Harbormaster 978-741-0098 |
| Marblehead Harbor | Marblehead, MA | Atlantic Coast | SMALL | Town of Marblehead Harbormaster harbor@marblehead.org 781-631-2386 |
| Lynn Harbor | Lynn, MA | Atlantic Coast | SMALL | City of Lynn Harbormaster 781-595-9770 |
| Scituate Harbor | Scituate, MA | Atlantic Coast | SMALL | Town of Scituate Harbormaster harbormaster@town.scituate.ma.us 781-545-2130 |
| Port of Plymouth | Plymouth, MA | Atlantic Coast | VERY SMALL | Plymouth Marine Authority 508-830-4182 |
| Port of Provincetown | Provincetown, MA | Atlantic Coast | SMALL | Provincetown Port Authority 508-487-7030 |
| Port of Sandwich | Sandwich, MA | Atlantic Coast | SMALL | Port of Sandwich Harbormaster info@sandwichmarina.com 508-833-0808 |
| Cape Cod Canal | Buzzards Bay, MA | Atlantic Coast | SMALL | n/a |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-----------------------|----------------------|------------------------------|-------------------------------|---|
| Hyannis Harbor | Hyannis, MA | Atlantic Coast | SMALL | Hyannis Harbormaster 508-790-6273 |
| Falmouth Harbor | Falmouth, MA | Atlantic Coast | SMALL | Falmouth Harbormaster falhmast@falmouthmass.us 508-457-2550 |
| Woods Hole Harbor | Woods Hole, MA | Atlantic Coast | SMALL | n/a |
| Vineyard Haven Harbor | Vineyard Haven, MA | Atlantic Coast | SMALL | Vineyard Haven Harbormaster 508-693-1368 |
| Oak Bluffs Harbor | Oak Bluffs, MA | Atlantic Coast | SMALL | Oak Bluffs Port Authority 508-693-4355 |
| Edgartown Harbor | Edgartown, MA | Atlantic Coast | SMALL | Town of Edgartown Harbormaster 508-627-4746 |
| Nantucket Harbor | Nantucket, MA | Atlantic Coast | SMALL | City of Nantucket Harbormaster 508-228-8565 |
| Cuttyhunk Harbor | Cuttyhunk Island, MA | Atlantic Coast | VERY SMALL | Cuttyhunk Marina Harbormaster harbormaster@cuttyhunkmarina.net 508-990-7578 |
| MICHIGAN | | | | |
| Holland Harbor | Holland, MI | In-Land Rivers & Great Lakes | SMALL | City of Holland info@cityofholland.com |
| Port of Ferrysburg | Ferrysburg, MI | In-Land Rivers & Great Lakes | SMALL | City of Ferrysburg info@ferrysburg.org 616-842-5803 |
| Grand Haven Marina | Grand Haven, MI | In-Land Rivers & Great Lakes | VERY SMALL | City of Grand Haven 616-847-3478 |
| Ludington Harbor | Ludington, MI | In-Land Rivers & Great Lakes | SMALL | City of Ludington 231-845-6237 |
| Manistee Harbor | Manistee, MI | In-Land Rivers & Great Lakes | SMALL | City of Manistee Harbormaster 231-723-2558 |
| Port of Charlevoix | Charlevoix, MI | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Cheboygan | Cheboygan, MI | In-Land Rivers & Great Lakes | SMALL | City of Cheboygan Port Authority portofcheboygan@cheboygan.org 231-627-9931 |
| Rogers City Marina | Rogers City, MI | In-Land Rivers & Great Lakes | SMALL | Rogers City Harbormaster 989-734-3808 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-------------------------|---------------------|------------------------------|-------------------------------|---|
| Port of Calcite | Rogers City, MI | In-Land Rivers & Great Lakes | SMALL | Port of Calcite Authority info@portcalcite.com 989-734-7678 |
| Presque Isle Harbor | Presque Isle, MI | In-Land Rivers & Great Lakes | SMALL | Presque Isle Harbor Association 989-595-2411 |
| Port of Bay City | Bay City, MI | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Port Huron | Port Huron, MI | In-Land Rivers & Great Lakes | SMALL | City of Port Huron 810-984-9744 |
| Port of Algonac | Algonac, MI | In-Land Rivers & Great Lakes | SMALL | City of Algonac 810-794-9361 |
| Wyandotte Harbor | Wyandotte, MI | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Monroe | Monroe, MI | In-Land Rivers & Great Lakes | SMALL | Monroe Port Commission mail@portofmonroe.com 734-241-6480 |
| Port of Ontonagon | Ontonagon, MI | In-Land Rivers & Great Lakes | SMALL | Ontonagon County Economic Development Corp 906-884-4188 ontcoedc@up.net |
| Houghton Harbor | Houghton, MI | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Marquette | Marquette, MI | In-Land Rivers & Great Lakes | SMALL | Marquette Public Works Department 906-228-0450 |
| Port of Sault Ste Marie | Sault Ste Marie, MI | In-Land Rivers & Great Lakes | SMALL | City of Sault Ste Marie, Economic Development 906-635-9131 |
| Port of Escanaba | Escanaba, MI | In-Land Rivers & Great Lakes | SMALL | City of Escanaba 906-786-9614 |
| Port of Menominee | Menominee, MI | In-Land Rivers & Great Lakes | SMALL | City of Menominee 906-863-2656 |
| MINNESOTA | | | | |
| Port of St. Paul | St. Paul, MN | In-Land Rivers & Great Lakes | SMALL | Saint Paul Port Authority 651-224-5686 |
| Port of Minneapolis | Minneapolis, MN | In-Land Rivers & Great Lakes | SMALL | City of Minneapolis 612-673-3000 |
| Port of Duluth | Duluth, MN | In-Land Rivers & Great Lakes | SMALL | Duluth Seaway Port Authority admin@duluthport.com 213-727-8525 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-----------------------------------|-------------------------|------------------------------|-------------------------------|---|
| Port of International Falls | International Falls, MN | In-Land Rivers & Great Lakes | SMALL | City of International Falls 218-283-9484 |
| Taconite Harbor | Taconite Harbor, MN | In-Land Rivers & Great Lakes | SMALL | n/a |
| MISSISSIPPI | | | | |
| Biloxi Port | Biloxi, MS | Gulf Coast | SMALL | City of Biloxi Port Division 228-374-6600 |
| Port of Bienville Industrial Park | Bienville, MS | Gulf Coast | SMALL | Hancock County Development Commission 228-467-9231 |
| Lowndes County Port | Lowndes, MS | Gulf Coast | VERY SMALL | Lowndes County Port Authority 662-329-5886 |
| Port of Clay County | West Point, MS | Gulf Coast | VERY SMALL | Port of Clay County 662-494-3754 |
| Aberdeen Port | Aberdeen, MS | Gulf Coast | VERY SMALL | Aberdeen Port Authority 662-369-4165 |
| Port of Amory | Amory, MS | Gulf Coast | VERY SMALL | Port of Amory Authority 662-256-5635 |
| Port Itawamba | Itawamba, MS | Gulf Coast | VERY SMALL | Itawamba County Development Council admin@portitawamba.com 662-862-4573 |
| Yellow Creek Port | Yellow Creek, MS | Gulf Coast | VERY SMALL | Yellow Creek Port Authority 662-423-6088 |
| Port of Rosedale | Rosedale, MS | Gulf Coast | VERY SMALL | Rosedale-Bolivar County Port Commission 662-759-6212 |
| Port of Greenville | Greenville, MS | Gulf Coast | SMALL | Greenville Port Commission gvlpport@tecinfo.com 662-335-2683 |
| Yazoo County Port | Yazoo, MS | Gulf Coast | VERY SMALL | Yazoo County Port Commission 662-746-1273 |
| Port of Vicksburg | Vicksburg, MS | Gulf Coast | SMALL | Warren County Port Commission 601-631-0555 |
| Port of Claiborne County | Clairborne, MS | Gulf Coast | VERY SMALL | Mississippi Department of Transportation 601-437-5216 |
| Natchez Adams County Port | Natchez, MS | Gulf Coast | VERY SMALL | Natchez Port Authority 601-442-2561 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|----------------------------------|--------------------|------------------------------|-------------------------------|--|
| MISSOURI | | | | |
| Southeast Missouri Regional Port | Scott City, MO | In-Land Rivers & Great Lakes | SMALL | Southeast Missouri Regional Port Authority semoport@semoport.com 573-264-4045 |
| Port of Mississippi County | East Prairie, MO | In-Land Rivers & Great Lakes | VERY SMALL | Mississippi County Port Authority misscoport@gmail.com 573-683-0290 |
| New Madrid County Port | New Madrid, MO | In-Land Rivers & Great Lakes | SMALL | New Madrid County Port Authority portauthority@semo.net 573- 748-2530 |
| Pemiscot County Port | Caruthersville, MO | In-Land Rivers & Great Lakes | VERY SMALL | Pemiscot County Port Authority pemiscotport@yahoo.com 573-333-4125 |
| Port of Granite City | Granite City, MO | In-Land Rivers & Great Lakes | SMALL | Tri-City Regional Port District 618-877-8444 |
| Howard/Cooper County Port | Boonville, MO | In-Land Rivers & Great Lakes | VERY SMALL | Howard/Cooper County Regional Port Authority howcoop-port@sbcglobal.net 660-882-5858 |
| Port of Kansas City | Kansas City, MO | In-Land Rivers & Great Lakes | SMALL | Port Authority of Kansas City 816-691-2135 |
| Port of St. Joseph | St. Joseph, MO | In-Land Rivers & Great Lakes | VERY SMALL | St. Joseph Regional Port Authority 816-364-4110 |
| Port of Hannibal | Hannibal, MO | In-Land Rivers & Great Lakes | VERY SMALL | Mid-America Port Commission maiaport@adams.net 217-222-3111 |
| NEW JERSEY | | | | |
| Port of Hackensack | Hackensack, NJ | Atlantic Coast | SMALL | City of Hackensack Port Authority 201-646-3980 |
| Port of Trenton | Trenton, NJ | Atlantic Coast | VERY SMALL | n/a |
| Port of Paulsboro | Paulsboro, NJ | Atlantic Coast | SMALL | Borough of Paulsboro 856-423-1500 |
| Deepwater Point | Penns Grove, NJ | Atlantic Coast | SMALL | Deepwater Point Harbor 302-472-7678 |
| Port of Norris Harbor | Port Norris, NJ | Atlantic Coast | VERY SMALL | Port of Norris Harbormaster info@portnorrismarina.com 856-785-1205 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|------------------------|--------------------|----------------|-------------------------------|--|
| Cape May Terminal | North Cape May, NJ | Atlantic Coast | SMALL | n/a |
| Cape May Harbor | Cape May, NJ | Atlantic Coast | SMALL | City of Cape May 609-884-9525 |
| NEW YORK | | | | |
| Port of Rochester | Rochester, NY | Atlantic Coast | SMALL | City of Rochester Port Authority info@cityofrochester.gov 585-428-5978 |
| Sodus Point Harbor | Sodus Point, NY | Atlantic Coast | SMALL | Village of Sodus Point Harbormaster 315-483-9881 |
| Port of Oswego | Oswego, NY | Atlantic Coast | SMALL | Port of Oswego Authority shipping@portoswego.com 315-343-4503 |
| Port of Cape Vincent | Cape Vincent, NY | Atlantic Coast | SMALL | Village of Cape Vincent Harbormaster 315-654-2533 |
| Port of Clayton | Clayton, NY | Atlantic Coast | SMALL | Town of Clayton Port Authority 315-686-2651 |
| Port of Alexandria Bay | Alexandria Bay, NY | Atlantic Coast | SMALL | City of Alexandria Bay Harbormaster 315-482-2065 |
| Port of Ogdensburg | Ogdensburg, NY | Atlantic Coast | SMALL | Ogdensburg Bridge and Port Authority obpa@ogdensport.com 315-393-4080 |
| Port of Rouses Point | Rouses Point, NY | Atlantic Coast | SMALL | Village of Rouses Point Port Authority 518-297-5502 |
| Port of Troy | Troy, NY | Atlantic Coast | SMALL | City of Troy 518-270-4401 |
| Port of Catskill | Catskill, NY | Atlantic Coast | SMALL | Town of Catskill info@portofcatskill.com 518-943-5088 |
| Port of Kingston | Kingston, NY | Atlantic Coast | SMALL | City of Kingston 360-297-3545 |
| Port of Poughkeepsie | Poughkeepsie, NY | Atlantic Coast | SMALL | City of Poughkeepsie 845-451-4200 |
| Port of Newburgh | Newburgh, NY | Atlantic Coast | SMALL | City of Newburgh Harbormaster 845-569-7300 |
| Greenport Harbor | Greenport, NY | Atlantic Coast | SMALL | Greenport Harbor 631-477-0392 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|---------------------------|---------------------|------------------------------|-------------------------------|---|
| United Riverhead Terminal | Riverhead, NY | Atlantic Coast | SMALL | United Riverhead Terminal 631-284-2000 |
| Port Jefferson Harbor | Port Jefferson, NY | Atlantic Coast | SMALL | Village of Port Jefferson 631-451-6455 |
| Patchogue Harbor | Patchogue, NY | Atlantic Coast | SMALL | Village of Patchogue 631-475-4300 |
| Ocean Beach Harbor | Ocean Beach, NY | Atlantic Coast | SMALL | Ocean Harbor Harbormaster 631-665-3600 |
| Kismet Harbor | Kismet, NY | Atlantic Coast | SMALL | Kismet Harbormaster 631-665-3600 |
| Bay Shore Harbor | Bay Shore, NY | Atlantic Coast | SMALL | n/a |
| Port of Northport | Northport, NY | Atlantic Coast | SMALL | Northport Harbormaster 631-261-7502 |
| Port Chester Harbor | Port Chester, NY | Atlantic Coast | SMALL | Village of Port Chester 914-939-9687 |
| Mamaroneck Harbor | Mamaroneck, NY | Atlantic Coast | SMALL | Mamaroneck Harbormaster 914-777-7744 |
| Port of Yonkers | Yonkers, NY | Atlantic Coast | SMALL | City of Yonkers Harbormaster 914-377-6000 |
| NORTH CAROLINA | | | | |
| Port of Morehead City | Morehead City, NC | Atlantic Coast | SMALL | North Carolina State Ports Authority 910-763-1621 |
| OHIO | | | | |
| Port of Cincinnati | Cincinnati, OH | In-Land Rivers & Great Lakes | SMALL | Port of Greater Cincinnati Development Authority info@cincinnatiport.org 513-621-3000 |
| Port of Sandusky | Sandusky, OH | In-Land Rivers & Great Lakes | SMALL | Sandusky Dock Corp 419-626-1214 |
| Port of Huron | Huron, OH | In-Land Rivers & Great Lakes | SMALL | Huron Joint Port Authority 419-433-5000 |
| Port of Cleveland | Cleveland, OH | In-Land Rivers & Great Lakes | SMALL | Cleveland-Cuyahoga County Port Authority info@portofcleveland.com 216-241-8004 |
| Fairport Harbor | Fairport Harbor, OH | In-Land Rivers & Great Lakes | SMALL | Fairport Harbor Port Authority 440-357-8466 |
| Port of Ashtabula | Ashtabula, OH | In-Land Rivers & Great Lakes | SMALL | Ashtabula City Port Authority 440-992-7154 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|--------------------------|----------------------|------------------------------|-------------------------------|---|
| Port of Conneaut | Conneaut, OH | In-Land Rivers & Great Lakes | SMALL | Conneaut Port Authority cpadmin@conneautportauthority.com 440-593-1300 |
| OKLAHOMA | | | | |
| Port of Muskogee | Muskogee, OK | In-Land Rivers & Great Lakes | SMALL | Muskogee City-County Port Authority muskogeeport@muskogeeport.com 918- 682-7886 |
| Tulsa Port of Catoosa | Tulsa, OK | In-Land Rivers & Great Lakes | SMALL | Tulsa Port of Catoosa Authority info@tulsaport.com 918-266-2291 |
| OREGON | | | | |
| Port of Newport | Newport, OR | Pacific Coast | SMALL | Port of Newport Authority portman@portofnewport.com 541 265 7758 |
| Gold Beach Harbor | Gold Beach, OR | Pacific Coast | SMALL | City of Gold Beach Harbormaster 541-247-7526 |
| Port of Brookings Harbor | Brookings Harbor, OR | Pacific Coast | SMALL | Port of Brookings Harbor Authority 541-469-2218 |
| Port of Astoria | Astoria, OR | Pacific Coast | SMALL | Port of Astoria Commissioners admin@portofastoria.com 503-325-4521 |
| Port of the Dalles | The Dalles, OR | Pacific Coast | SMALL | The Dalles Port Authority porttd@gorge.net 541- 298- 4148 |
| Port of Arlington | Arlington, OR | Pacific Coast | SMALL | Arlington Port Authority info@PortofArlington.com 541-454-2868 |
| Port of Morrow | Morrow, OR | Pacific Coast | SMALL | Morrow Port Commission port@portofmorrow.com 541-481-7678 |
| Port of Umatilla | Umatilla, OR | Pacific Coast | SMALL | Umatilla Port Authority portinfo@uci.net 541-922-3224 |
| PENNSYLVANIA | | | | |
| Penn Terminals | Eddystone, PA | Atlantic Coast | SMALL | Penn Terminals Inc sales@pennterminals.com 610-499-3000 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|--------------------------|----------------------|------------------------------|-------------------------------|---|
| RHODE ISLAND | | | | |
| Bristol Harbor | Bristol, RI | Atlantic Coast | SMALL | Town of Bristol Harbormaster 401-253-1700 |
| Tiverton Harbor | Tiverton, RI | Atlantic Coast | SMALL | Town of Tiverton Harbormaster 401-625-6708 |
| Port of Melville | Melville, RI | Atlantic Coast | SMALL | Port Authority of Melville 401-683-0300 |
| Quonset Point | North Kingstown, RI | Atlantic Coast | SMALL | Quonset Development Corporation 401-295-0044 |
| Port of Newport | Newport, RI | Atlantic Coast | SMALL | Port of Newport Harbormaster 401-845-5815 |
| SOUTH CAROLINA | | | | |
| Port of Georgetown | Georgetown, SC | Atlantic Coast | SMALL | South Carolina State Ports Authority 843-577-8659 |
| Port of Port Royal | Port Royal, SC | Atlantic Coast | SMALL | South Carolina State Ports Authority 843-577-8659 |
| TENNESSEE | | | | |
| Port of Chattanooga | Chattanooga, TN | In-Land Rivers & Great Lakes | VERY SMALL | Port of Chattanooga Authority 423-855-6625 |
| Port of Knoxville | Knoxville, TN | In-Land Rivers & Great Lakes | VERY SMALL | Port of Knoxville Authority 865-523-6157 |
| Port of Nashville | Nashville, TN | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of New Johnsonville | New Johnsonville, TN | In-Land Rivers & Great Lakes | SMALL | n/a |
| Port of Memphis | Memphis, TN | In-Land Rivers & Great Lakes | SMALL | International Port of Memphis Authority info@portofmemphis.com 901-948-4422 |
| TEXAS | | | | |
| Port of Orange | Orange, TX | Gulf Coast | SMALL | Port of Orange Authority 409-883-4363 |
| Port of Atreco | Atreco, TX | Gulf Coast | SMALL | n/a |
| Sun Marine Terminals | Nederland, TX | Gulf Coast | SMALL | Sun Marine Terminals Authority 409-287-5000 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|---------------------|------------------|----------------|-------------------------------|---|
| Port of Beaumont | Beaumont, TX | Gulf Coast | SMALL | Port of Beaumont Authority info@portofbmt.com 409-835-5367 |
| Port of Bay City | Bay City, TX | Gulf Coast | SMALL | Port of Bay City Authority port@portofbaycity.com 979 245 5831 |
| Port of Palacios | Palacios, TX | Gulf Coast | SMALL | Matagorda County Navigation District No. 1 info@portofpalacios.com 361-972-5556 |
| Port Lavaca | Port Lavaca, TX | Gulf Coast | SMALL | Calhoun County Port Authority RHVB@portofplpc.com 361-987-2813 |
| Port of Victoria | Victoria, TX | Gulf Coast | VERY SMALL | The Port of Victoria 361-570-8855 |
| Port of Port Isabel | Port Isabel, TX | Gulf Coast | SMALL | Port Isabel and San Benito Navigation District 956-943 7826 |
| VERMONT | | | | |
| Burlington Harbor | Burlington, VT | Atlantic Coast | SMALL | Vermont Department of Parks and Recreation 802-864-0123 |
| VIRGINIA | | | | |
| Port of Alexandria | Alexandria, VA | Atlantic Coast | SMALL | Alexandria Port Authority 703-684-5700 |
| Port Cape Charles | Cape Charles, VA | Atlantic Coast | SMALL | Port of Cape Charles Authority 757-331 2357 |
| Port of Yorktown | Yorktown, VA | Atlantic Coast | SMALL | Port of Yorktown Harbormaster 757-890-3317 |
| Port of Hopewell | Hopewell, VA | Atlantic Coast | SMALL | Port of Hopewell Authority 757-541-6417 |
| Port of Richmond | Richmond, VA | Atlantic Coast | SMALL | City of Richmond Port Authority portrich@ci.richmond.va.us 804-646-2020 |
| Port of Chesapeake | Chesapeake, VA | Atlantic Coast | VERY SMALL | Port of Chesapeake Authority 757-382-8040 |
| WASHINGTON | | | | |
| Port of Walla Walla | Walla Walla, WA | Pacific Coast | SMALL | Walla Walla Port Authority 509-525-3100 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-------------------------|-------------------|---------------|-------------------------------|--|
| Port of Pasco | Pasco, WA | Pacific Coast | SMALL | Pasco Port Authority portofpasco@portofpasco.org 509-547-3378 |
| Port of Kennewick | Kennewick, WA | Pacific Coast | SMALL | Kennewick Port Authority pok@portofkennewick.org 509-586-1186 |
| Port of Benton | Richland, WA | Pacific Coast | VERY SMALL | Port of Benton Authority 509-375-3060 |
| Port of Central Ferry | Central Ferry, WA | Pacific Coast | VERY SMALL | Port of Whitman County Authority portwhit@stjohncable.com 509-397-3791 |
| Port of Alмота | Alмота, WA | Pacific Coast | SMALL | Port of Whitman County Authority portwhit@stjohncable.com 509-397-3791 |
| Port of Wilma | Wilma, WA | Pacific Coast | SMALL | Port of Whitman County portwhit@stjohncable.com 509-397-3791 |
| Port of Clarkston | Clarkston, WA | Pacific Coast | SMALL | Clarkston Port Authority portofclk@clarkston.com 509-758-5272 |
| Port of Longview | Longview, WA | Pacific Coast | SMALL | Port of Longview Authority marketing@portoflongview.com 360-425-3305 |
| Port of Kalama | Kalama, WA | Pacific Coast | SMALL | Port of Kalama Authority pok@portofkalama.com 360-673-2325 |
| Port of Woodland | Woodland, WA | Pacific Coast | SMALL | Port of Woodland Authority portwood@worldaccessnet.com 360-225-6555 |
| Port of St. Helens | St. Helens, WA | Pacific Coast | SMALL | Port of St. Helens Harbormaster 503-397-2888 |
| Port of Vancouver | Vancouver, WA | Pacific Coast | SMALL | The Vancouver Port Authority POVinfo@PortVanUSA.com 360-693-3611 |
| Port of Camas-Washougal | Washougal, WA | Pacific Coast | SMALL | Camas-Washougal Port Authority info@portcw.com 360-835-2196 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|-----------------------|-------------------|---------------|-------------------------------|---|
| Port of Klickitat | Bingen, WA | Pacific Coast | SMALL | Klickitat Port Authority 509-493-1655 |
| Neah Bay Harbor | Neah Bay, WA | Pacific Coast | SMALL | Neah Bay Harbormaster 360-645-3012 |
| Port of Port Angeles | Port Angeles, WA | Pacific Coast | SMALL | Port of Port Angeles Authority info@portofpa.com 360-457-8527 |
| Port of Friday Harbor | Friday Harbor, WA | Pacific Coast | SMALL | Town of Friday Harbor Harbormaster 360-378-2810 |
| Port of Semiahmoo | Semiahmoo, WA | Pacific Coast | SMALL | n/a |
| Port of Blaine | Blaine, WA | Pacific Coast | SMALL | City of Blaine Harbormaster 360-332-8311 |
| Port of Anacortes | Anacortes, WA | Pacific Coast | SMALL | Port of Anacortes Authority marina@portofanacortes.com 360-293-3134 |
| Port of Skagit | La Conner, WA | Pacific Coast | SMALL | Port of Skagit Authority posc@portofskagit.com 360-757-0011 |
| Port of Port Townsend | Port Townsend, WA | Pacific Coast | SMALL | Port of Townsend Authority info@portoftpt.com 360-385-0656 |
| Port of Port Gamble | Port Gamble, WA | Pacific Coast | SMALL | Port Gamble Authority - Olympic Property Group 360-297-8074 |
| Port of Kingston | Kingston, WA | Pacific Coast | SMALL | Port of Kingston Authority 360-297-3545 |
| Port of Edmonds | Edmonds, WA | Pacific Coast | SMALL | Port of Edmonds Authority 425-774-0549 |
| Port of Keyport | Keyport, WA | Pacific Coast | SMALL | Port of Keyport Authority 306-779-4259 |
| Port of Brownsville | Brownsville, WA | Pacific Coast | SMALL | Port of Brownsville Authority 360-692-5498 |
| Port of Allyn | Allyn, WA | Pacific Coast | VERY SMALL | Port of Allyn Port District 360-275-2430 |
| Port of Shelton | Shelton, WA | Pacific Coast | SMALL | Port of Shelton Authority info@portofshelton.com 360-426-1151 |

| Port | City | Region | World Port Source Designation | Port Authority/Port Administration POC |
|------------------------|---------------------|------------------------------|-------------------------------|--|
| Hoquiam Harbor | Hoquiam, WA | Pacific Coast | SMALL | n/a |
| Port of Grays Harbor | Aberdeen, WA | Pacific Coast | SMALL | The Port of Grays Harbor Authority 360-533-9528 |
| Port of Peninsula | Ocean Park, WA | Pacific Coast | SMALL | Port of Peninsula Authority 360-665-4547 |
| Port of Ilwaco | Ilwaco, WA | Pacific Coast | SMALL | Port of Ilwaco Authority 360-642-3143 |
| WISCONSIN | | | | |
| Port of Sturgeon Bay | Sturgeon Bay, WI | In-Land Rivers & Great Lakes | SMALL | City of Sturgeon Bay Harbormaster 920-746-2914 |
| Port of Green Bay | Green Bay, WI | In-Land Rivers & Great Lakes | SMALL | Port of Green Bay- Brown County Authority 920-492-4961 |
| Manitowoc Harbor | Manitowoc, WI | In-Land Rivers & Great Lakes | SMALL | Manitowoc Harbor Commission 920-686-6550 |
| Port of Sheboygan | Sheboygan, WI | In-Land Rivers & Great Lakes | SMALL | City of Sheboygan 920-459-3317 |
| Port Washington Marina | Port Washington, WI | In-Land Rivers & Great Lakes | SMALL | Port Washington Harbour Commission mrnport@execpc.com 262-284-6606 |
| Port of Racine | Racine, WI | In-Land Rivers & Great Lakes | VERY SMALL | Racine Harbour Commission 262-636-9191 |
| Port of Kenosha | Kenosha, WI | In-Land Rivers & Great Lakes | SMALL | Port of Kenosha Authority 262-652-3125 |
| Ashland Harbor | Ashland, WI | In-Land Rivers & Great Lakes | SMALL | City of Ashland Harbor Commission ashchamb@centurytel.net 715-682-2500 |
| Port Wing Harbor | Port Wing, WI | In-Land Rivers & Great Lakes | VERY SMALL | Port Wing Marina, Inc info@portwingwi.com |
| Port Superior | Superior, WI | In-Land Rivers & Great Lakes | SMALL | City of Superior Port Authority 715-395-7335 |

Acknowledgments

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Their sharing of lessons learned, concerns, industry experience, and existing risk assessment efforts will contribute to safer operations for all involved in LNG use as a fuel, an essential element necessary to allow industry to pursue this attractive opportunity.

We will continue to rely on information provided from interested professionals to update this document, and we encourage readers to bring errors, omissions, updates, or additional information to our attention.



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