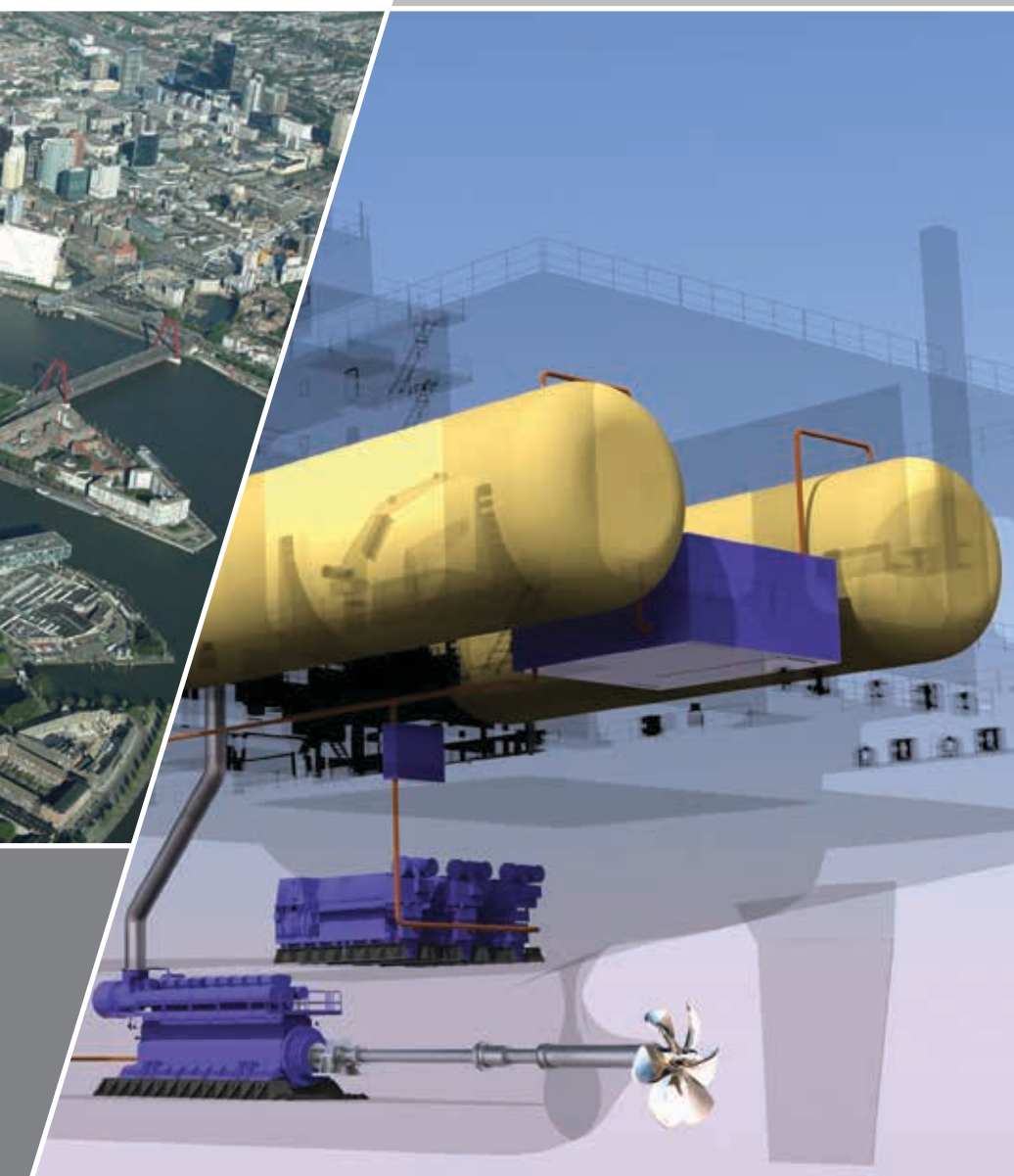
Bunkering of Liquefied Natural Gas-fueled Marine Vessels in North America

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.

FOUNDED 1862 ABS

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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
CH4	Methane
CNG	Compressed Natural Gas
COE	Corps of Engineers
COTP	Captain of the Port

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

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 ENERGY[1].

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 info graphic 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.

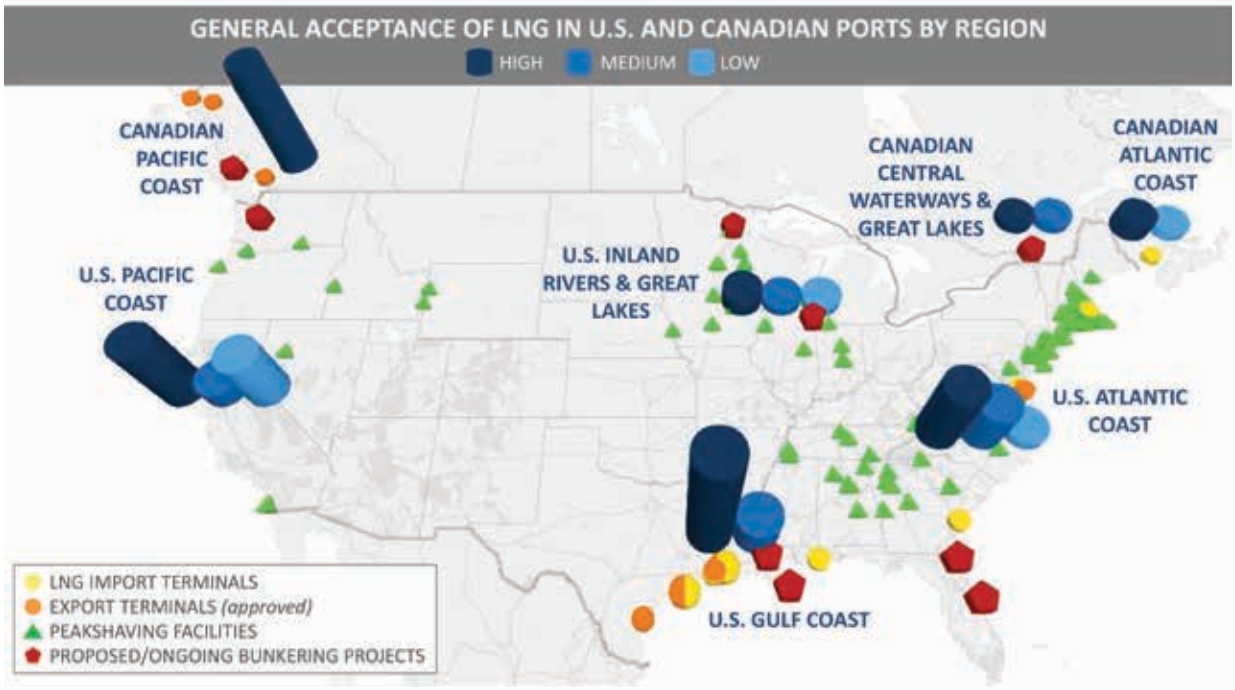

Figure 2. LNG General Acceptance by Regions vs. Potential LNG Sources and Proposed/Ongoing Bunkering Project Locations

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 01-15[2] and 02-15[3].

The ABS Guide for LNG Fuel Ready Vessels[4] 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.

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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 SOx 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 NOx 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 Notice[7] 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]

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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 Adminsitration. "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.

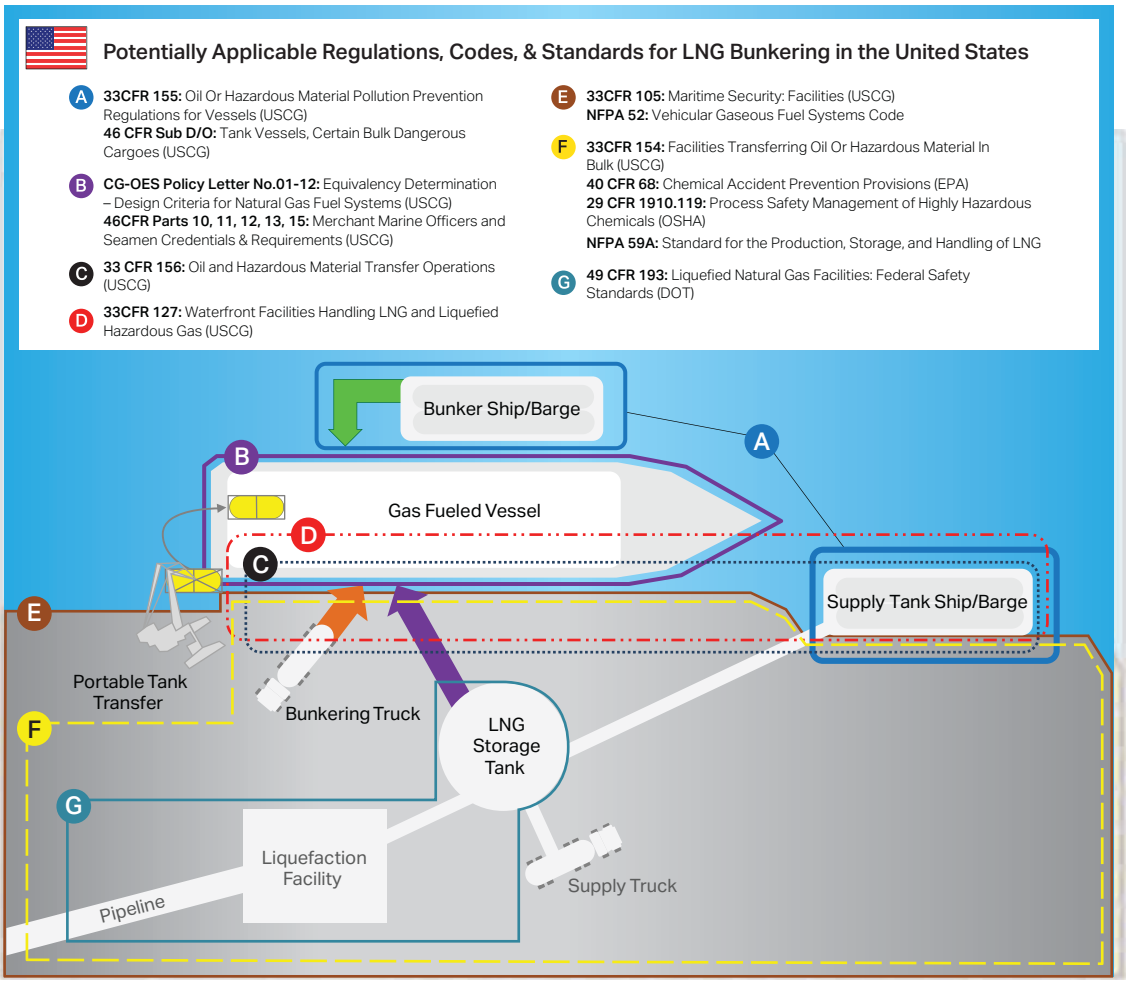


Figure 3. Potentially Applicable Regulations, Codes and Standards for LNG Bunkering in the US

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).

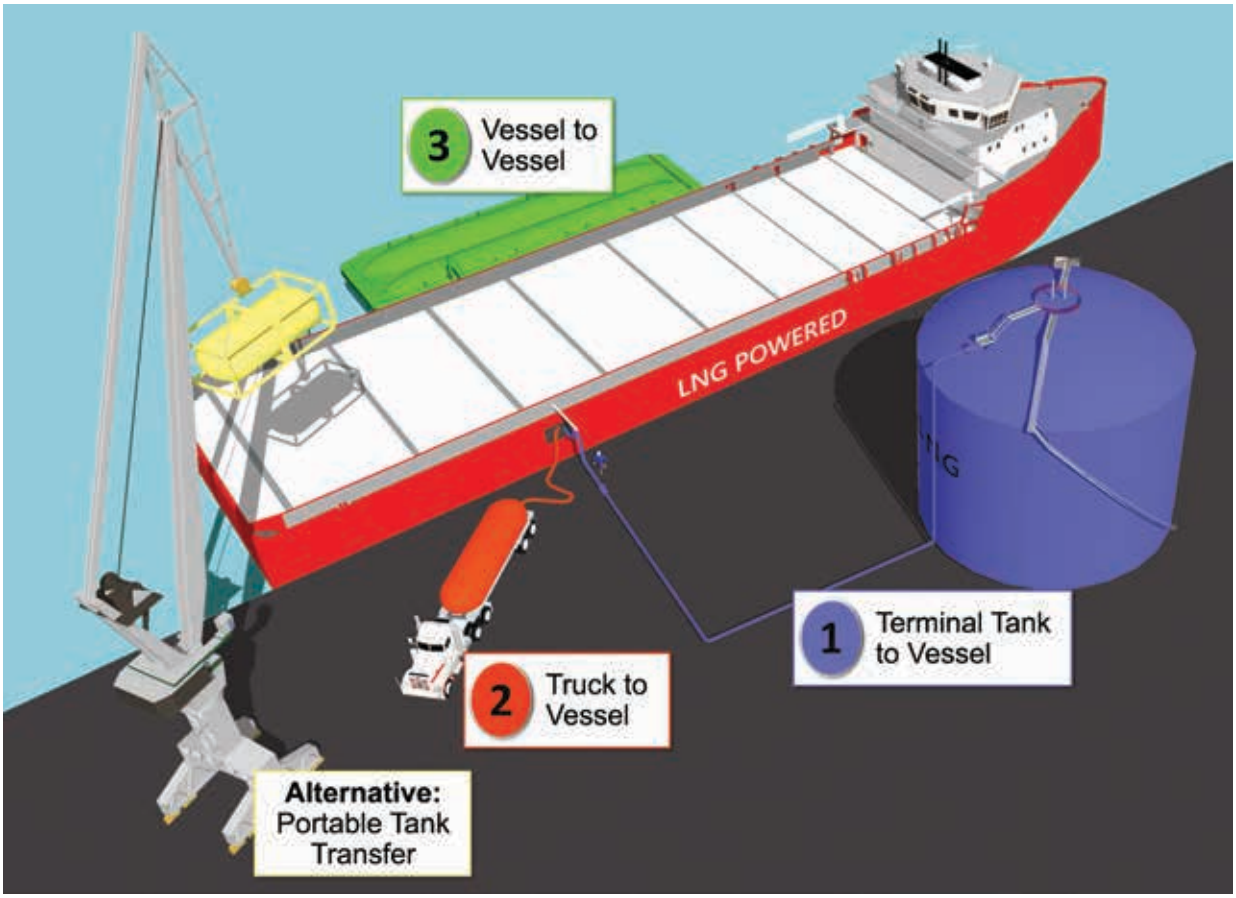


Figure 4. Standard LNG Bunkering Options

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.

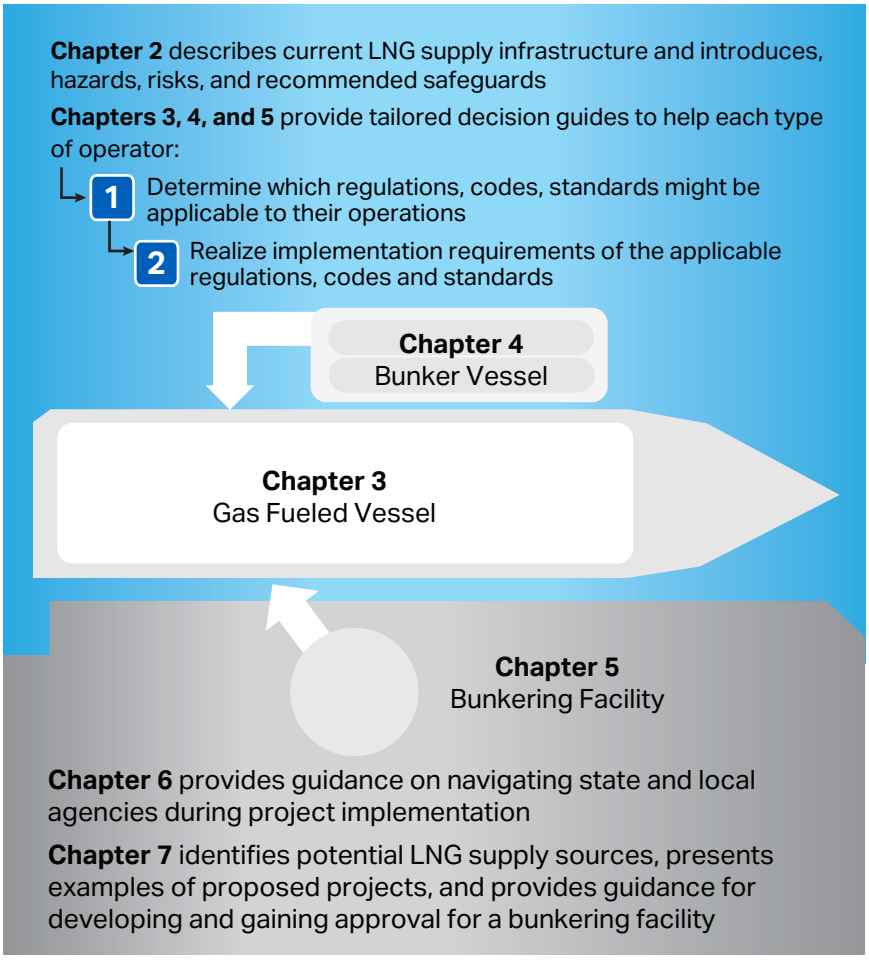
Chapter 6 describes specific studies that, in some cases, may be required in addition to or in support of the regulatory requirements. These studies play an important role in the permitting and approval of LNG bunkering projects and facilities. These sections have been expanded to provide additional 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 on overview of the document content including a listing of new material in this update.



What's New

Chapter 2 - Insights from early adopters

Chapter 3 and 4 - Discussion of the differences between the interim guidance of MSC.285(86), the approved in principle IGF Code and the Standards of Training, Certification and Watchkeeping (STCW) Convention and Code as well as draft letters issued by the USCG for public comment on the topic of LNG transfer operations and training.

Chapter 5 - Guidance and input from the applicable regulatory bodies on the interpretation of regulations effecting bunkering facilities.

Chapter 6 - Additional detail and content for the studies.

Chapter 7 - Findings from the extensive port survey and lessons learned from securing and LNG supply for existing projects.

Appendix E - Detailed contact list and resources for North American Ports to support project developers in their early research of potential project development.

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.

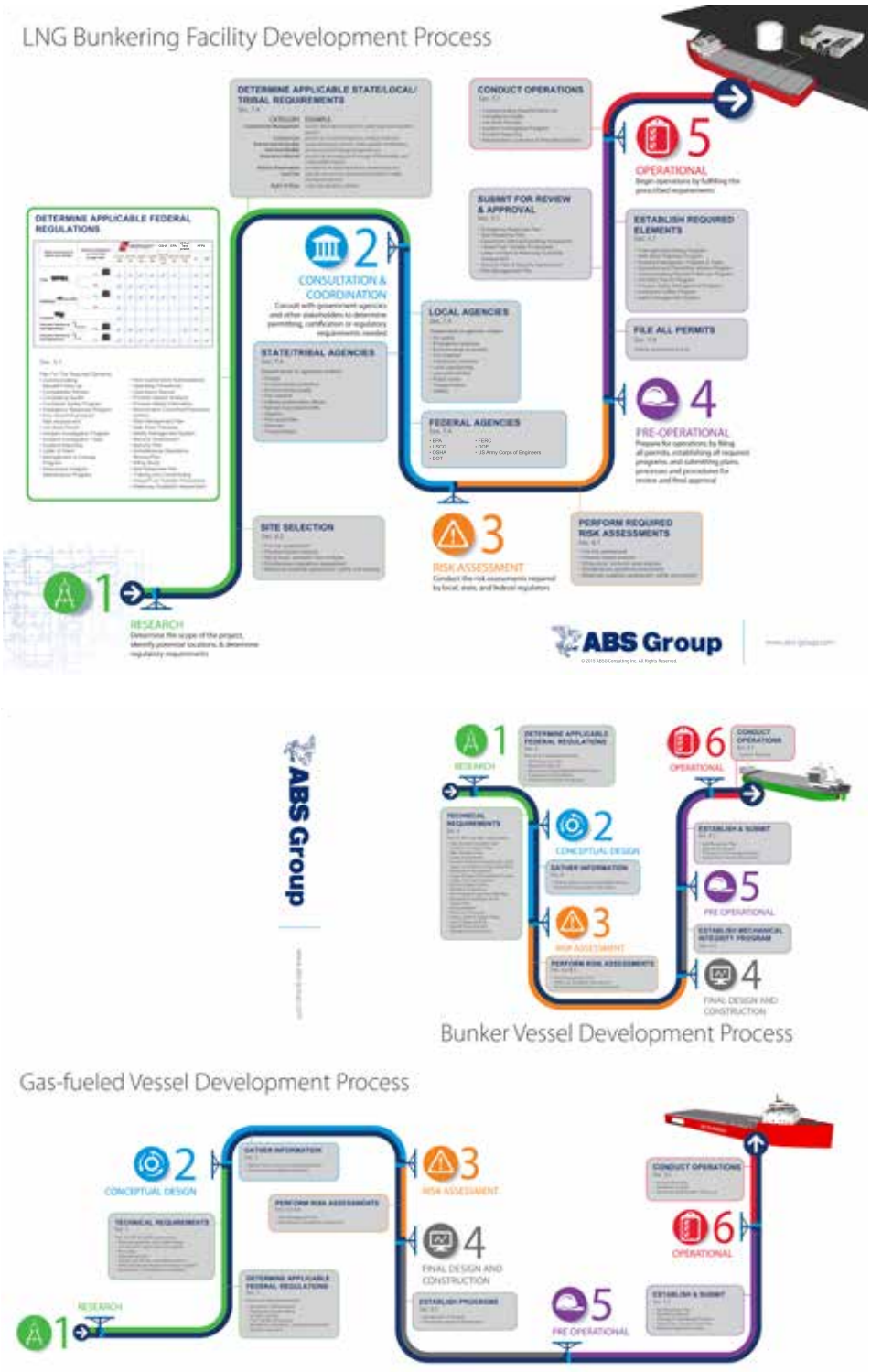


Figure 6. Project Phases

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 by 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 tradition 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 Specification[14] 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: • 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: • 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: • 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: • 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 systems[20] 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
• 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
• 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
• 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	• 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter C – Parts 24-28
Fishing Vessels	• 46 CFR Subchapter C – Parts 24-28
Tank Vessels	• 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter D – Parts 30-39
Passenger Vessels	• 46 CFR Subchapter B – Merchant Marine Officers and Seaman – Parts 10-16 • 46 CFR Subchapter I – Passenger Vessels – Parts 70-80
Cargo Vessels	• 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	• 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	• 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.

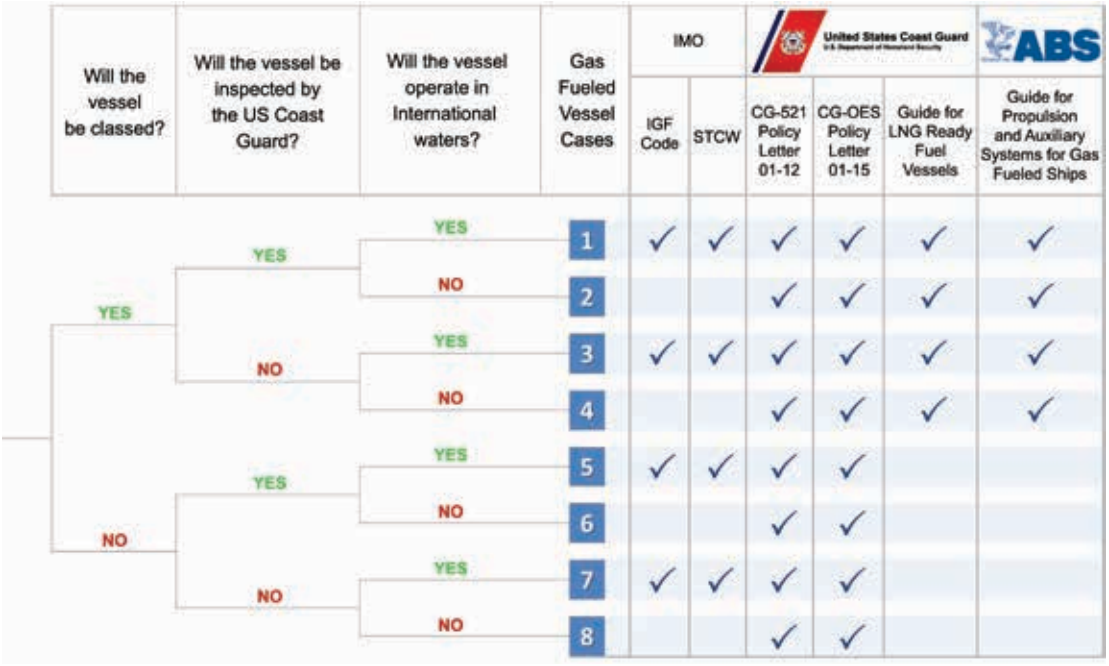


Figure 7. Gas-fueled Vessel Decision Tree

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		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
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
• International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)
USCG
• 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
• 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.

Bunker Vessel Cases	IMO	United States Coast Guard				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
1	✓	✓	✓	✓	✓	✓	
2		✓	✓	✓	✓	✓	
3		✓	✓	✓	✓	✓	✓
4		✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓		
6		✓	✓	✓	✓		
7		✓	✓	✓	✓		
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				ABS	
	IGC Code	USCG Policy Letter OC-OES 02-15	33 CFR 155	33 CFR 156	46 CFR Sub D/C	Steel Vessel Rules Part 5C Chapter 8	Steel Barges Rules Part 5 Chapter 2
	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	3 4 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
• 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)
• 29 CFR 1910.119 – Process Safety Management Of Highly Hazardous Chemicals
Environmental Protection Agency
• 40 CFR 68 – EPA Risk Management Rule
Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA)
• 49 CFR 193 – LNG Facilities: Federal Safety Standards
National Fire Protection Association (NFPA)
• 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.

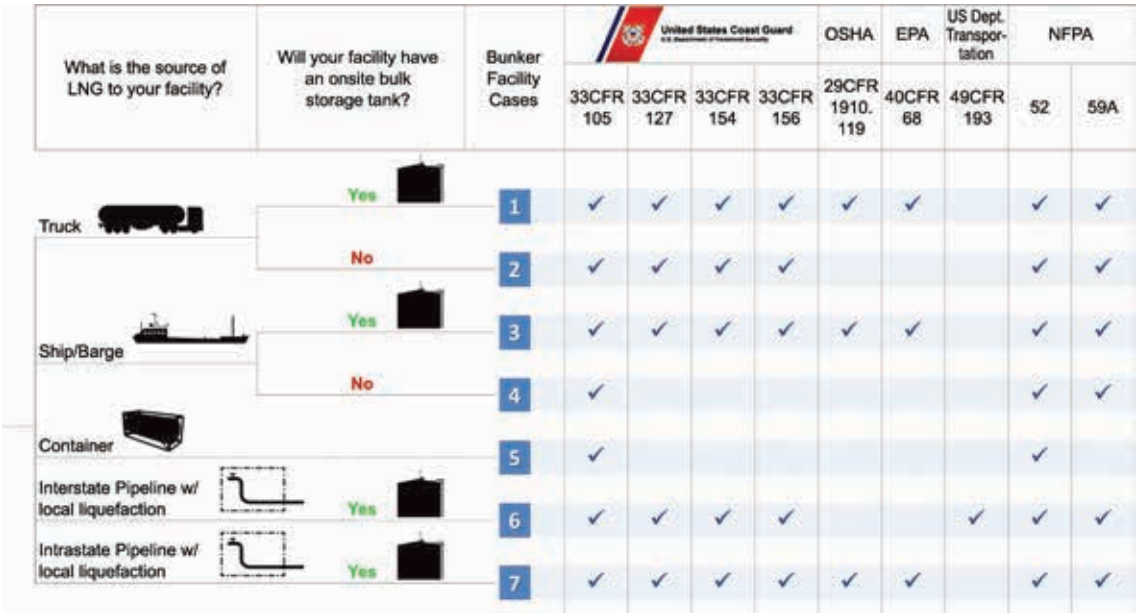


Figure 9 Bunker Facility Decision Tree

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

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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.		✓	✓	✓					✓

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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.	✓	✓	✓		✓	✓	✓	✓	✓

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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.					✓	✓			

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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.		✓							

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Incident Investigation Program									
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.					✓	✓			
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.					✓	✓			
Recommend Corrective and Preventive Actions. Establish system to address and resolve the incident report findings and recommendations.					✓	✓			
Communicating Results/Follow-up. Documented resolutions and corrective actions for review by all affected personnel whose job tasks are relevant to the incident findings.					✓	✓			
Incident Reporting. Notification of security breaches, spills, safety incidents, safety-related conditions, and annual pipeline summary data.	✓						✓		

Key Elements	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
	Applicable Bunkering Facility Cases								
	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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 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
	Applicable Bunkering Facility Cases								
Key Elements	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
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 [m^3]) 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:

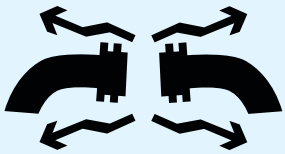
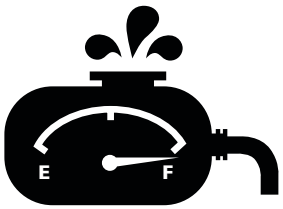
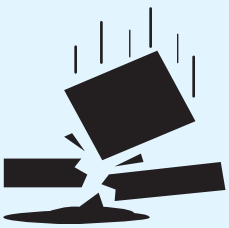
- **Serious injuries to personnel in the immediate area if they come in contact with cryogenic liquids.** Skin contact with LNG results in effects similar to thermal burns and with exposure to sensitive areas, such as eyes, tissue can be damaged on contact. Prolonged contact with skin can result in frostbite 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
Leaks from LNG pumps, pipes, hoses or tanks 	• 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
Inadvertent disconnection of hoses 	• 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)
Overfilling/overpressuring vessel fuel tanks 	• Operator and level controller fail to stop flow when tank is full
External impact 	• 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).

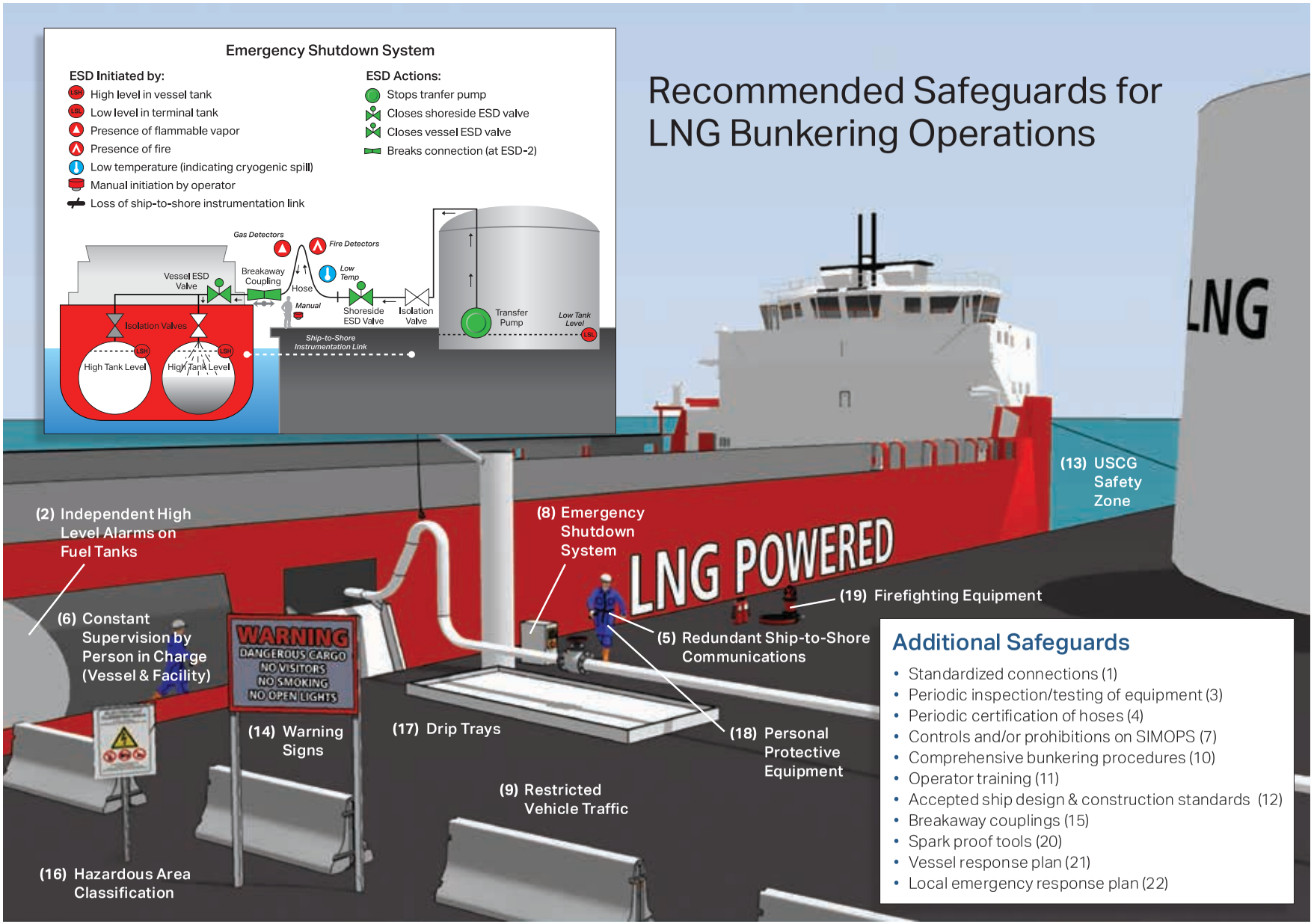


Figure 10. Recommended Safeguards for LNG Bunkering Operations

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.

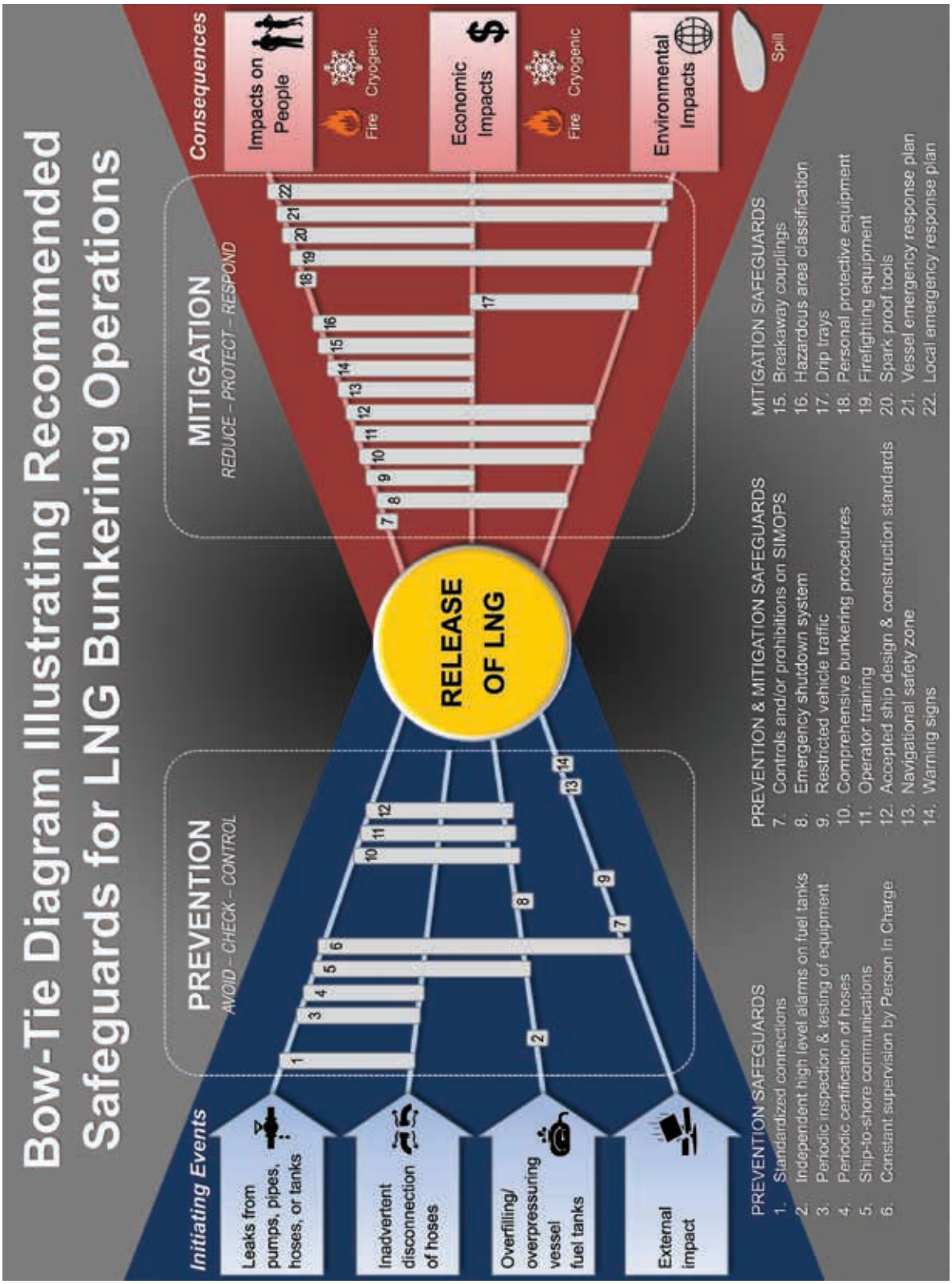


Figure 11. Bow-tie Diagram Illustrating Safeguards for LNG Bunkering Operations

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 01-15[37] 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 01-15[38] 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 Specification[39] 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.

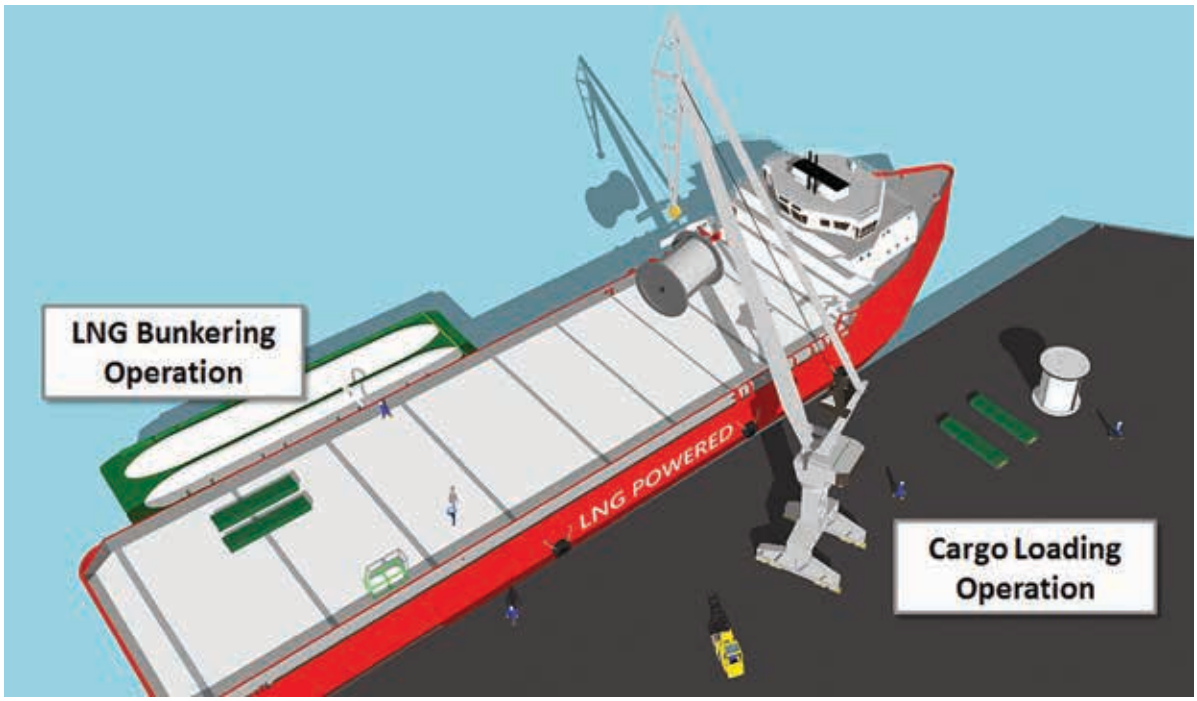


Figure 12. Example SIMOPS: LNG Bunkering and Cargo Loading

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	• 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	• 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	• 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, breath, 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 02-15[40]).

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 Construc-tion
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 Construc-tion
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 Construc-tion
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.		.0.002 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/lngxprtlcncpplctns/lngxprtlcncpplctns-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 m^3 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/rnrgynfmtn/nrgyrprt/ntrlgs/lqfdntrlgscndnprspctv2009/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 Bcfd). 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 Liquified Natural Gas," (http://www.corporatif.gazmetro.com/corporatif/communique/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 Geismer, 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 m^3). 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 Rending 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.suezenergyna.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.

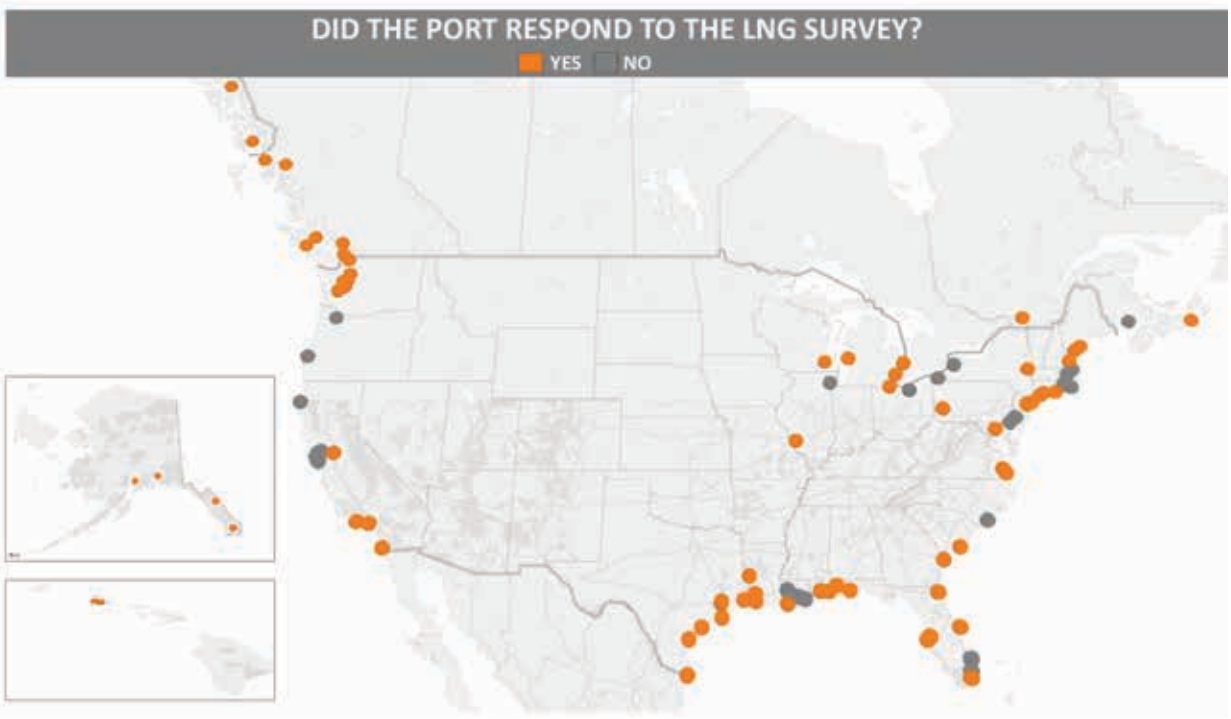


Figure 14. Ports Contacted in ABS Port Survey

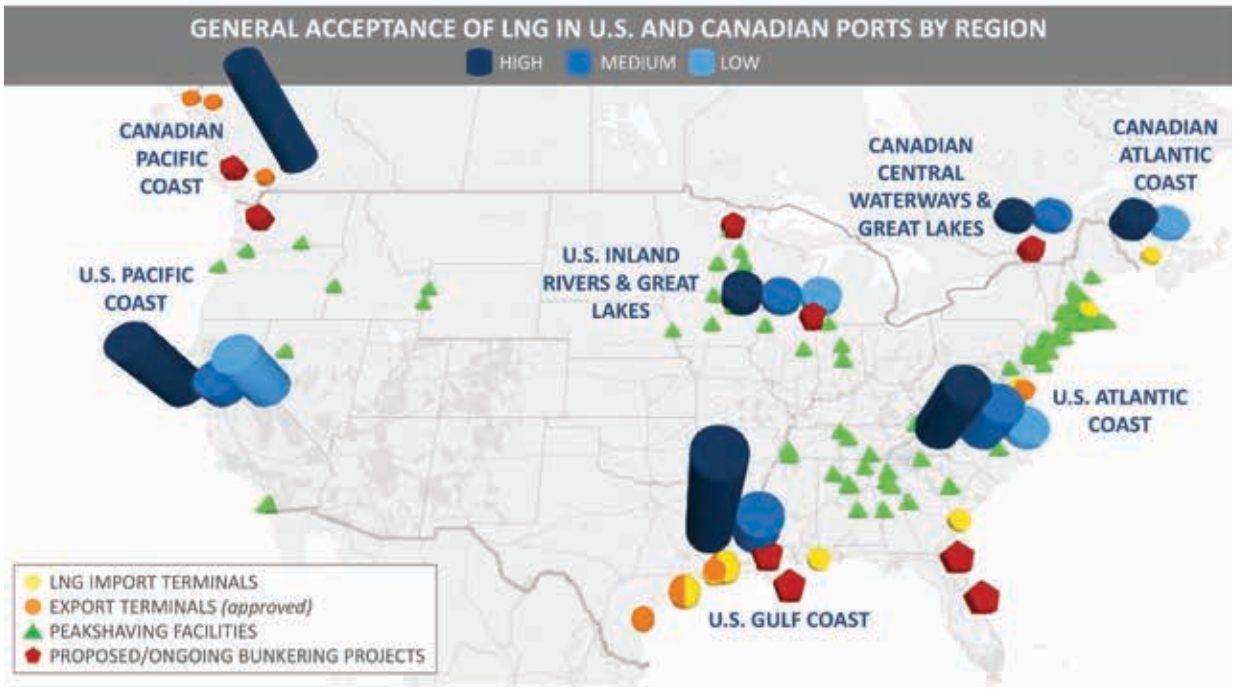


Figure 15. LNG General Acceptance by Regions vs. Potential LNG Sources and Proposed/ Ongoing Bunkering Project Locations

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 • 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)	✓ 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	✓ 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 ✓ 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 ✓ Regulatory procedures, including: – Information that must be submitted – Permits/approvals that are required
State, Provincial and/or Local Fire Marshal Office	✓ 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] ✓ Relevance of state/provincial natural gas regulations (if any) to bunkering facilities

57 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHSMA), "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	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: ✓ Clean Air Act ✓ Clean Water Act ✓ Resource Conservation and Recovery Act ✓ Other requirements depending on the technology involved 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.
State, Provincial, and Local Environmental Regulators (e.g., Division of Environmental Quality, Department of Ecology, State EPA)	Environmental regulations at the state, provincial, local level can vary greatly. Reaching out to the applicable organizations early is important ✓ Applicable environmental agencies and regulations ✓ Extent of EPA/Environment Canada versus local permitting
Local planning/zoning commission	✓ Discussion of local planning/zoning requirements
Local Maritime Community	
Port Authority	Port authorities may have specific requirements regarding bunkering within the port
Marine Exchange	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) ✓ Experience with regulators ✓ Concerns from other users of the port
Marine Pilot Associations	✓ 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	✓ Concerns/requirements for facility access and fire response planning ✓ Coordination of training regarding LNG hazards
Emergency Medical Services Agency	✓ Concerns/requirements for facility access and medical response planning ✓ Coordination of training regarding LNG hazards
State/Provincial/Local/Port Law Enforcement Agencies	Security assessments, plans, and coordination requirements

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-Z276[66], 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 Coast[68], 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 Tilbury 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-subsidiary-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, Fincantierri, 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.

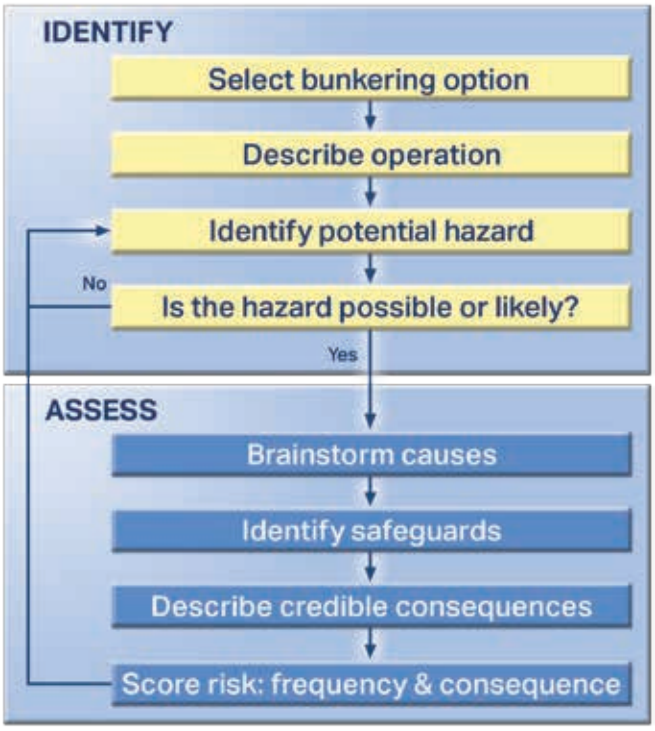


Figure A1. Risk Assessment Process

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.

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							
Item	**Hazard**	**Typical Causes**	**Typical Consequences**	**Impact**	**S**	**L**	**Risk Level**	**Representative Safeguards**
1.1	What if there is an LNG leak from pump/piping/ hoses during transfer?	Corrosion/erosion External impact Fatigue failure Gasket, packing failure Hose failure or disconnection Improper hose connection Improper maintenance Material defect (e.g., weld) Piping not properly cooled down prior to transfer Seal failure Use of inappropriate piping/ hoses (e.g., not LNG rated) Valve leaking or misaligned to the atmosphere Vibration 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 dropped onto tank or loading lines (linked from 1.13) Fire aboard the receiving vessel (linked from 1.14) Extreme sea state (linked from 1.17) Earthquake (linked from 1.18)	Small release of LNG	Environmental				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 Pressure testing 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
			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				
			Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area	Death & Injury				
1.2	What if there is an LNG leak from the supply truck?	Corrosion/erosion External impact Gasket/packing failure Improper maintenance Material defect Valve leaking or misaligned to the atmosphere	Small release of LNG	Environmental				Bunkering procedures Controls and/or prohibitions of simultaneous passenger and bunkering operations Equipment inspection/testing prior to bunkering ESD system ESD system tests
			Small release of LNG, resulting in fire damage to ship/supply tank/ surrounding equipment potentially affecting a small area	Economic				
			Small release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the immediate area	Death & Injury				

No. 1	Truck to Vessel							
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	Environmental				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
			Very small release of LNG, resulting in cryogenic hazards to personnel in the immediate area	Death & Injury				
			Very small release of LNG; no economic consequence					
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	Environmental				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
			Large release of LNG, resulting in brittle fracture of ship deck; fire damage to ship/supply tank/ surrounding equipment potentially affecting a large area	Economic				

No. 1	Truck to Vessel							
Item	**Hazard**	**Typical Causes**	**Typical Consequences**	**Impact**	**S**	**L**	**Risk Level**	**Representative Safeguards**
		improper logic) Use of nonstandard equipment	personnel in the surrounding area					where accidental releases could occur to limit ignition sources Vessel emergency response plans Local emergency response plans
			Serious media attention and public outcry	Reputation				
1.5	What if there is excessive movement of the hose/loading arm?	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)	LNG leak from pump/piping/hoses during transfer (linked to 1.1)					Bunkering procedures ESD system Loading arm design standards and inspections Maintenance procedures
			Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)					
1.6	What if the tank is overfilled?	Level controller and operator fail to stop flow when tank is full	Small to medium release of LNG	Environmental				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
			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	Economic				
			Small to medium release of LNG, resulting in fire/explosion/ cryogenic hazards to personnel in a small area	Death & Injury				
1.7	What if the tank is overpressured?	Continued transfer to liquid-full tank and relief valve fails to open Fire aboard the receiving vessel (linked from 1.14)	Large release of LNG	Environmental				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
			Large release of LNG, resulting in brittle fracture of ship deck/ fire damage to ship/supply tank/ surrounding equipment potentially affecting a large area	Economic				
			Large release of LNG, resulting in fire/explosion/cryogenic hazards to personnel in the surrounding area	Death & Injury				
			Serious media attention and public outcry	Reputation				
1.8	What if the transfer lines are not de-inventoried and/or purged properly?	Operator error	Small release of LNG	Environmental				Bunkering procedure, including: de-inventorying, purging, inerting, and disconnection steps Operator training
			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				

No. 1	Truck to Vessel							
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	Economic				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
			Very small release of LNG	Environmental				
			Very small release of LNG, resulting in cryogenic hazards to personnel in the immediate area	Death & Injury				
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)					Bunkering procedures, including steps to secure supply truck Driver training Limit traffic in bunkering area
			Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)					
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)					Mariner training and credentials Piloted operations, where employed USCG safety zones and regulated navigational areas
			Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)					
1.12	What if a vehicle collides with the supply truck?	Driver error	LNG leak from the supply truck (linked to 1.2)					Bunkering procedures Driver training Limited traffic in bunkering area Vehicle guards around fixed storage tank
			Truck drives/rolls away with hoses still connected (linked to 1.10)					
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)					Bunkering procedures Controls and/or prohibitions of simultaneous cargo and bunkering operations Crane design standards and inspections Crane operator training and certification Maintenance procedures
			LNG leak from the supply truck (linked to 1.2)					
			Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)					
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)					Bunkering procedures, including emergency operations ESD system Firefighting system Shipboard emergency response procedures
			Tank is overpressured (linked to 1.7)					

No. 1	Truck to Vessel							
Item	**Hazard**	**Typical Causes**	**Typical Consequences**	**Impact**	**S**	**L**	**Risk Level**	**Representative Safeguards**
1.15	What if there is an external fire near the supply truck?	Onshore/dock fire Transportation equipment fire	Large release of LNG	Environmental				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
			Large release of LNG, resulting in fire/explosion damage to ship/supply tank/surrounding equipment potentially affecting a large area	Economic				
			Large release of LNG, resulting in fire/explosion/BLEVE/cryogenic hazards to personnel in the surrounding area	Death & Injury				
			Serious media attention and public outcry	Reputation				
1.16	What if there is extreme wind during the bunkering operation?	Weather	Excessive movement of the loading arm (linked to 1.5)					Bunkering procedures, including weather limits
			Cargo is dropped onto tank or loading lines (linked to 1.13)					
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)					Bunkering procedures, including weather limits
			Disconnect of piping/hoses during transfer (prior to stopping flow) (linked to 1.3)					
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)					Seismic qualifications of cranes Seismic qualifications of fixed onshore tanks
			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)					

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
Contribute to the safe operation of a ship subject to the IGF Code	Design and operational characteristics of ships subject to the IGF Code Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: 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. Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: 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 Basic knowledge of the physical properties of fuels on board ship subject to the IGF Code, including: 1. Properties and characteristics 2. Pressure and temperature, including vapour pressure/ temperature relationship Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.

Competence	Knowledge, Understanding and Proficiency
Take precautions to prevent hazards on a ship subject to the IGF Code	Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: 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 Basics knowledge of hazard controls: 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) Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS).
Apply occupational health and safety precautions and measures	Awareness of function of gas-measuring instruments and similar equipment 1. Gas testing Proper use of safety equipment and protective devices, including: 1. Breathing apparatus 2. Protective clothing 3. Resuscitators and equipment 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: 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 Basic knowledge of first aid with reference to an SDS.

Competence	Knowledge, Understanding and Proficiency
Carry out firefighting operations on a ship subject to the IGF Code	Fire organization and action to be taken on ships subject to the IGF Code. Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code 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 Firefighting system operations
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	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: 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	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: 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: 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
	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 Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code
Operate remote controls of fuel related to propulsion plant and engineering systems and services on ships subject to the IGF Code	Operating principles of marine power plants and ships' auxiliary machinery General knowledge of marine engineering terms
Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code	Design and characteristics of ships subject to the IGF Code Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: 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: 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 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 1. Low pressure pumps 2. High pressure pumps 3. Vaporizers 4. Heaters 5. Pressure Build-up Units

Competence	Knowledge, Understanding and Proficiency
	Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including: 1. Inerting 2. Cooling down 3. Initial loading 4. Pressure control 5. Heating of fuel 6. Emptying systems
Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code	General knowledge of ships subject to the IGF Code Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker- supply ship Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships subject to the IGF Code Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: 1. Bunkering procedures 2. Emergency procedures 3. Ship-shore/ship-ship interface 4. Prevention of rollover Proficiency to perform fuel-system measurements and calculations, including: 1. Maximum fill quantity 2. On board quantity (OBQ) 3. Minimum remain on board (ROB) 4. Fuel consumption calculations
Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code	Knowledge of the effects of pollution on human and environment
Monitor and control compliance with legislative requirements	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. Proficiency in the use of the IGF Code and related documents.

Competence	Knowledge, Understanding and Proficiency
Take precautions to prevent hazards	Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: 1. Flammability 2. Explosion 3. Toxicity 4. Reactivity 5. Corrosivity 6. Health hazards 7. Inert gas composition 8. Electrostatic hazards 9. Pressurized gases Proficiency to calibrate and use monitoring and fuel detection systems, instruments, and equipment on board ships subject to the IGF Code. Knowledge and understanding of dangers of noncompliance with relevant rules/ regulations. Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code. Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code. Ability to elaborate and develop safety plan and safety instructions for ships subject to the IGF Code.
Application of leadership and teamworking skills on board a ship subject to the IGF Code	Ability to apply task and workload management, including: 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 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.
Apply occupational health and safety precautions and measures on board a ship subject to the IGF Code	Proper use of safety equipment and protective devices, including: 1. Breathing apparatus and evacuating equipment 2. Protective clothing and equipment 3. Resuscitators 4. Rescue and escape equipment Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety, including: 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 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code.

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	Ship construction, including damage control Knowledge and understanding of shipboard emergency procedures for ships subject to the IGF Code, including: 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 Action to be taken following collision, grounding or spillage and envelopment of the ship in toxic or flammable vapour including: 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 jettisioning of fuel Actions to be taken following envelopment of the ship in flammable fluid or vapour 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).

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.	Moderate There are two proposed LNG facilities in Guysborough, Nova Scotia, and one in Port Hawkesbury, Nova Scotia. Discussions with local stakeholders and authorities in Nova Scotia indicate that public sentiment is very favorable to LNG.	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.	Moderate/High 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.	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. 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. 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.
Canada, Central Water-ways and Great Lakes	Limited	Gaz Métro LNG has a liquefaction, storage and regasification plant in Montreal, QU.	Moderate Mostly centering on Ontario and Quebec, overall LNG interest in the region can be moderate. Royal Dutch Shell proposed LNG facility in Sarnia, Ontario has been temporarily put on hold.	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.mxsocal.org/)
	Marine Exchange of the San Francisco Bay Region (http://www.sfmx.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://depsc.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_marshal/state_fire_marshal_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.portmetrovancouver.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-Iles 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
GNDR, 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
	State Permit to Construct
Mississippi Department of Marine Resources	Coastal Zone Consistency Determination
	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
	Water Use Permit (marine water intake)
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=73 index.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.pwsrcac.org/programs/maritime/valdez-marine-safety-committee/	http://www.harboradvice.com/wp-content/uploads/2011/10/Valdez-Waterfront-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
Humbaldt Bay Harbor	Sector San Francisco/ Eureka, CA	Pacific Coast	MEDIUM	Humboldt Bay Area Harbor Safety Committee 707-834-4938	http://humboldtharborsafety.org/	http://humboldtbay.org/sites/humboldtbay.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_committee.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.mxsocal.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/TranSystems_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
Port of San Diego	Sector San Diego/ San Diego, CA	Pacific Coast	VERY LARGE	San Diego Harbor Safety Committee 619-686-6526	https://www.portofsandiego.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.sfmx.org/support/hsc/	http://www.sfcontroller.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.sfmx.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.sector.org/Home/Programs/ThamesMaritimeCoalition/tabid/79/Default.aspx	https://www.bridgeportct.gov/filestorage/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.sector.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.sector.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
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.macdelriv.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/govaction/agendas.asp?Action=Agendas&Oper=DisplayAgenda&Agenda=EDP&AgendaName=Economic+Development+%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
Port of Pensacola	Sector Mobile/ Pensacola, FL	Gulf Coast	MEDIUM	Pensacola Bay Pilots Association 850-434-8163	http://florida pilots.com/word press/?page_ id=45	http://portofpensa cola.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.pro 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.pro pellerclubtampa. com/index.asp? pageId=86	https://www.tam paport.com/user files/files/TPA%20 2008%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. savannah maritime.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.portof guam.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://hosthawaii. 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://hosthawaii. 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

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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:// coastguard news.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/online pubs/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/online pubs/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
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/HSCAMSC/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.mpa.maryland.gov/_media/client/planning/StategicPlanFinal1208OS.pdf	Maryland Port Administration 410-385-4401	410-576-2561	410-576-2619	410-576-2568

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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 Develop-ment 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.macdelriv.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

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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_Departments/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.toledoseaport.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.lcrhsc.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
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/cmmplan.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.waterwaysassociationpgh.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.maritimedelriv.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/about/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/environment/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-port/projects/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/StrategicPlanBrochure.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/CouncilCommitteees/Public-Works.htm#.VJBwetLF87M	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@decaturtransit.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 prtdutch@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@cityofseldovia.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 lrport@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				
Cresent City Harbor	Cresent 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	Stongington 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 machiastownmanager@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	Camben, 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	Monehegan 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@ci.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 gvlport@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 Claireborne County	Clairborne, MS	Gulf Coast	VERY SMALL	Mississippi Department of Transportation 601-437-5216
Natchaz Adams County Port	Natchaz, 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 Mississippi 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@portofcallcatskill.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	Kismit 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 cpaadmin@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
TENNESEE				
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

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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 Almota	Almota, 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@portofpt.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 mrnaport@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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