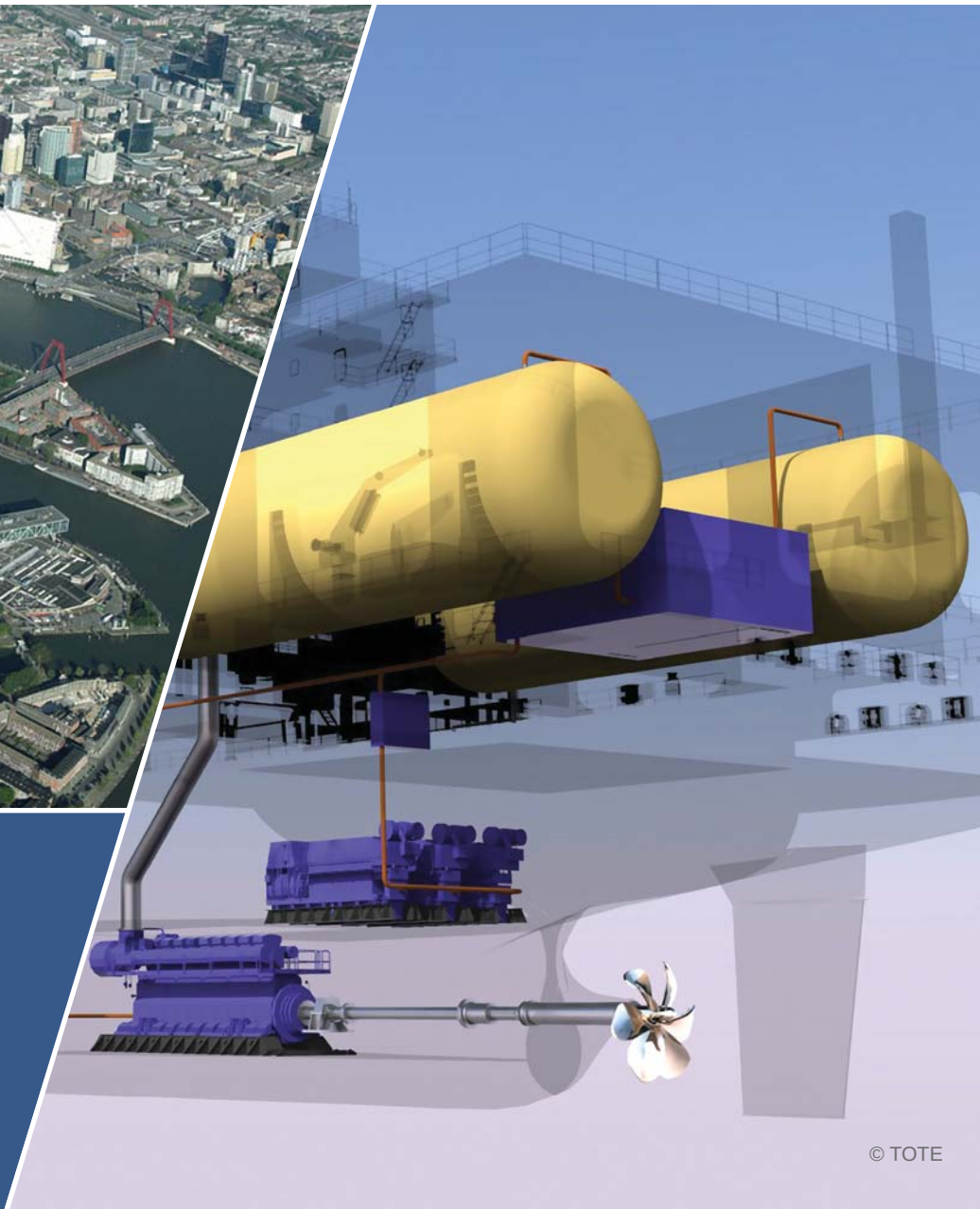
Bunkering of Liquefied Natural Gas-fueled Marine Vessels in North America



Our Mission

The mission of ABS is to serve the public interest as well as the needs of our 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 clients and the public by delivering quality service in support of our mission that provides for the safety of life and property and the preservation of the marine environment.

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

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

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Acronyms

ABS	American Bureau of Shipping
ASME	American Society of Mechanical Engineers
CDC	Certain Dangerous Cargo
CFR	Code of Federal Regulations
CH4	Methane
CNG	Compressed Natural Gas
COE	Corps of Engineers
COTP	Captain of the Port
CSA	Canadian Standards Association
DEC	Department of Conservation
DOE	Department of Energy
DOT	Department of Transportation
ECA	Emission Control Area
ECL	Environmental Conservation Law
ECO	Edison Chouest Offshore Companies
EGC	Exhaust Gas Cleaning
EIA	US Energy Information Administration
EPA	Environmental Protection Agency
EPC	Engineering, Procurement and Construction
ESD	Emergency Shutdown
FERC	Federal Energy Regulatory Commission
FRA	Fire Risk Assessment
FSA	Facility Security Assessment
FSO	Facility Security Officer
FSP	Facility Security Plan
GE	General Electric
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HFO	Heavy Fuel Oil
HQ	Headquarters
HSE	Health, Safety and Environmental
IAPH	International Association of Ports and Harbors
IGC	International Gas Code
IGF Code	Code of Safety for Gas-Fuelled Ships
IMO	International Maritime Organization
ISM Code	International Safety Management Code
ISO	International Organization for Standardization
kW	kilowatt
LNG	Liquefied Natural Gas
MARAD	Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships
MARSEC	Maritime Security
MDO	Marine Diesel Oil
MERPAC	Merchant Marine Personnel Advisory Committee
MGO	Marine Gas Oil
MMC	Merchant Mariner's Credential

MSC	Maritime Safety Committee
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
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
PSM	Process Safety Management
QRA	Qualitative or Quantitative Risk Assessment
RMP	Risk Management Program
RMPlan	Risk Management Plan
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
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
TWIC	Transportation Worker Identification Credential
US	United States
USCG	United States Coast Guard
WSA	Waterway Suitability Assessment
WSF	Washington State Ferries

1. Introduction

The effect of increasingly stricter air emissions legislation implemented through International Maritime Organization (IMO) Annex VI and other local air quality controls, together with favorable financial conditions for the use of natural gas instead of liquid fuel oil as a bunker fuel is increasing the number of marine vessel owners that are considering the use of liquefied natural gas (LNG) as a fuel. Existing United States Coast Guard (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. United States (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.

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 hazards identification and analysis.

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.

1.1. LNG Drivers

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

- Compliance with emissions regulations, and
- Economic and cost drivers, including fuel costs, repowering and newbuilds, availability and costs of LNG.

1.1.1. 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 (SOx), nitrogen oxide (NOx), 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.

NOx tier II requirements are currently in effect for applicable marine engines, and in ECA areas, more stringent tier III requirements begin on January 1, 2016.

The tiered approach for sulfur means that the existing global maximum sulfur content of 3.5% will be reduced to 0.5%, either in 2020 or 2025, depending on the outcome of an IMO review in 2018. In designated ECA areas, the current 1.0% sulfur fuel requirement will be reduced to 0.1% on January 1, 2015.

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.[1]

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

1. Use low sulfur residual or distillate marine fuels in existing machinery
2. Install new machinery (or convert existing machinery where possible) designed to operate on an inherently low sulfur alternative fuel, such as LNG
3. Install an exhaust gas cleaning (EGC) after-treatment system (scrubber)

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.

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

While scrubbers offer the potential for lower operating costs through the use of cheaper high sulfur fuels, purchase, installation, and operational costs associated with scrubbers would also need to be considered. These costs should be assessed against the alternatives of operating a ship on low sulfur distillate fuel or an alternative low sulfur fuel, such as LNG. Fuel switching, meaning using higher sulfur fuel where permitted and lower sulfur fuel where mandated, has its own complications and risks, but should also be considered as part of the evaluation of possible solutions to the emissions regulations. Refer to the ABS *Fuel Switching Advisory Notice*[2] for more information on the issues related to fuel switching.

1 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, April 30, 2010 / Rules and Regulations. http://edocket.access.gpo.gov/2010/pdf/2010-2534.pdf

2 *Fuel Switching Advisory Notice*, ABS, March 2010.

1.1.2. Economic Factors

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 in the US move in a favorable direction.

Today, shale gas accounts for a significant portion of US natural gas production. Up from near zero in 2000, it is predicted to account for about half of US gas output by 2040.[3] A significant effect of the fracking revolution has been in LNG. In 2008, US gas production had been relatively flat for years and was expected to decline. The outlook was that the country would be importing 20% of its gas needs by 2020, becoming in the process the world's number one LNG consumer.

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.[4] Many major LNG exporters who had spent years building business plans around a US import market found themselves in a different position. Forecasts in 2006 had most future US LNG imports coming from suppliers in the Persian Gulf; today any such dependence has been all but eliminated. On top of that, the 14 gas exporting nations that talked about forming an Organization of the Petroleum Exporting Countries (OPEC)-like gas cartel in 2007 are now adjusting to a market that is very different from that of six to eight years ago.

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. Much of Asia's overall imports will be in the form of LNG and, according to market analysts Wood Mackenzie, China and Southeast Asian countries will become increasingly important components of overall Asian demand through 2025. Despite the opportunity for American businesses, how much of Asian demand will be filled by US gas remains an open question. Under US law, the Department of Energy (DOE) must determine whether an LNG export proposal will serve the national interest; definitive answers to questions of exports affecting trends in domestic gas use, the drive for energy security, and the growth in the domestic economy are still being pursued.

Desire for the US to hold onto its gas is understandable since the gas revolution, in just these early years, has already done much to help the country's economy. The abundant US gas supply is not only making many major manufacturers switch from oil to natural gas as their feedstock source, but also encouraging them to build new plants in America and renovate old ones.

3 Medlock, K. B., III. The Impacts of the Natural Gas Shale Boom on US Energy Security. Retrieved from Baker Institute: http://bakerinstitute.org/files/3882/, (December 29, 2010).

4 US Energy Information Administration. US Crude Oil and Natural Gas Proved Reserves. Retrieved from US Energy Information Administration: http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm, (August 1, 2013).

1.2. 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 (Figure 1).

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, and Society of Gas as a Marine Fuel) and regulations (e.g., IMO) that provide guidance for the equipment and operation of natural gas-fueled engine installations on ships.

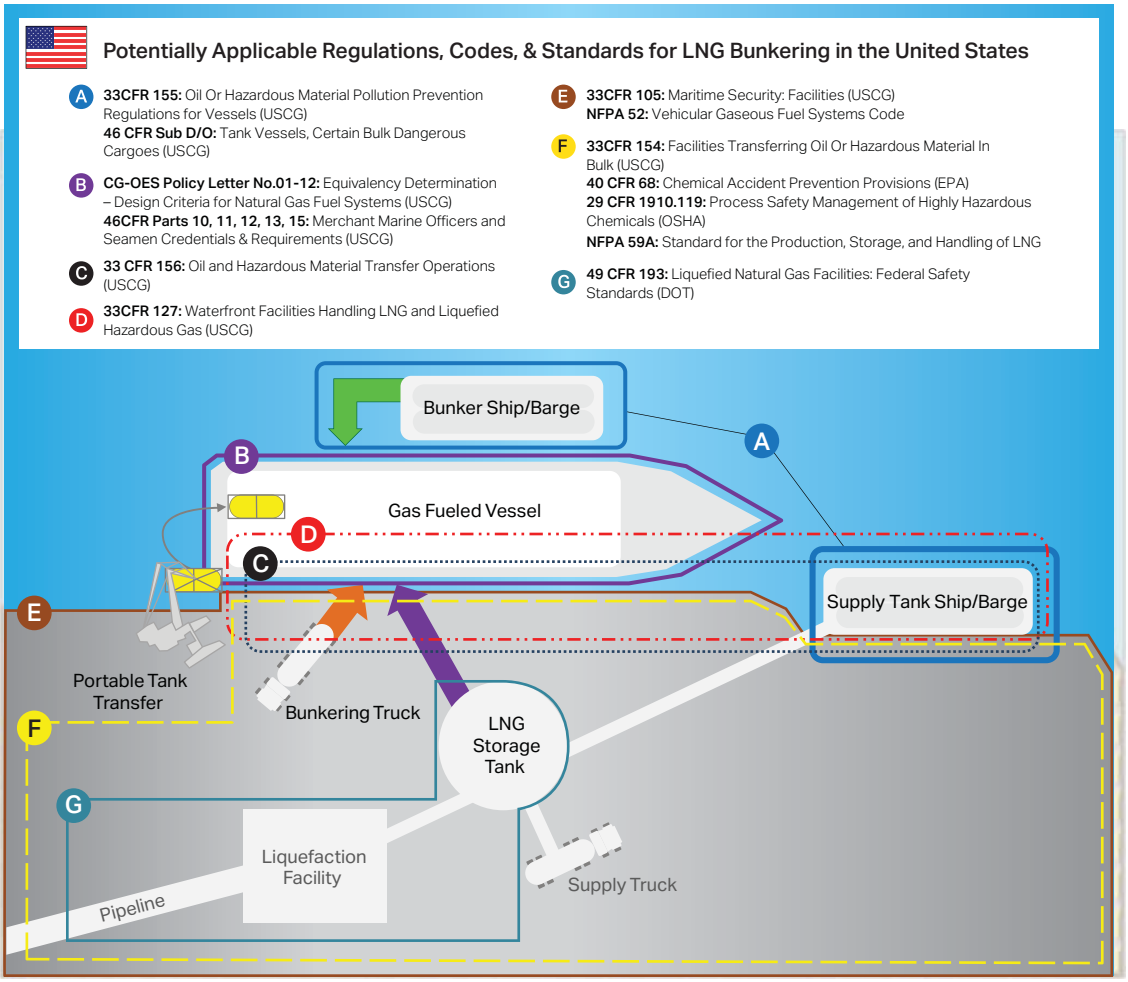


Figure 1. Potentially Applicable Regulations, Codes, and Standards for LNG Bunkering in the US

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 proposed Code of Safety for Gas-Fuelled Ships (IGF Code) 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,[5] are moving forward with plans to build gas-fueled vessels for operation in Canada.

5 "Wärtsilä's integrated solution selected for two environmentally advanced Canadian ferries," Reuters, September 11, 2013.

1.3. 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. Figure 2 is an overview of the document to help guide owners and operators to the applicable chapter(s) applicable to their operations.

Chapter 2 describes current LNG bunkering options and introduces hazards, risks, and recommended safeguards.

Chapters 3, 4, and 5 provide guidelines for 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, and Chapter 5 provides guidelines for bunkering facility operators.

Chapter 6 describes specific studies that, in some cases, may be required in addition to the regulatory requirements.

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.

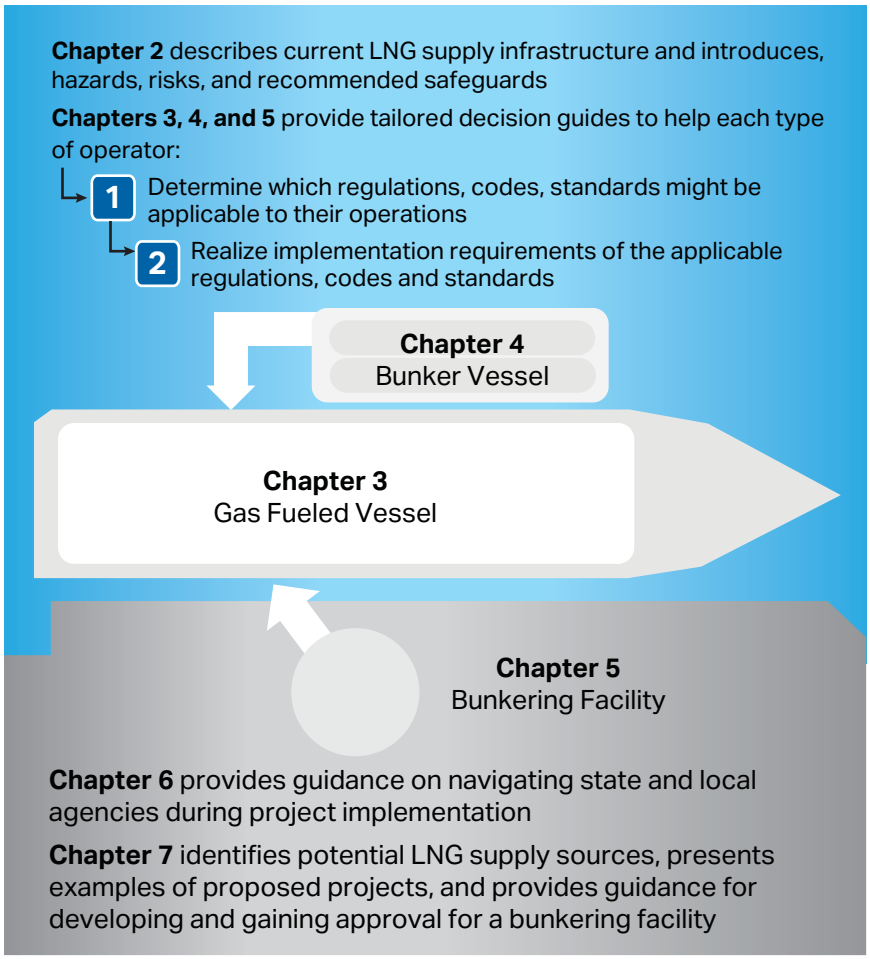


Figure 2. Document Guide

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 yet exist.

2. Key Issues with LNG Supply

2.1. LNG Bunkering Options

There are multiple options for bunkering LNG onto 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 LNG bunkering options (Figure 3).

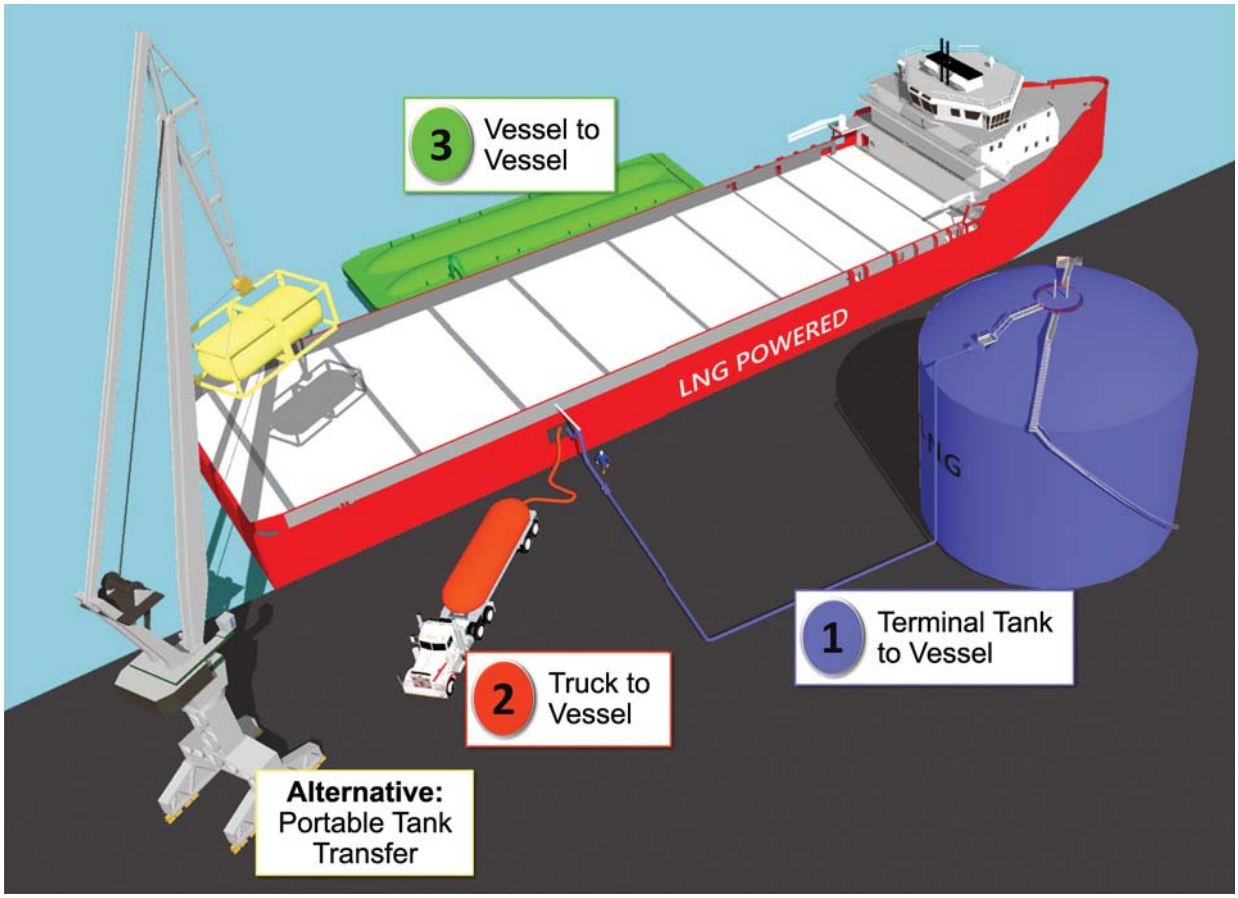


Figure 3. Standard LNG Bunkering Options

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" (0.05-0.1m) 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.

An Alternate to "Bunkering": 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., ASME/ISO 1496 Part 3, USCG 46 Code of Federal Regulations [CFR] 173).

This approach can simplify bunkering facility project startup by leveraging intermodal transportation capacity and by not requiring large and expensive land-based storage tanks. In addition, it may have some regulatory advantages. For instance, the USCG does not consider the loading or unloading of these portable LNG tanks for use as fuel as bunkering. Rather, these operations would follow the hazardous cargo stowage and handling requirements (e.g., 49 CFR Part 176). Therefore, facilities performing these types of operations would be considered cargo facilities rather than bunkering facilities and would fall under the simpler regulatory regime for safe transfer of cargo.

For vessels, there are various proposals on how to connect these types of fuel tanks to meet the USCG's draft vessel safety policies, but no designs for vessels using portable fuel tanks have been approved yet. Also, the limited capacity of these tanks when compared to the capacity of permanent vessel fuel tanks, would, for most vessel types, necessitate multiple portable tanks feeding a manifold to the vessel's fuel system to meet fuel capacity requirements. In this case, the vessel crew would frequently make and break piping connections to facilitate the replacement of these portable tanks, increasing the likelihood for small releases of LNG due to improper connections. In addition, there is the potential for high consequence accidents to occur if full tanks are dropped during lifting operations.

The remainder of this study focuses on the three bunkering options introduced above and does not address portable tank transfer.

2.2. 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:

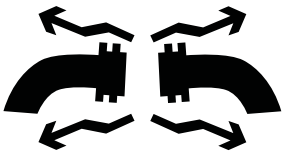
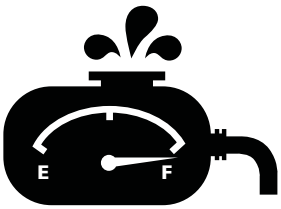
- **Serious injuries to personnel in the immediate area if they come in contact with cryogenic liquids.** Skin contact with LNG results in effects similar to thermal burns and with exposure to sensitive areas, such as eyes, tissue can be damaged on contact. Prolonged contact with skin can result in frostbite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

2.3. 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 2.1 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 1 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 1. 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
	• 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

2.4. 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 4).

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*, the National Fire Protection Association's (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 4. 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 (Table 2), others are designed to mitigate certain types of consequences (Table 4), and some play a role in both prevention and mitigation (Table 3). Tables 2, 3 and 4 introduce each of the safeguards and describe their role in reducing risk of LNG bunkering operations.

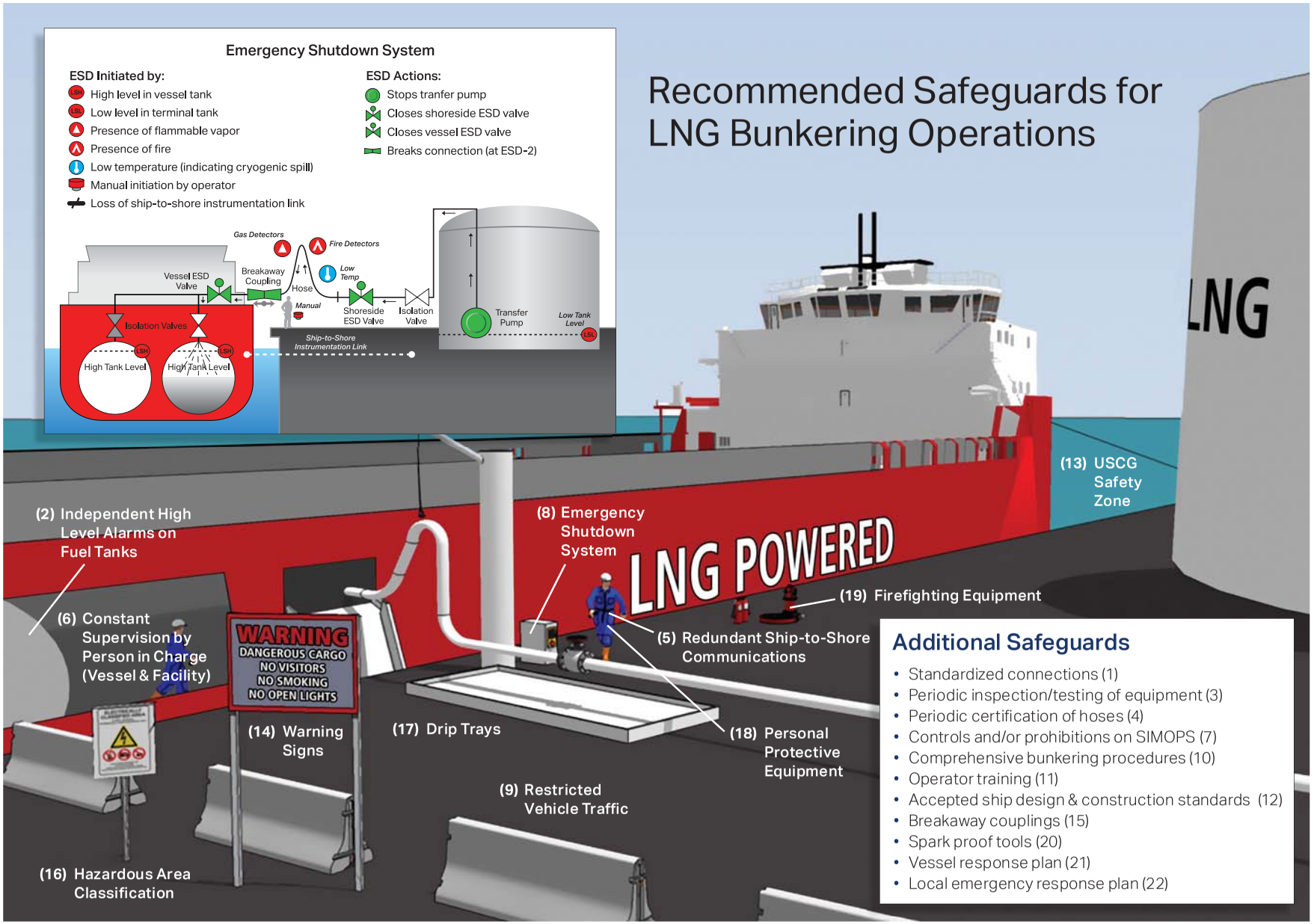


Figure 4. Recommended Safeguards for LNG Bunkering Operations

Table 2. 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 3. Safeguards that Prevent and Mitigate

Prevention Characteristics	Mitigation Characteristics
7. Controls and/or prohibitions on simultaneous operations (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 nonroutine operations.	Covers a broad array of mitigation topics to ensure that operators are aware of LNG hazards and are trained for emergency operations.
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 4. 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 5 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.

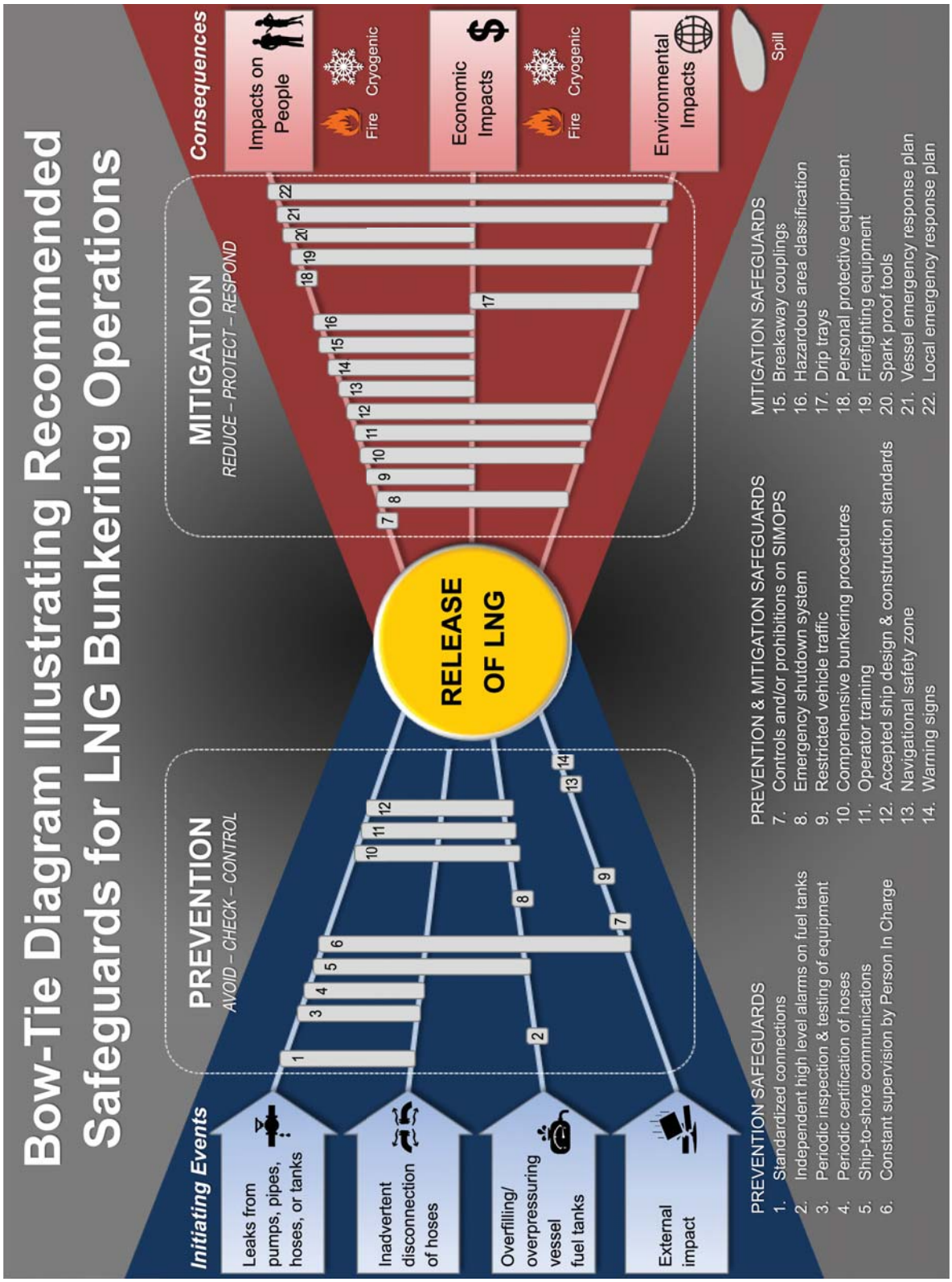


Figure 5. Bow-tie Diagram Illustrating Safeguards for LNG Bunkering Operations

3. Guidelines for Gas-fueled Vessel Operators

This chapter provides 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. Specific regulatory requirements are discussed to provide gas-fueled operators with a comprehensive means to navigate the regulatory framework.

International standards for the design of various systems on 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. The guidelines, which are not compulsory by IMO, stipulated, "the whole operational crew of a gas-fueled cargo and a passenger ship should have necessary training in gas-related safety, operation and maintenance prior to the commencement of work on board."[6] The goal of these guidelines is to provide criteria that will have an equivalent level of safety as that which can be achieved with new and comparable conventional oil fueled machinery. The interim guidelines also provide operational and training requirements for personnel working on board gas-fueled ships. Owners and operators of US flag and foreign flag vessels operating in North America and using LNG as a fuel will need to consider these guidelines. Specific requirements for bunkering operations are provided in Chapter 5.

3.1. Ship Arrangements and System Design

IMO Maritime Safety Committee (MSC) Resolution MSC.285(86) provides guidelines for the arrangement of ship systems and the design of various systems on board ships using LNG as fuel.[6] These guidelines include specifications for systems, including:

- Ship arrangements and system design
- Fire safety
- Electrical systems
- Control, monitoring and systems
- Compressors and gas engines
- Manufacture, workmanship and testing

3.2. Operational and Training Requirements for Personnel

In addition to establishing guidelines for ship arrangements and system design, Resolution MSC.285(86) also provides operational and training requirements for seafarers for ships using gases or low-flashpoint fuels, which would be incorporated into future amendments to the Standards of Training, Certification and Watchkeeping (STCW) Convention and Code. In November 2013, the Correspondence Group submitted guidelines on developing, training and certification requirements for seafarers on board ships subject to the International Code of Safety for Ships using Gases or other Low Flashpoint Fuels (IGF Code).

6 Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships. International Maritime Organization Resolution MSC.285(86), London, June 1, 2009.

The guidelines also recommend dividing training on gas-fueled ships into three categories (i.e., basic training for the basic safety crew, supplementary training for deck officers, and supplementary training for engineering officers).[7] In its report, the Correspondence Group recommends two levels of training:

- Basic training
- Advanced training

Operators of gas-fueled vessels subject to the IGF Code should begin to consider basic and advanced training for their crew members as outlined in Table 5.

Table 5. Crew Member Training Levels

If crew members are…	Then the following training levels apply:
Seafarers responsible for designated safety duties	Basic training
Masters, engineers 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 are found in Table 6. 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 6.

Table 6. Competency Standards

Category	Competency
Basic Training	1. Contribute to the safe operation of a ship subject to the IGF Code 2. Take precautions to prevent hazards on a ship subject to the IGF Code 3. Apply occupational health and safety precautions and measures 4. Carry out firefighting operations on a ship subject to the IGF Code 5. Respond to emergencies 6. Take precautions to prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code
Advanced Training	1. Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code 2. Operate remote controls of fuel related to propulsion plant and engineering systems and services on ships subject to the IGF Code 3. Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code 4. Plan and monitor safe bunkering, stowage, and securing of the fuel on board ships subject to the IGF Code 5. Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code 6. Monitor and control compliance with legislative requirements 7. Take precautions to prevent hazards 8. Application of leadership and team-working skills on board a ship subject to the IGF Code 9. Apply occupational health and safety precautions and measures on board a ship subject to the IGF Code 10. Prevent, control, and fight fires on board ships subject to the IGF Code 11. Develop emergency and damage control plans and handle emergency situations on board ships subject to the IGF Code

7 Development of the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels, Development of Training and Certification Requirements for Seafarers for Ships Using Gases or Low-flashpoint Fuels, HTW 1/17. United States' Report to the Correspondence Group, November 29, 2013.

3.3. United States

This section outlines the regulations for US and foreign flag gas-fueled vessels operating in the US Table 7 lists the current regulations, codes, and guides that may be applicable for US flag gas-fueled vessels. 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 7. US Regulations, Codes and Standards for Gas-fueled Vessels

IMO
• Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships (MSC.285(86)) • International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code) – in development
USCG
• CG-521 Policy Letter 01-12 Equivalency Determination: Design Criteria for Natural Gas Fuel Systems • 46 CFR Parts 10, 11, 12, 13, and 15
ABS
• *Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships*

Figure 6 is a simple decision tree to assist potential LNG gas-fueled vessel operators in identifying which of the current regulations, codes, and standards may be applicable to their vessels 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 Gas Code (IGC) 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 6. Gas-fueled Vessel Decision Tree

Table 8 presents key elements required under each regulation, code, standard, or guideline, and identifies which of the eight gas-fueled cases from Figure 6 are applicable to each key element.

Table 8. Key Elements of Applicable Regulations, Codes, Standards and Guidelines for Gas-fueled Vessels

Key Elements	IMO	United States Coast Guard		ABS
	MSC 285(86)	CG-521 Policy Letter 01-12**	46 CFR Parts 10, 11, 12, 13, 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
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	✓	✓		✓

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

3.3.1. USCG Regulations

US flag vessels that use LNG as a fuel are subject to USCG regulations outlined in various Subchapters of Title 46 CFR that 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.

Changes to all of these regulations are being considered given the increased interest by the maritime industry of adopting LNG as a fuel. Until the regulations are revised, the USCG and the IMO have established interim guidelines and equivalency determinations to provide a level of safety that is at least equivalent to that provided for traditional fuel systems and fueling operations.

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, including bunkering vessels that intend to transfer LNG to other vessels that are using LNG as a fuel. Existing regulations also address the fueling systems for boil-off gas used on LNG carriers. However, currently 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 that is at least equivalent to that provided for traditional fuel systems in the regulations for various types of vessels inspected and certificated by the USCG.[8] This policy letter, which is based on international standards established by the IMO, namely Resolution MSC.285(86), may serve as interim guidance for vessel owners and operators until such time as the USCG regulations are revised and the IGF Code is completed.

Enclosure 1 of CG-521 Policy Letter Number 01-12 refers to the IMO's Resolution MSC.285(86) and describes the equivalencies and additional requirements for various arrangements, shipboard systems, and equipment.

As such, 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 Marine Safety Center, and a design basis letter would be issued detailing the specific requirements for the project. In both cases, plan review by the USCG Marine Safety Center and inspection by the local USCG inspector are required.

8 USCG CG-521 Policy Letter 01-12, April 2012.

3.3.1.2. Operating Standards

The USCG is developing two operating policies for LNG fuel transfer operations and training of personnel on vessels that use natural gas as fuel.[9] The first draft operations policy letter provides voluntary guidance for LNG fuel transfer operations on vessels using natural gas as fuel in US waters, and training of personnel on those vessels. It recommends transfer and personnel training measures that the USCG believes will achieve a level of safety that is at least equivalent to that provided for traditional fueled vessels. It 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.

The second draft operations policy letter provides guidance for bunker vessels and waterfront facilities conducting LNG fuel transfer operations and is further discussed in Chapter 5.

The purpose of the draft operations policy for vessels using natural gas as a fuel is to provide guidance for LNG bunker operations in order to achieve a level of safety considered equivalent to the regulation applicable to traditional bunker operations. The policy, based on the interim guidelines contained in the IMO resolution, MSC.285(86), includes guidance on equivalent standards for the following aspects of bunkering operations on gas-fueled vessels:

- Fuel transfer procedures as described in 46 CFR 154 and 33 CFR 127.319
- Operations, emergency, and maintenance manuals as discussed in 33 CFR 127.309
- Mariner training and drills
- Transfer operations, including PIC designation and qualifications, Notification of Transfer, and transfer procedure requirements contained in 33 CFR 155 and 33 CFR 156
- Simultaneous operations
- Pre-transfer actions
- Conduct during and after an 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, emergency shutdown systems, and alarms and indicators

Once finalized, these policies will serve as guidance for the USCG Captains of the Port (COTPs) and guidelines 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.

3.3.1.3. Crew Certification and Training Requirements - 46 CFR Parts 10, 11, 12, 13 and 15

Owners and operators of gas-fueled vessels will need to take into account the existing and emerging requirements for crew certification and training that are being developed by the USCG and the IMO. Mariners on US vessels must currently comply with existing requirements in 46 CFR 15.405 regarding familiarity with vessel characteristics and 46 CFR 15.1105 regarding familiarity with basic safety training before assuming their responsibilities. Mariners on foreign flag vessels are required to receive familiarity training based on the International Convention on STCW Regulations I/14. Current regulations in Title 46 CFR Parts 10, 11, 12, 13 and 15 provide credentialing and training requirements for US merchant mariners.

9 Federal Register/Vol. 79, No. 26/Friday, February 7, 2014 /Notices 7471.

The USCG recognized that the current national regulations do not adequately address the training and experience prerequisites needed to meet Chapter 8 of Resolution MSC.285(86) and requested input from the Merchant Marine Personnel Advisory Committee (MERPAC) on crew training and certification requirements for vessels using LNG as fuel. On February 7, 2014, the USCG issued draft policies for public comment outlining personnel training measures that it believes will achieve a level of safety that is at least equivalent to that provided for traditional fueled vessels.[10] The draft guidelines suggest the following training and certification as equivalent measures.

Mariners working on board a natural gas-fueled vessel who hold a Merchant Mariner's Credential (MMC) endorsed as Tankerman PIC (LG) are considered as meeting categories A, B, and C gas-related training criteria of the IMO Resolution MSC.285(86), Chapter 8, Section 8.2, (Enclosure 2), but should still receive company and vessel-specific training before assuming their duties (see 46 CFR 15.405 and 15.1105). Also, a mariner working on board a natural gas-fueled vessel who holds an MMC endorsed as Tankerman Assistant (LG) is considered as meeting category A training of the IMO training criteria, but should also receive company- and vessel-specific training before assuming their duties (see 46 CFR 15.405 and 15.1105).[11]

The draft policy guidance also states, "gas-related emergency exercises should be conducted at regular intervals and comply with Chapter 8, Section 8.1.3, (Enclosure 2), of IMO Resolution MSC.285(86). These gas-related exercises may include a tabletop exercise, a review of fueling procedures and responses to potential contingencies, tests of equipment intended for contingency response, and reviews that assigned personnel are trained to perform assigned duties during fueling and contingency response. Gas-related exercises should be conducted at regular intervals and may be incorporated into the periodic fire drills required by Safety of Life at Sea (SOLAS) Regulation III/19."[12]

3.3.2. ABS Guidance

Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships

ABS has also developed criteria for propulsion and auxiliary systems for gas-fueled ships.[13] This Guide has been developed in order to provide guidance for the design and construction of the aforementioned propulsion prime mover arrangements, auxiliary power generation arrangements, and associated systems for gas-fueled ships and may be applied to all types of vessels, other than those covered by the IMO IGC Code, that use natural gas as fuel.

10 Federal Register/Vol. 79, No. 26/Friday, February 7, 2014 /Notices 7471.

11 USCG Draft CG-OES Policy Letter No. 01-14, Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels Using Natural Gas as Fuel, released for public comment Federal Register/Vol. 79, No. 26/Friday, February 7, 2014 /Notices 7471.

12 Ibid.

13 *Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships*. ABS, May 2011.

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.[14] 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 Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships for training and certification requirements being considered by the IMO.

3.4.2. Gas-fueled Vessel Requirements

Within the Transport Canada Safety and Security organization is the Marine Safety and Security Department. The Marine Safety and Security 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. Accordingly, until the IGF Code is complete, Transport Canada will apply the IMO interim guidelines established by IMO resolution MSC.285(86) to new vessel construction and existing vessel conversion projects. The interim guidelines will be applied, together with the rules of a recognized organization (e.g., classification society). 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.

14 http://laws-lois.justice.gc.ca/eng/regulations/SOR-2007-115/

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

- Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships (MSC.285(86))
- International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code) – currently being developed
- International Convention on STCW – does not yet address gas handling
- International Safety Management Code (ISM Code)
- International Convention for SOLAS

Transport Canada

- Acceptance of an Alternative Regulatory Regime for Inspection, Construction, and Safety Equipment (TP13585)

ABS

- *Rules for Building and Classing Steel Vessels*
- *Guide for Propulsion and Auxiliary Systems for Gas Fueled Ships*

4. Guidelines for Bunker Vessel Operators

4.1. International

4.1.1. IGC Code

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.[15] 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.

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

Seafarers operating LNG bunkering vessels must meet the provisions of the 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.[16] 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

Classification societies, regulatory agencies, and international organizations have long-standing guidelines and regulations for vessels carrying LNG in bulk. Regulations for LNG bunker vessels are the same as LNG cargo vessels. While this study primarily focuses on the emerging use of LNG as fuel for non-LNG cargo vessels, this section provides a summary of the current regulations, codes, and standards addressing LNG bunker vessels as listed in Table 9.

15 International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, IMO Publishing, 1993.

16 Standards of Training, Certification and Watchkeeping for Seafarers, 1978, Including the Manila Amendments, IMO Publications, 2010.

Table 9. US Regulations, Codes and Standards 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 • 33 CFR 155 – Oil or Hazardous Material Pollution Prevention Regulations for Vessels • 33 CFR 156 – Oil and Hazardous Material Transfer Operations
ABS
• Steel Vessel Rules Part 5C, Chapter 8, Vessels Intended to Carry Liquefied Gases in Bulk

Figure 7 is a simple decision tree to assist potential LNG bunker vessel operators with identifying which of the current regulations, codes, and standards may be applicable to their vessels based on whether the vessel (1) will be classed, (2) will be a self-propelled tank ship or a barge, and (3) will operate in international waters. Answering those three simple questions categorizes a prospective vessel into one of eight unique bunker vessel cases.

Figure 7. Bunker Vessel Decision Tree

Table 10 presents key elements required under each regulation, code, standard, or guideline, and identifies which of the eight bunker vessel cases from Figure 7 are applicable to each key element.

Table 10. Key Elements of Applicable Regulations, Codes, Standards and Guidelines for Bunker Vessels

Key Elements	IMO	United States Coast Guard U.S. Department of Homeland Security			ABS
	IGC Code	33 CFR 155	33 CFR 156	46 CFR Sub D/C	Steel Vessel Rules 5C-8
	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
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	✓				✓
Electrial 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			✓		

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

4.2.1. USCG Regulations

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 vessels carrying LNG and include:

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

US flag 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.

- Requirements
- 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
- Insulation
- Cargo Tank 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

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 11.

Table 11. Transfer Personnel, Procedures Equipment, and Records Requirements

33 CFR	Requirement
§155.700	Designation of person in charge
§155.710	Qualifications of person in charge
§155.715	Contents of letter of designation as a person-in-charge 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	Emergency shutdown
§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 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.

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 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, International Association of Classification Societies, etc., and additional ABS requirements.

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 12.[17]

Table 12. Canadian Requirements for a Certificate as Supervisor of a Liquefied Gas Transfer Operation

Item	Requirements	Specifications
1	Experience	At least three 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; and (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. 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*
- *Rules for Building and Classing Steel Barges*

Note: ABS will also publish a Guide for bunkering vessels in the summer of 2014

17 Transport Canada, Marine Personnel Regulations (SOR/2007-115) Part 1, Section 164.

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 13.

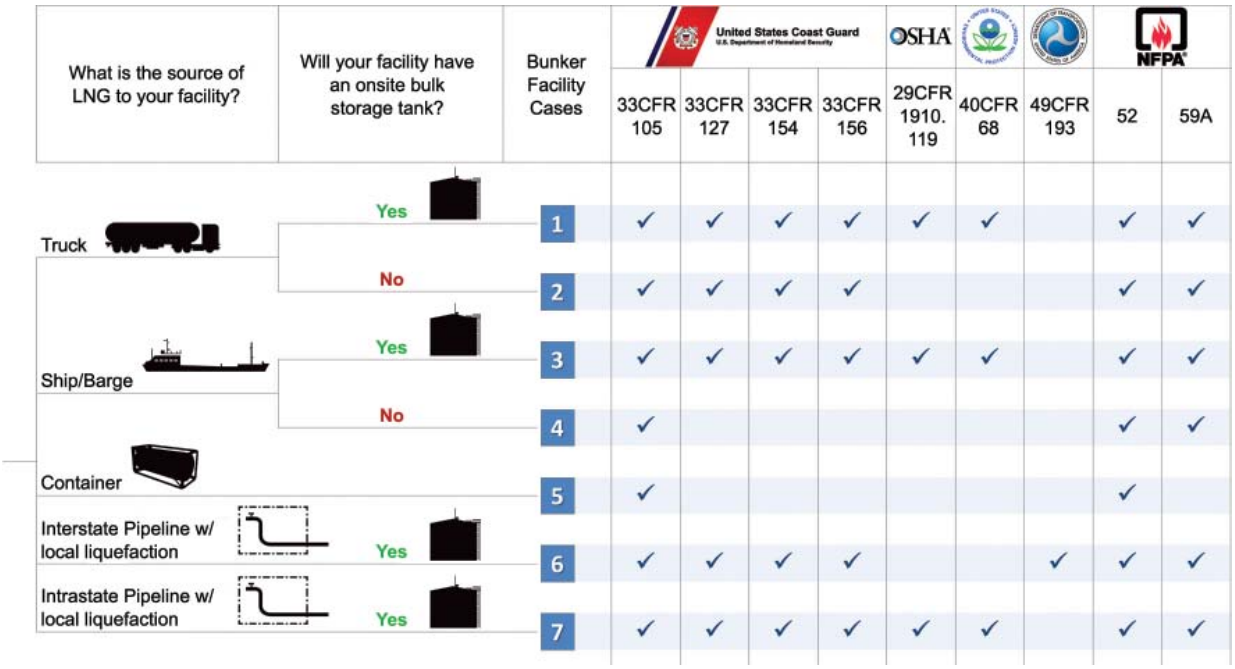
Table 13. US Regulations, Codes and Standards for LNG Facilities

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
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 13, there may be several state and local regulations with which bunkering facility operators must comply.

Figure 8 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.



United States Coast Guard				OSHA			NFPA	
33CFR 105	33CFR 127	33CFR 154	33CFR 156	29CFR 1910. 119	40CFR 68	49CFR 193	52	59A
✓	✓	✓	✓	✓	✓		✓	✓
✓	✓	✓	✓				✓	✓
✓	✓	✓	✓	✓	✓		✓	✓
✓							✓	✓
✓							✓	
✓	✓	✓	✓			✓	✓	✓
✓	✓	✓	✓	✓	✓		✓	✓

Figure 8. Bunker Facility Decision Tree

Table 14 presents key elements required under each regulation, code, standard, or guideline, and identifies to which of the seven facility bunker cases from Figure 8 each key element applies.

Table 14. Key Elements of Applicable Regulations, Codes, Standards, and Guidelines for Bunker Facilities

Key Elements	United States Coast Guard U.S. Department of Homeland Security				OSHA			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 Captain of the Port (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	DOT	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 process operating limits and steps for conducting each operating phase, including: initial startup, normal operations, temporary operations, emergency shutdown, 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, emergency shutdown 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.	✓	✓	✓		✓	✓	✓	✓	✓

Table 14. Key Elements of Applicable Regulations, Codes, Standards, and Guidelines for Bunker Facilities (continued)

Key Elements	United States Coast Guard U.S. Department of Homeland Security				OSHA			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. Documents 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	DOT	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.		✓							

Table 14. Key Elements of Applicable Regulations, Codes, Standards, and Guidelines for Bunker Facilities (continued)

Key Elements	United States Coast Guard U.S. Department of Homeland Security				OSHA				
	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	DOT	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.					✓	✓			
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.		✓	✓		✓	✓			

Table 14. Key Elements of Applicable Regulations, Codes, Standards, and Guidelines for Bunker Facilities (continued)

	United States Coast Guard U.S. Department of Homeland Security				OSHA				
	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
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 13 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 Facility Security Officer (FSO)
- Performing a security assessment
- Developing and submitting an 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. Waterfront Facilities Handling LNG and Liquefied Hazardous Gas - 33 CFR 127

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 7, 2014, the USCG released draft operating policies for LNG fuel transfer operations.[18] The first draft operations policy letter provides voluntary guidance for LNG fuel transfer operations on vessels using natural gas as fuel in US waters. The second draft 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. The draft 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. Facilities Transferring Oil or Hazardous Material in Bulk - 33 CFR 154

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, including: development of a letter of intent prior to operation, submission to periodic USCG examinations, development of an operations manual, equipment requirements, PIC requirements, safety requirements, and response plans.

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.

5.1.2. Occupational Safety and Health Administration Regulation

5.1.2.1. Process Safety Management (PSM) of Highly Hazardous Chemicals - 29 CFR 1910.119

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; and
- A process which involves a Category 1 flammable gas [as defined in 1910.1200(c)] or a flammable liquid with a flashpoint below 100°F (37.8°C) on site in one location, in a quantity of 10,000 lb (4,536 kg) or more. This would apply to LNG since its primary component is methane, a flammable gas.

18 Federal Register/Vol. 79, No. 26/Friday, February 7, 2014/Notices 7471.

Therefore, OSHA's PSM would apply to LNG bunkering facilities (assuming they have an LNG storage inventory of more than 10,000 lb [4,536 kg] of LNG). However, if another federal agency regulates the facility for fire and safety hazards, OSHA is precluded from regulating it under the PSM regulation. For example, there are clear interpretations by OSHA that it is precluded from covering a facility under its PSM regulation if the facility is regulated under the DOT 49 CFR 192 and 193 regulations. At this time, there are no clear indications that OSHA would exempt a facility based on USCG regulatory coverage, but that is a question to be pursued with the agency.

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 exempted 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.

The accident prevention program requirements for an LNG facility that has the potential to impact members of the public offsite (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 (PHMSA) Regulations

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

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

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. Vehicular Gaseous Fuel Systems Code - NFPA 52

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 American Society of Mechanical Engineers (ASME) containers of 70,000 gal (265 m^3) or less. Although not as widely known in the LNG industry, NFPA 52 may be the an 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. 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)

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 14 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 Section 2.2 for LNG bunkering alternatives using the hazard identification (HAZID) method.

6.2. Siting Study

LNG bunkering facilities are generally going to be much smaller that LNG import and export facilities; however, 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. If a bunkering facility needs to defend its choice of siting, it may be useful (or even required) to perform a facility siting study. The siting study should focus on quantification of risks to populations outside the LNG terminal to ensure they do not exceed acceptable levels. Siting studies should follow preferred guidance, such as Chapter 15 of NFPA 59A: Standard for the Production, Storage and Handling of LNG. The siting study could employ qualitative or quantitative risk assessment (QRA) protocols to estimate the risk to surrounding populations. NFPA 59A specifically recommends addressing the following items using a QRA approach that addresses the following:

- Release Specifications: release rates, substrate characteristics, hazardous behavior of LNG
- Release Probabilities and Conditional Probabilities: annual probability of LNG release from equipment, conditional probability for each type of hazardous behavior
- Environmental Conditions and Occurrence Probabilities: site-specific environmental conditions, occurrence frequency of weather conditions, topography, ignition sources
- Hazard and Consequence Assessment: distance to limit concentration levels, distance to limit heat flux from pool fires/vapor fires/fireballs, distance to limit overpressure from explosions, cascading damages, lower flammability limit distance, etc.
- Risk Results: risk contours, societal risks (frequency vs. consequence), estimated error values
- Risk Tolerability Criteria: individual risk, societal risk, acceptability criteria
- Risk Mitigation Approaches: additional mitigation measures

The NFPA 59A Chapter 15 risk assessment approach is included in the body of the 2013 version of the standard. In the previous version of NFPA 59A (e.g., the 2009 version), the risk assessment approach was included as Annex E to the standard and entitled the "Performance-Based Alternative Standard for Plant Siting." There is not yet an extensive experience base in the application of Chapter 15 analyses, so a 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).

6.3. Simultaneous Operations

A SIMOPS assessment may be required if owners/operators wish to perform other activities, such as cargo or passenger loading, while bunkering (although not currently included in the US regulations, the draft ISO standard on LNG bunkering lists a SIMOPS study as an essential requirement).[19] 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.

19 International Standards Organization, Draft Standard – Guidelines for Systems and Installations for Supply of LNG as Fuel to Ships, OGP Draft 118683, June 4, 2013.

6.4. Fire Risk Assessment

An 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 Society of International Gas Tanker and Terminal Operators' (SIGTTO) "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, including:

- Qualitative: what-if, risk matrices, risk indices, fire safety concepts tree
- Semi-quantitative: actuarial/loss statistical analysis, stand-alone event tree analysis, enclosure fire models
- Quantitative: event tree combined with fire model
- Cost-benefit: computational models that incorporate probability, consequences, and cost data in an integrated manner

To use this 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.

6.5. Waterway Suitability Assessment

USCG Navigation and Vessel Inspection Circular (NVIC) No. 01-2011 requires owners and 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).

Full scope WSAs are risk-based assessments that address the following items:

- Port characterization
- Characterization of the LNG bunkering facility and vessel routes
- Risk assessment for maritime safety and security
- Risk management strategies
- Resource needs for maritime safety, security and response
- 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

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.

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.

6.6. Ship-to-shore Interface Compatibility Review

LNG bunkering facility owners/operators should perform a ship-to-shore interface review to ensure the equipment is compatible to facilitate safe bunkering. The review should address all ship-to-shore considerations, including:

- Mooring equipment
- Vessel size constraints (length, freeboard)
- Hose connections (size, fittings, couplings)
- ESD (pin connections)
- Ship-to-shore communications

SIGTTO provides a ship-to-shore compatibility questionnaire that was developed for LNG carriers.[20] Although bunkering compatibility is a much simpler issue, some of the items addressed in the SIGTTO document would also be applicable to development of guidance for bunkering compatibility.

20 SIGTTO Ship-Shore Compatibility Questionnaire at http://www.sigtto.org/publications/publications-and-downloads

6.7. Process Hazards Analyses

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 hazard and operability (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.

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 in the US and Canada that are currently in operation (or soon to be in operation) and are potentially suppliers of LNG for the bunkering of marine vessels.

In addition to describing the various types of facilities, this section also lists example projects or activities 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 may change and many new suppliers may 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 that the LNG bunkering business is undergoing, this information is subject to 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 process
- 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 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 into onshore storage tanks, and vaporize it into a natural gas pipeline for transmission to customers, including distribution networks. These types of facilities were initially built in the US in the 1970s with the Everett (Boston, Massachusetts), Cove Point (Cove Point, Maryland), Elba Island (Savannah, Georgia), and Lake Charles, Louisiana terminals.

Several of these facilities have not operated continuously since the 70s, but all have been restarted at this point. In addition, from 2002 to 2011 several new import terminals opened. Table 15 lists all of the existing import terminals (as of February 2014) 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). 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.

Table 15. Currently Operating North American LNG Facilities with Maritime Access

Terminal	Location	Owners and/or Operators	Year Service Began	Notes
Atlantic Coast				
Distrigas LNG Terminal	Everett (Boston), MA	GDF Suez	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	Offshore buoy served by regasification carriers. Not relevant for LNG supply on shore.
Neptune LNG	Offshore, MA	GDF Suez	2009	Offshore buoy served by regasification carriers. Not relevant for LNG supply on shore.
Cove Point LNG	Cove Point, MD	Dominion	2003	
Elba Island LNG	Savannah, GA	El Paso (Kinder Morgan)/ Southern LNG	2003	Includes proposed liquefaction project and export.
Canaport LNG	St. John, NB	Repsol/Irving Oil	2009	
Gulf Coast				
Lake Charles	Lake Charles, LA	Southern Union-Trunkline LNG	1981	
Sabine Pass LNG	Cameron Parish, LA	Cheniere	2008	Approved by DOE to re-export delivered LNG. Approved export terminal with liquefaction process under construction.
Golden Pass LNG	Sabine Pass, TX	Qatar Petroleum/ ExxonMobil/ ConocoPhillips	2010	
Cameron LNG	Hackberry, LA	Sempra	2009	Approved by DOE to re-export delivered LNG.
Freeport LNG	Brazoria, TX	Cheniere	2008	Expanded import terminal approved, but not under construction.
Gulf LNG	Pascagoula, MS	El Paso (Kinder Morgan)/Crest/ Sonangol	2011	Export

Table 15. Currently Operating North American LNG Facilities with Maritime Access (continued)

Terminal	Location	Owners and/or Operators	Year Service Began	Notes
Alaska				
Point Nikiski LNG	Cook Inlet, 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 large interest in new LNG import facilities has waned from nearly 40 proposed import facilities in 2008 to 4 listed by FERC in 2014 as still pursuing licenses. These facilities include:

- Downeast LNG (Robbinston, ME)
- Oregon LNG (Warrenton, OR)
- Cheniere Corpus Christi (Corpus Christi, TX)
- Liberty Natural Gas (Port Ambrose, located off the NY coastline – LNG is not provided on shore)

Although the LNG market in the US has swung largely to interest in exporting LNG, two of these projects (Oregon LNG and Cheniere Corpus Christi) have filed both import and export applications. The other two facilities (Downeast LNG and Port Ambrose) are proposed because of their ability to supply natural gas to regions of the US that are not 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. Based on discussions with FERC personnel, it is not clear that any existing LNG import facilities are planning on adding bunkering facilities, but it is a possibility that could be developed. 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 7.1.2 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 has approved more than 20 applications to export LNG.[21] Many of those projects are now under review 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 16 provides a list of proposed US LNG export terminals and Table 17 provides a list of proposed Canadian export terminals

Table 16. Proposed US LNG Export Terminals

Company	Location	Export Quantity	Project Status			
			Application Approved by DOE[+]	Under Review by FERC[‡]	Approved by FERC	Under Construc-tion
Sabine Pass Liquefaction	Sabine Pass, LA	1.3 Bcfd	✓		✓	✓
Freeport LNG Dev/ Freeport LNG Expansion/FLNG Liquefaction	Freeport, TX	1.8 Bcfd	✓	✓		
Southern Union – Trunkline LNG	Lake Charles, LA	2.4 Bcfd	✓	✓		
Dominion – Cove Point LNG	Cove Point, MD	0.82 Bcfd	✓	✓		
Jordan Cove Energy Project	Coos Bay, OR	0.9 Bcfd	✓	✓		
Sempra – Cameron LNG	Hackberry, LA	1.7 Bcfd	✓	✓		
Gulf Coast LNG Export	Brownsville, TX	2.8 Bcfd	✓	✓		
Gulf LNG Liquefaction	Pascagoula, MS	1.5 Bcfd	✓	✓		
Oregon LNG	Astoria, OR	1.25 Bcfd	✓	✓		
Southern LNG Company	Elba Island, GA	0.35 Bcfd	✓	✓		
Excelerate Liquefaction	Lavaca Bay, TX	1.38 Bcfd	✓	✓		
ExxonMobil – Golden Pass	Sabine Pass, TX	2.1 Bcfd	✓	✓		
Cheniere – Corpus Christi LNG	Corpus Christi, TX	2.1 Bcfd	✓	✓		
Main Pass – Freeport-McMoRan	Gulf of Mexico	3.22 Bcfd	✓	✓		
CE FLNG	Plaquemines Parish, LA	1.07 Bcfd	✓	✓		

21 Summary of LNG Export Applications, http://energy.gov/fe/downloads/summary-lng-export-applications.

Table 16. Proposed US LNG Export Terminals (continued)

Company	Location	Export Quantity	Project Status			
			Application Approved by DOE*	Under Review by FERC‡	Approved by FERC	Under Construction
Pangea LNG (North America)	Ingleside, TX	1.09 Bcfd	✓	✓		
Magnolia LNG	Lake Charles, LA	1.07 Bcfd	✓	✓		
Gasfin Development	Cameron Parish, LA	0.20 Bcfd	✓	✓		
Venture Global	Cameron Parish, LA	0.67 Bcfd	✓	✓		
Floridian Natural Gas Storage	Indiantown, FL	0.02 Bcfd	✓	✓		
Eos LNG & Barca LNG	Brownsville, TX	3.2 Bcfd	✓	✓		
ConocoPhillips Alaska Natural Gas Corp. (CPANGC)	Kenai, AK	40 Bcf (2-yr total)	✓	n/a†	n/a†	n/a†
Delfin LNG LLC	Gulf of Mexico (off Cameron Parish)	1.8 Bcfd				
Annova LNG LLC	Brownsville, TX	0.94 Bcfd				
Texas LNG LLC	Brownsville, TX	0.27 Bcfd				
Louisiana LNG Energy LLC	Plaquemines Parish, LA	0.27 Bcfd				

* Based on Free Trade Agreement application status as of February 11, 2014 (http://energy.gov/fe/downloads/summary-lng-export-applications)

‡ Review and approval status as of February 21, 2014 (http://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-potential-export.pdf)

† Kenai is an existing LNG export terminal that began operation in 1969. It was mothballed in 2013 when its export license expired. In early 2014, DOE granted a 2-year blanket authorization to the facility to export up to 40 Bcf (cumulative) of LNG.

Table 17. Proposed Canadian LNG Export Terminals

Project	Location	Approved by National Energy Board*
KM LNG Operating General Partnership	Kitimat, BC	✓
BC LNG Export Co-operative LLC	Kitimat, BC	✓
LNG Canada Development Inc.	Kitimat, BC	✓
Pacific NorthWest LNG Ltd.	Prince Rupert, BC	✓
WCC LNG Ltd.	Kitimat or Prince Rupert, BC	✓
Prince Rupert LNG Exports Limited	Prince Rupert, BC	✓
Woodfibre LNG Export Pte. Ltd.	Squamish, BC	✓
Jordan Cove LNG L.P.	Kingsgate, BC - Eastport, ID Huntingdon, BC - Sumas, WA	✓

Project	Location	Approved by National Energy Board+
Triton LNG Limited Partnership	Kitimat or Prince Rupert, BC	
Pieridae Energy Ltd. (Goldboro LNG)	Guysborough County, NS	
Aurora Liquefied Natural Gas Ltd.	Prince Rupert, BC	
Kitsault Energy Ltd.	Kitsault, BC	
Oregon LNG Marketing Company LLC	Kingsgate, BC - Eastport, ID Huntingdon, BC - Sumas, WA	

+ Based on National Energy Board's LNG Export Licence Application Schedule as of March 7, 2014, http://www.neb-one.gc.ca/clf-nsi/rthnb/pplctnsbfrthnb/lngxprtlcncpplctns/lngxprtlcncpplctns-eng.html

As shown in Table 16, most of the proposed US export facilities are proposed 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 supply to the US Northwest ports from Canadian export facilities, if that market demand is not met by US facilities. Also, both DOE and energy industry analysts agree that not all of the export facilities will be built. However, facilities that will be 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. The Magnolia LNG Export Terminal proposed in Lake Charles, Louisiana, 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 by the end of 2015 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 cubic meters (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. In the US, there are about 100 LNG peakshaving facilities. 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.[22] 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.[23]

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[24, 25]
- Gaz Métro LNG has a liquefaction, storage, and regasification plant in Montreal, Quebec currently servicing other transportation modes

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

23 Liquefied Natural Gas – A Canadian Perspective. National Energy Board, http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/ntrlgs/lqfdntrlgscndnprspctv2009/lqfdntrlgscndnprspctv2009qa-eng.html, (May 17, 2013).

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

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

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.

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. Their plans 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 recently announced the inauguration of the 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 November 2013, Gaz Métro issued a nonbinding call for submissions for the purchase of LNG from its liquefaction plant in Montreal.[26] 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 the marine fuel businesses.[27]

26 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

27 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

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

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.[28, 29] These two units will form the basis of two new LNG transport corridors in the Great Lakes and Gulf Coast regions. This decision follows an investment decision in 2011 on a similar corridor in Alberta, Canada. In 2013, Shell indicated the facilities would take three years to come into operation. The liquefaction plants each have a planned capacity of 250-million kilograms (250,000 tonnes) of LNG per year.

In the Gulf Coast corridor, Shell plans to install a liquefaction unit at the Shell Geismar Chemicals facility in Geismar, Louisiana. Once operational, this unit will 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.

Shell has a memorandum of understanding with Edison Chouest Offshore (ECO) companies to supply LNG fuel to marine vessels that operate in the Gulf of Mexico and to provide what is anticipated to be the first LNG barging and bunkering operation in North America at Port Fourchon, Louisiana. Shell is developing LNG transport barges to move the fuel from the Geismar production site to Port Fourchon, where it will be bunkered into customer vessels.

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

29 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/

In the Great Lakes corridor, Shell plans to install a liquefaction unit at its Shell Sarnia Manufacturing Centre in Sarnia, Ontario, Canada. Once operational, this project will supply LNG fuel to all five Great Lakes, their bordering US states and Canadian provinces and the St. Lawrence Seaway. The Interlake Steamship Company is expected to be the first marine customer in this region, as it begins the conversion of its vessels.

Pending regulatory permitting, these two new liquefaction units are expected to begin operations and production by 2016.

Waller Marine Facilities in Baton Rouge and Cameron Parish, Louisiana. Waller Marine has announced a project to provide an integrated LNG bunkering operation that includes liquefaction facilities (in Cameron Parish and Baton Rouge) 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.[30]

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 February 6, 2014 that they have been selected by Totem Ocean Trailer Express (TOTE), Inc. to provide LNG to fuel TOTE's two new state-of-the-art containerships in Jacksonville, Florida. TOTE's new dual fuel LNG containerships are expected to be delivered to the port in Jacksonville in late 2015 and early 2016.[31]

Pivotal LNG, WesPac, and TOTE have signed a letter of intent and are working toward definitive agreements. While there is still work to be done, Pivotal LNG and WesPac plan to work together on this project to create a joint venture to develop a new LNG plant in Jacksonville, Florida.

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.

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

31 TOTE website at https://toteinc.com/pivotal-lng-and-wespac-midstream-llc-selected-to-serve-totes-lng-vessels-in-jacksonville-florida/

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

Harvey Gulf Port Fourchon, Louisiana. Harvey Gulf is building a bunkering facility at Port Fourchon, Louisiana (Figure 9) to support offshore supply vessels (OSVs).[32] Harvey Gulf has broken ground for its $25 million Phase 1 LNG fueling facility at Port Fourchon, Louisiana.

The Port Fourchon facility will include double-walled, vacuum-insulated LNG storage tanks that meet ASME Boiler and Pressure Vessel Code requirements. For LNG storage at vehicle fueling stations, the applicable requirements for such storage tanks are detailed in Chapter 13 of NFPA 52. In accordance with those requirements, the containers can be of 100,000 gal (378,000 L) capacities or less, with maximum aggregate storage capacity at a single fueling facility of 280,000 gal (1060 m³). Note: NFPA 59A also provides requirements for such tanks.

Figure 9. Artist's Rending of Harvey Gulf International Marine's LNG facility at Port Fourchon, LA

This development will consist of two facilities, each having 270,000 gal (1,022 m³) of LNG storage capacity. 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.

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

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.

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 DOT is going to convert one of its small ferries to accept LNG as a fuel source. The plan for the pilot project is 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. 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 matured and some 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.

7.3.1. AGL Resources

AGL Resources (AGL) is one of the pioneers of downstream LNG fuel markets, acquiring a network of liquefaction plants, including, most recently, the Trussville Utilities District peakshaving facility in Alabama.[33, 34] 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.

AGL has been operating LNG liquefaction facilities since the 1970s and is the largest operator of liquefaction in the US AGL established Pivotal LNG to build, own, operate, and sell LNG. Pivotal LNG acquired the Trussville LNG facility and its 60,000 gal (227 m^3) per day capacity, which brings the company's total capability to 540,000 gal (2,044 m^3) per day.

That liquefaction capability serves the peakshaving facilities owned by AGL, but that type of operation does not occupy the liquefaction capacity on a daily basis. AGL has indicated that it has between 50,000 gal (189 m^3) and 60,000 gal (227 m^3) a day available from a Chattanooga, Tennessee, facility and another 60,000 gal (227 m^3) a day out of Trussville. Within Georgia, there may be three more plants that have 60,000 gal (227 m^3) a day capability.

Pivotal LNG 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. There are reports that AGL is already in contract negotiations to supply one or more LNG proposed bunkering facilities on the Gulf Coast from its Trussville facility.

7.3.2. GDF SUEZ advanceLNG Project

In October 2013, GDF SUEZ Gas NA announced the advanceLNG Project, an initiative to provide attractively priced LNG to a wide array of customers in the US Northeast.[35] Through December 31, 2013, GDF SUEZ Gas NA accepted nonbinding 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.

33 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. Bulk Transporter, http://bulktransporter.com/tank-fleets/agl-resources-v-p-lays-out-plan-price-lng-cost-plus-basis-use-existing-idle-lng-processi, (May 1, 2012).

34 LNG and Propane. AGL Resources, http://www.aglresources.com/about/lng.aspx

35 GDF SUEZ Gas NA LLC Announces Non-Binding LNG Supply Offering, http://www.suezenergyna.com/news/advancelng-press-release-sept-16-2013

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 that were 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 will (1) outline some of those lessons learned, centering around the federal, state, tribal, and local agencies and organizations with whom coordination may be required (Section 7.4.1) and (2) provide suggestions on how to properly coordinate and communicate (Section 7.4.2). 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 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, which can take 1 to 2 years to obtain construction license approval, 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 are positives 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 7.4.2 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 two 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 (ECL). 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. In a 2013 survey of 17 US port authorities from the East, West, and Gulf coasts, only 9% of survey respondents indicated that they had current plans to explore installation of LNG marine fueling stations, and only 30% indicated it was a possibility for the future (Figure 10).[36] These results imply that most US port organizations are not yet directly involved in planning for LNG bunkering. 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. It is expected that in the near future, LNG availability will be a potential competitive advantage for ports working to attract new shipping operations.

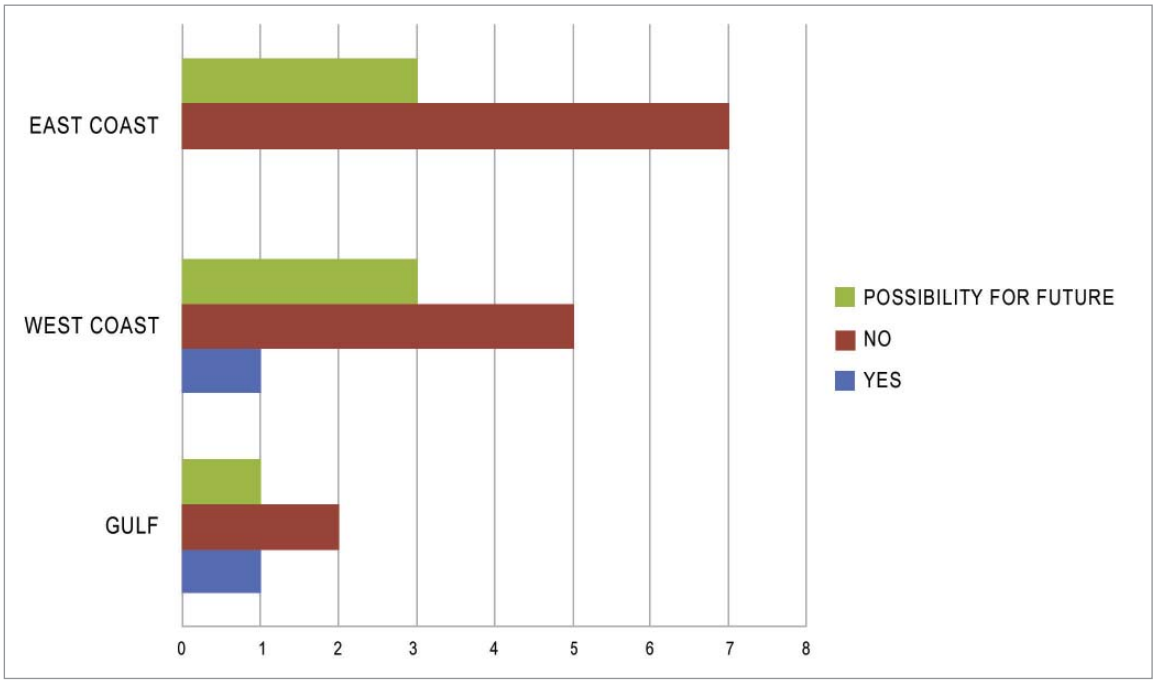


Figure 10. Results from LNG-related Survey of Port Organizations (2013)

Port Plans to Make LNG Fuel Available. As part of this project, ABS representatives reached out to one or more organizations in the following major US ports to determine plans and progress related to making LNG fuel available:

- New York/New Jersey
- Baltimore
- Houston
- San Francisco
- Los Angeles/Long Beach
- Seattle/Tacoma

36 Decas, K. (June 11-12, 2013). Marine Transportation and LNG. Paper presented at LNG for Marine Transportation USA, Houston, Texas.

The contacts in these ports included USCG representatives, municipal/port employees, environmental agencies, and LNG developers. The discussions with these representatives largely focused on the following topics:

- 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

In these discussions, the local representatives generally confirmed what ABS had learned from LNG bunkering project developers and what is conveyed in the port survey results (Figure 10). 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, 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. However, none of these representatives had experience with the development of a bunkering facility that included a liquefaction process; so, they could not provide input regarding federal and state pipeline regulatory issues.

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 18 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 18. 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).[37] 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.[38] ✓ Relevance of state/provincial natural gas regulations (if any) to bunkering facilities

37 PHSMA website for State Pipeline Programs, http://phmsa.dot.gov/pipeline/state-programs

38 220 CMR 112.00: Design, Operation, Maintenance and Safety of Liquefied Natural Gas (LNG) Plants and Facilities, found at http://www.lawlib.state.ma.us/source/mass/cmr/220cmr.html

Table 18. Organizations for Consultation and Coordination Efforts (continued)

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 19 presents the state and local permitting agencies identified for the Long Beach LNG Import Project proposed for Long Beach, California.

Table 19. 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[39]
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	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	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.

39 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.

7.4.2. 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 who can provide some of the expertise listed above. 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 communication is key to LNG bunkering project success was also emphasized at the recent LNG as Fuel conference held in Seattle on January 29, 2014. The conference was attended by more than 200 representatives from every interest group in the LNG community. The single biggest message from 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
- US Army Corps of Engineers
- State regulators from the Washington State Department of Ecology
- Puget Sound Clean Air Agency
- Industry representatives from Harvey Gulf and the Washington State Ferry system

Harvey Gulf and the Washington State Ferries are well into the planning and development stages of the LNG as fuel process and acknowledged 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. Table 20 lists some of the kinds of communications efforts and organizations with whom a developer may want to communicate.

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 20. 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.

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.
Critial (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.

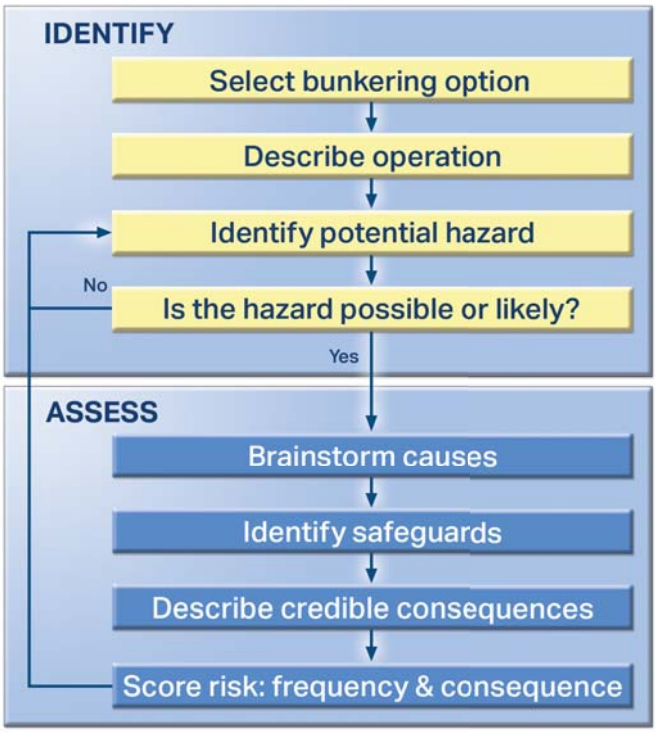


Figure A1. Risk Assessment Process

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.

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	Death & Injury				

Table A4. Template Worksheet for Truck to Vessel Hazard Assessment (continued)

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)	fire/explosion/cryogenic hazards to personnel in the immediate area					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				
			Large release of LNG, resulting in fire/explosion/cryogenic hazards to	Death & Injury				

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				

Table A4. Template Worksheet for Truck to Vessel Hazard Assessment (continued)

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 Other Low Flashpoint Fuels for each of the competencies listed in Table 6.

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 vessels 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.

Table A5. Recommended Minimum Standards of Competence – Basic Training (continued)

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. Oritical 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

Table A6. Recommended Minimum Standards of Competence – Advanced Training (continued)

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.

Table A6. Recommended Minimum Standards of Competence – Advanced Training (continued)

Competence	Knowledge, Understanding and Proficiency
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.
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 manoeuvre 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	Projects Underway	Unique Issues
Canadian East Coast	Available	Gaz Métro LNG has a liquefaction, storage and regasification plant in Montreal, QU currently offering LNG and LNG transportation services from the plant	High	1. Recently, Gaz Métro issued a non-binding call for submissions for the purchase of LNG from its liquefaction plant in Montreal and has expressed interest in supporting marine fueling. 2. Two 92m RoPax gas-fueled passenger ferries and one 130m RoPax gas-fueled passenger ferry are under construction for Societe des traversiers du Quebec (STQ) operating on the St. Lawrence and Saguenay rivers.	LNG will need to be delivered by tank truck
New York / New Jersey	Because of the NYC transportation ban for LNG, supply would likely have to come in via interstate transportation like is planned by GDF SUEZ's offer to supply users by truck from New England. If the NYC ban is lifted, there are three LNG storage facilities in the city that were grandfathered when the ban was established.	Interstate tank truck delivery only	Moderate to High	The Staten Island Ferry System, run by New York City Department of Transportation, received a $2.34 million federal grant to help pay for a conversion of one of their ferries to operate on LNG	New York has had a four-decade-long ban on storing liquefied natural gas. The moratorium was lifted for locations in NY other than NYC. The storage ban has kept fueling stations out NYC. There is a movement to lift that ban and a draft regulation for LNG storage and fueling stations was released for comment in late 2013. It is not clear when action will be taken on that draft proposal.

Table A7. Summary of Regional Bunkering Infrastructure (continued)

Region	LNG Availability	Existing Infrastructure	Market Interest	Projects Underway	Unique Issues
Jacksonville, FL	None currently, but see projects planned	None	High	1. Pivotal LNG (subsidiary of AGL Resources and WesPac) announced on February 6, 2014 that it had been selected by TOTE to provide fuel for TOTE's gas-fueled ships operating out of Jacksonville. 2. Clean Energy Fuels Corporation's Eagle LNG consortium hopes to build an LNG fuel terminal in Jacksonville, Fla. Reports in 2013 indicated that construction of the facility is anticipated to begin in the second quarter of 2014 and it is estimated to be completed in the fourth quarter of 2015. 3. Jacksonville will be the primary port for two new construction of 3,100 TEU gas-fueled container ships for TOTE and two new construction gas-fueled container/ro-ro vessels for Crowley Maritime.	None
Mobile, AL	There are several land side peak shaver in the area, these will serve as the source for the Harvey Gulf facility in Port Fourchon, LA. Trucks will carry the LNG.	No current maritime infrastructure for bunkering	Few inquiries	None	

Region	LNG Availability	Existing Infrastructure	Market Interest	Projects Underway	Unique Issues
Louisiana Coast	Peak shaving facilities inland and large import terminals. Currently large terminals are constructing infrastructure to export LNG. Some of these terminals may add truck racks but there is no discussion on adding vessel bunkering docks.	In Port Fourchon, construction is underway for a facility that will serve the six new Harvey Gulf OSVs	Interest but market is watching Harvey Gulf operations before going forward.	1. Shell is currently working on building an LNG transfer facility at their established Geismar LA terminal. The facility will transfer LNG as cargo to bunker barges. 2. The Magnolia LNG complex in Lake Charles is proposing to include the loading of bunkering barges and ships at its planned export terminal. The plan is not to bunkering gas-fueled vessels, but a dock will be provided to load vessels that would then bunker gas-fueled vessels at other locations. This dock will be operated by G2X. 3. Houston, Texas-based Waller Marine has plans to build a small-scale LNG liquefaction facility in Cameron Parish, Louisiana, to fuel vessels. 4. 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 by the end of 2015 and plans to expand to other regions as commercial agreements are completed.	

Table A7. Summary of Regional Bunkering Infrastructure (continued)

Region	LNG Availability	Existing Infrastructure	Market Interest	Projects Underway	Unique Issues
Mississippi River System	Limited availability	None	Low	1. Waller Marine has plans to build a small-scale LNG liquefaction facility at the Port of Greater Baton Rouge, Louisiana, to fuel vessels. 2. Shell is currently working on building an LNG transfer facility at their established Geismar, LA terminal. The facility will transfer LNG as cargo to bunker barges that can serve the river. 3. Towing vessel operators and the Port of Pittsburgh are studying the feasibility of developing the infrastructure to conduct underway vessel-to-vessel bunkering of LNG on the Ohio River, similar to the methods used to bunker diesel to line-haul tows.	Emission control areas (ECAs) do not apply to the inland rivers, making the need or urgency to convert to lower emissions standards a lower priority for vessel companies operating there than companies operating in ECAs. Underway bunkering, while common on the inland rivers with diesel, would present some unique hazards when conducted with LNG. Considerable safeguards would need to be developed to obtain approval
Texas Coast	Limited to trucks	Large import terminals. Currently large terminals are constructing infrastructure to export LNG. Some of these terminals may add truck racks but there is no discussion on adding vessel bunkering docks.	None	None	

Region	LNG Availability	Existing Infrastructure	Market Interest	Projects Underway	Unique Issues
California	Available	None	High	1. The Port of Los Angeles is very active in global LNG working groups, following the port of Antwerp model, to provide LNG bunkering services as part of the World Ports Climate Initiative of International Association of Ports & Harbors (IAPH). 2. Horizon Lines plans to convert two existing container ships to use LNG as fuel. MARAD will provide Horizon Lines with $900,000 to assist. 3. Two 3600 TEU container ships with LNG fuel capability are under construction for Matson Navigation.	Due to seismic concerns, initial LNG bunkering operations in Oakland are expected to be either truck-to-vessel or vessel-to-vessel
Seattle/ Tacoma, WA	Available	Tank truck bunkering capabilities only, LNG pipeline project between Canada and Oregon being considered.	High	1. Washington State Ferris conversion of six Issaquah class vessels to LNG. 2. Two TOTE ORCA class trailer vessels are to be converted to use LNG as fuel.	Lack of bunkering infrastructure
Vancouver, BC	Available	Several proposed projects being considered, no bunkering infrastructure currently exists.	High	1. BC Ferries plans to construct three gas-fueled intermediate class passenger ferries.	None
Anchorage, AK	Available	No bunkering infrastructure exists	Low	There is a proposed 800 mile LNG pipeline project in the planning stages between the North slope and the Kenai region.	Significant geographic challenges due to village remoteness and location

Table A7. Summary of Regional Bunkering Infrastructure (continued)

Region	LNG Availability	Existing Infrastructure	Market Interest	Projects Underway	Unique Issues
Great Lakes Region	Available	The Shell facility in Sarnia, Ontario is a major refueling location. The Sarnia facility will also target trucks and trains as these industries consider switching to LNG.	High	The Interlake Steamship Company is planning to convert several bulk carriers to use LNG as fuel.	None
Hawaii	None	Limited pipeline available due to Synthetic Natural Gas (SNG) production. No LNG bunkering infrastructure exists.	High	Proposed plans to develop LNG infrastructure throughout the Hawaiian island are being considered.	Geographic challenges due to location.

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/)

Table A8. Key State, Provincial and Territorial Stakeholders (continued)

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)

Table A8. Key State, Provincia and Territorial Stakeholders (continued)

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)

Table A8. Key State, Provincial and Territorial Stakeholders (continued)

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)

Table A8. Key State, Provincial and Territorial Stakeholders (continued)

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)

Table A8. Key State, Provincial and Territorial Stakeholders (continued)

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 Deprtment 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"

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

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

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

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
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

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

Agency	Permit/Approval
Local	
City of Port Arthur	Development Permit
	Fire Marshall Permit
	Food Service Permit
	Specific Use Permit
Jefferson County	Building Permits
	Flood Plan Management Permit

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Their sharing of 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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