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TERMPOL Review Process on the LNG CANADA Project

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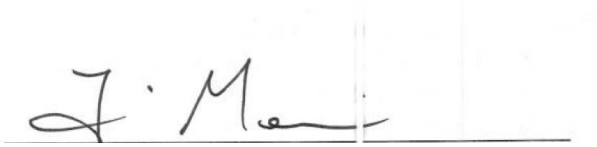

Timothy Meisner
Director General, Marine Safety and Security
Transport Canada

GLOSSARY

Aids to Navigation – Devices or systems, external to a vessel, which help mariners determine their position and course, warn of dangers or obstructions, or advise on the location of the best or preferred route.

Automated Identification System (AIS) – AIS automatically provide information, including the vessel's identity, type, position, course, speed, navigational status and other safety-related information, to equipped shore stations, other vessels and aircraft. It is required on vessels of 300 tonnes gross tonnage or more (other than fishing vessels) on an international voyage and domestic vessels of 500 tonnes gross tonnage or more (other than fishing vessels).

Ballast – Bringing ballast water on board a vessel increases the draught and changes the trim to regulate the stability or maintain stress loads within acceptable limits.

Ballast Water Control and Management Regulations – Under the *Canada Shipping Act, 2001,* regulate how to manage ballast water on all ships arriving from beyond the Canadian exclusive economic zone and entering waters under Canadian jurisdiction.

Canada Shipping Act, 2001 **(CSA, 2001)** – The CSA, 2001 is the principal law that governs safety in marine transportation including the protection of the marine environment. It:

- Seeks to balance shipping safety and marine environment protection while encouraging maritime commerce.
- Applies to all vessels operating in Canadian waters and Canadian vessels worldwide and in some cases, to foreign vessels up to the Exclusive Economic Zone.

Classification Societies - Organizations such as Lloyd's Register, the American Bureau of Shipping, DNV-GL, etc., with the expertise and capabilities to inspect, verify and certify that vessels are built, maintained and operated according to established and recognized rules, regulations and standards to ensure vessel safety.

Collision Regulations – Under the CSA, 2001, rules vessels must follow to prevent collisions while in Canadian waters, which are based on the *Convention on the International Regulations for Preventing Collisions at Sea.*

Convention on the International Regulations for Preventing Collisions at Sea (COLREG) –The COLREGs include 38 rules divided into five sections:

- Part A - General
- Part B - Steering and Sailing

- Part C - Lights and Shapes
- Part D - Sound and Light signals
- Part E - Exemptions

The COLREGs also include four Annexes containing technical requirements for:

- Lights and shapes and their positioning
- Sound signalling appliances
- Additional signals for fishing vessels when operating in close proximity
- International distress signals

Electronic Chart Display and Information System – A computer-based navigation information system that complies with International Maritime Organization regulations. It displays information from electronic navigational charts or digital nautical charts and integrates position information from the Global Positioning System and other navigational sensors, such as radar and automatic identification systems. It may also display additional navigation-related information, such as sailing directions and fathometer readings.

Escort Tug – A vessel able to assist and accompany another vessel. Service users determine the scope and range of assistance they require. Some escort tugs can tether to the vessel to provide a different level of service.

Fisheries Act – An Act to protect the productivity of recreational, commercial, and Aboriginal fisheries.

Flag State – Country of registry of a vessel, often a seagoing one. A flag state sets the safety standards and pollution prevention requirements that apply to the vessels flying its flag.

Inner Waters – Defined by LNG Canada as the waters from Triple Island, through Principe and Douglas Channels, to the marine terminal at the Port of Kitimat

In-Heel Vessels – vessels carrying 6,000 tonnes of cargo or less.

In-Product Vessels – vessels carrying over 6,000 tonnes of cargo.

International Convention for the Control and Management of Ships' Ballast Water and Sediments – Adopted in 2004, this Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by:

- Establishing standards and procedures for managing and controlling ships' ballast water and sediments.
- Requiring all ships in international traffic to manage their ballast water and sediments to a certain standard, according to a ship-specific ballast water management plan.
- Requiring all ships to carry a ballast water record book and an international ballast water management certificate.

International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS Convention) – Established in 2010, and based on the model for pollution damage caused by spills of persistent oil from tankers. Once in force, the HNS Convention will establish a two-tiered system for compensation to claimants following a ship-source accident at sea involving HNS.

***International Convention for the Prevention of Pollution from Ships (MARPOL*) –** The main international convention aimed at preventing pollution of the marine environment by ships from operational or accidental causes.

International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) – Adopted in 1990, the OPRC Convention aims to provide a global framework for international co-operation in combating major incidents or threats of marine pollution. Parties to this Convention must establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers – This Convention sets minimum standards that countries must meet or exceed, relating to training, certification and watchkeeping for seafarers.

International Maritime Organization (IMO) – Established in 1948 at an international conference in Geneva, the *IMO Convention* entered into force in 1958 and the new organization met for the first time the following year. The IMO's main task has been to develop and maintain a comprehensive regulatory framework for shipping. Its scope today includes safety, environmental concerns, legal matters, technical co-operation, maritime security and the efficiency of shipping.

LNG Canada Project - LNG Canada is a joint venture company with four project participants. Through the LNG Canada Project (the Project), LNG Canada is proposing to develop and operate a liquefied natural gas (LNG) facility and marine terminal, to store and export LNG, within the District of Kitimat, British Columbia.[1] The Project may proceed in two phases:

- **Phase 1** will have the ability to export 13 million tones per annum (mtpa) of LNG and will require approximately 170 vessel calls at the Project terminal
- **Phase 2** will have the ability to store and export approximately 26 mtpa, and at full production, will require approximately 350 vessel calls per annum.

Liquefied Natural Gas (LNG) – LNG is natural gas in its liquid state. When natural gas is chilled to approximately minus 160° C (minus 260° F) at atmospheric pressure it becomes a clear, colourless, and odourless liquid. LNG is non-corrosive, non-toxic,

1 LNG Canada TERMPOL Submission, chapter 1, section 2.1-2.2, page 10

cryogenic, and classified as a hazardous and noxious substance by the International Maritime Organization. As a liquid, natural gas is reduced to one six-hundredth of its original volume, making it feasible to transport LNG long distances in specially designed ocean tankers. After shipping, the LNG is converted back into gas.

Marine Communications and Traffic Services (MCTS) – The MCTS program provides safety radio-communication services, vessel traffic information and a commercial marine telephone call service on a 24/7 basis. MCTS falls under the responsibility of the Minister of Fisheries and Oceans under the CSA, 2001.

Marine Control Framework – An extensive Shell process that provides vetting approval. A positive vetting combined with a satisfactory assessment by marine terminal staff determines if a nominated LNGC will receive clearance to come to and load at LNG Canada's terminal.

Marine Liability Act **(MLA)** – In force since August 2001, the MLA is the principal law dealing with ship-owner and vessel operator liability towards passengers, cargo, pollution and property damage. Its intent is to set limits of liability and establish uniformity by balancing the interests of shipowners and other parties. The MLA gives many IMO international conventions the force of law.

National Oil Spill Response and Preparedness Regime – Established in 1995 as a partnership between government and industry, Transport Canada as the lead federal regulator, sets the guidelines and regulatory structure for the preparedness and response to marine oil spills.

Outer Waters – Defined by LNG Canada as the waters from Canada's territorial limit, through Dixon entrance, to Triple Island.

Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (OPRC –HNS Protocol) – Established in 2000 by the International Maritime Organization, this Protocol is an addition to the OPRC Convention and follows similar principles. Its intent is for ships carrying HNS, and HNS facilities involved in handling activities to or from a ship, to be subject to preparedness and response programs similar to those in place for oil incidents.

Pacific Pilotage Regulations **–** Rules for operating, maintaining and managing pilotage services, including compulsory pilotage and qualifications for holding licences and pilotage certificates within the Pacific Pilotage Authority Region.

Paris Memorandum of Understanding (MOU) – An international agreement with among 27 participating maritime Administrations, including Canada, which covers the waters of the European coastal States and the North Atlantic basin from North America to Europe. Its aim is to:

- eliminate the operation of sub-standard ships through a harmonized system of port State control to ensure that ships meet international safety, security and environmental standards; and
- ensure crew members have adequate living and working conditions.

Pilotage – The rules requiring vessels operating within specified waters to take on board a marine pilot with local knowledge of the waterway to help guide the vessel safely to its destination.

Pilotage Act – Enacted in 1972 and amended in 1998, this law establishes the following four Pilotage Authorities that operate, maintain and administer a safe and efficient pilotage service within their respective regions:

1. The Atlantic Pilotage Authority
2. The Laurentian Pilotage Authority
3. The Great Lakes Pilotage Authority
4. The Pacific Pilotage Authority

Among other things, the Act allows Pilotage Authorities to establish, with the approval of the Governor in Council, compulsory pilotage areas in which ships must bring pilots on board.

Port State Control – The inspection of foreign vessels in national ports to verify they meet major international conventions related to their condition, equipment, crew and operations. In Canada, inspections determine compliance with conventions Canada has implemented under the CSA, 2001.

Regional Advisory Councils (RACs) – Appointed by the Minister of Transport under the CSA, 2001, section 172; RACs provide advice on the preparedness and response regime set out in the CSA, 2001, Part 8. RAC members provide a cross-representation of the communities and interests potentially affected by an oil spill.

Response Organizations and Oil Handling Facilities Regulations **–** Under the CSA, 2001, rules related to response organizations' and handling facilities' procedures, equipment and resources during an oil pollution incident.

Science Table – A panel that replaces the Regional Environmental Emergencies Team (REET) model. It brings together scientific and technical specialists from federal, provincial/territorial and local governments, First Nations, environmental non-government organizations, industry and academic institutions to address environmental concerns, protection and clean-up priorities and strategies.

Ship Inspection Report Program (SIRE)– Launched in 1993 by the Oil Companies International Marine Forum to address concerns about sub-standard shipping, it serves as a unique tanker risk assessment tool of value to charterers, vessel operators, terminal operators and government bodies concerned with vessel safety. The program operates a very large database of up-to-date information about tankers and barges.

SOLAS (International Convention for the Safety of Life at Sea) – An international maritime safety treaty that Canada is a signatory to. It includes the *International Convention for the Safety of Life at Sea, 1974*, the related Protocol of 1988, , as amended from time to time, and has a marine security component. It is generally seen as the most important international treaty on merchant ship safety. The first version was adopted in 1914, in response to the Titanic disaster. *SOLAS, 1974*, requires flag states to ensure that their ships meet minimum construction, equipment and operational standards.

TERMPOL – "Technical Review Process of Marine Terminal Systems and Transhipment Sites." It dates from the late 1970s, when an interdepartmental committee reviewing marine pollution issues identified the need for a precise and reliable way to measure the navigational risks associated with placing and operating marine terminals for large oil tankers. It was expanded in 1982 to include other cargos. The process was further revised in 2001 and 2014 to reflect program and regulatory changes. TERMPOL is an extensive voluntary review process a proponent involved in building and operating a marine terminal system for bulk handling of oil, chemicals and liquefied gases can request. It focuses on the marine transportation components of a project.

TERMPOL Review Committee (TRC) – Transport Canada chairs a TERMPOL Review Committee for this LNG Canada Project with representatives from the Canadian Coast Guard; the Canadian Hydrographic Service; Environment Canada; and the Pacific Pilotage Authority Canada.

Tokyo Memorandum of Understanding (MOU) – An international agreement of 18 member Authorities in the Asia-Pacific region that aims to establish an effective port State control regime through co-operation and harmonized activities to:

- eliminate substandard shipping
- promote maritime safety,
- protect the marine environment and
- safeguard working and living conditions on board ships.

Vessel Traffic Services (VTS) – A means of exchanging information between vessels and a shore-based centre. Canada's VTS system is operated by certified Marine Communications and Traffic Services officers who monitor vessel movements using a network of VHF (very high frequency) radio surveillance radar, AIS, direction-finding equipment, and a vessel traffic management and information system tracking computer network.

The Canadian Coast Guard, Western Region, oversees vessel traffic movements within three Vessel Traffic Services zones: Vancouver, Tofino and Prince Rupert.

Vessel Pollution and Dangerous Chemicals Regulations – Under the CSA, 2001, rules that impose standards to reduce oil pollution, sewage pollution, garbage pollution, air pollution, and greenhouse gas emissions from vessels.

***Vessel Traffic Services Zones Regulations* –** Under the CSA, 2001, rules that outline the requirements for Canadian and foreign vessels to report information before entering, while operating within, and upon leaving Canadian waters.

VHF Radiotelephone Practices and Procedures Regulations – Under the CSA, 2001, rules that set out the practices and procedures persons on board ships must follow when using bridge-to-bridge VHF radiotelephones to ensure safe navigation.

*Note full text of Canadian Acts and Regulations are available at http://www.laws-lois.justice.gc.ca. Simply enter the name of the Act or Regulation in the search box at the top right corner of the screen.

ACRONYMS

AIS - Automatic Identification Systems
BC OGC – BC Oil and Gas Commission
COLREG – Convention on the International Regulations for Preventing Collisions at Sea
CSA – Canada Shipping Act
DWT – Deadweight Tonnes
EAC – Environmental Assessment Certificate
ERS – Emergency Release System
ESD – Emergency Shutdown
FEED – Front-End Engineering Design
FMO – Federal Monitoring Officer
GMAS – Shell's Group Marine Assurance System
GPS – Global Positioning System
GRP – Geographical Response Plans
HAZID – Hazard Identification
HNS – Hazardous and Noxious Substance
IGC - International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IMO – International Marine Organization
LFL – Lower Flammability Limit
LNG – Liquefied Natural Gas
LNGC – Liquefied Natural Gas Carrier
MARPOL – International Convention for the Prevention of Pollution from Ships
MCTS – Marine Communications and Traffic Services
MLA – Marine Liability Act
MTPA – Million Tonnes per Annum
OCIMF – Oil Companies International Marine Forum
OSC – On-Scene Commander
QRA – Quantitative Risk Analysis
RAC – Regional Advisory Council
SIGTTO – Society of International Gas Tanker and Terminal Operators
SIRE – Ship Inspection Report Programme
SOLAS – International Convention for the Safety of Life at Sea
SMPEP – Shipboard Marine Pollution Emergency Plan
STCW – Standards for Training, Certification and Watchkeeping
TERMPOL – Technical Review Process of Marine Terminal Systems and Transshipment Sites
TRC – TERMPOL Review Committee
UKC – Underkeel Clearance
VHF – Very High Frequency
VTS – Vessel Traffic Services
WAAS – Wide Area Augmentation System
WCMRC – Western Canada Marine Response Corporation

EXECUTIVE SUMMARY

LNG Canada, a joint venture company, is proposing to build and operate a liquefied natural gas (LNG) facility and marine terminal for the storage and export of LNG, within the District of Kitimat, British Columbia.[2]

If the project proceeds, natural gas will arrive at the LNG Canada terminal via pipeline to be liquefied and loaded on to LNG Carriers (LNGCs) for export overseas. LNG Canada will produce up to 13 million tonnes per annum (mtpa) of LNG at the terminal, with an option to double the processing capacity to 26 mtpa in a second phase of the project, depending on market conditions. The first phase of the project will result in 170 vessel calls to the terminal per year, and if phase two proceeds, vessel calls will double to 350 per year.

While the terminal will be able to accommodate LNGCs between 125,000 cubic meters (m^3) (approximately 70,000 deadweight tonnes [DWT]) and 265,000 m^3 (approximately 130,000 DWT), LNG Canada does not expect LNGCs with a capacity greater than 177,000m^3 to call at the terminal. LNGCs transiting to and from the Project terminal will use existing shipping routes along BC's north coast.

LNG Canada has requested to have a TERMPOL Review Committee (TRC) assess the marine transportation components of its proposed LNG Canada Project (the Project) under the voluntary Technical Review Process of Marine Terminal Systems and Transshipment Sites (TERMPOL). TRC members include experts from federal departments and authorities with responsibilities related to safe marine transportation, reviews submissions. The purpose of the TERMPOL Review Process is to:

- Objectively appraise operational vessel safety, route safety and cargo transfer operations associated with a proposed marine terminal system or transshipment site.
- Focus on improving, where possible, those elements of a proposal which could, in certain circumstances, pose a risk to the integrity of a vessel's hull while navigating and/or the cargo transfer operations alongside the terminal.

On March 27, 2015 LNG Canada submitted its final studies and surveys relating to its proposed Project to the TRC for review. All analyses presented in LNG Canada's TERMPOL submission are based on the full build out (phase two) scenario. The submission contains vessel, route, and terminal operation information. It also identifies:

- Risk of a cargo spill due to the Project, based on quantitative risk assessment results
- A number of measures that may reduce these risks, for TRC consideration

[2] LNG Canada TERMPOL Submission, Chapter 1, Section 2.1-2.2, page 10

LNGCs and their operations must comply with the safety and environmental protection requirements of international conventions and, while in Canadian waters, with Canada's marine safety regulatory regime. Canadian and international requirements address such areas as:

- safe vessel design and construction, including requirements for safe manning;
- crew qualifications and training;
- working conditions;
- safety management systems;
- radio communications equipment;
- equipment for safe navigation, which further includes Electronic Chart Display and Information Systems and automatic identification systems (AIS);
- voyage planning;
- vessel reporting; and
- rules to prevent collisions.

Canada has several measures in place to help ensure large vessels entering Canadian waters comply with international and Canadian requirements and do not pose an undue risk to safety or the environment.

While every project poses some risk, after reviewing LNG Canada's studies and taking into account LNG Canada's commitments, the TRC:

- Did not identify regulatory concerns for the LNGCs, LNGC operations, the proposed route, navigability, other waterway users and the marine terminal operations associated with LNGCs supporting the Project. LNG Canada commitments and enhancements to the existing marine safety regime will provide for a higher level of safety for LNGC operations appropriate to the increase in traffic
- Identified several findings and recommendations in response to the submission, and has proposed actions for LNG Canada that will provide a higher level of safety for LNGC operations
- Acknowledges work authorities are doing to standardize procedures and enhance preparedness and response in anticipation of an LNG export industry in BC and subsequent projected growth of marine traffic.

The TRC supports the following key measures that will reduce risk and enhance safety:

- Tug escort in compulsory pilotage waters for in-heel and in-product LNGCs, with tethering in certain locations
- Berthing tug assistance at the terminal
- Identifying mitigations to prevent drift grounding in waters west of Triple Island towards the limit of Canada's territorial sea
- Passing and one-way traffic restrictions
- Operational limits for pilot boarding, transit with escort tug, berthing and unberthing, and vessel loading
- Training for pilots and tug providers on:

- communication protocols;
- tug operational plans;
- emergency procedures; and
- areas along route where other marine users may be encountered

A complete list of the TRC's findings and recommendations is in Appendix 1.

1. INTRODUCTION

1.1 PROJECT BACKGROUND AND DESCRIPTION

LNG Canada is a joint venture company with four project participants:

1. Shell Canada Energy (Shell),
2. Diamond LNG Canada Ltd. (an affiliate of Mitsubishi Corporation),
3. KOGAS Canada LNG Ltd. (an affiliate of Korea Gas Corporation), and
4. Brion Kitimat LNG Partnership (an affiliate of PetroChina Investment [Hong Kong] Ltd.).

Through the LNG Canada Project (the Project), LNG Canada is proposing to develop and operate a liquefied natural gas (LNG) facility and marine terminal, for the storage and export of LNG, within the District of Kitimat, British Columbia.[3]

LNG is natural gas in its liquid state. It is comprised primarily of methane, but also includes heavier hydrocarbons and trace amounts of other compounds. When cooled to approximately -160° C at atmospheric pressure, natural gas becomes a clear, colourless, and odourless liquid. LNG is cryogenic, non-corrosive and non-toxic. The process of liquefaction removes any water, oxygen, carbon dioxide and sulfur compounds from the natural gas. As a liquid, the volume of natural gas is reduced by 600 times, which allows for easier transportation overseas. After shipping, the LNG is re-heated and converted back into gas.[4]

The International Maritime Organization (IMO) classifies LNG as a hazardous and noxious substance (HNS). The IMO defines HNS as any substance other than oil that, if introduced into the marine environment, would likely create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea.[5] The TERMPOL Review Committee will apply the definition of LNG as an HNS throughout the Report.

If the project proceeds, natural gas will arrive at the LNG Canada terminal via pipeline, then be liquefied and loaded on to LNG Carriers (LNGCs) for export overseas. The Project will have two LNG liquefaction units (trains) with the ability to produce 6.5 million tonnes per annum (mtpa) each, 13 mtpa in total.[6] This first phase will require approximately 170 annual vessel calls[7]. As of September 2015, LNG Canada had not yet made a final investment decision. However, if the Project does proceed, there is the option to add two more trains in a second phase of development. With four trains at full build out and at full production, the Project will export

[3] LNG Canada TERMPOL Submission, Chapter 1, Section 2.1-2.2, page 10
[4] Natural Resources Canada. (2014). Liquefied Natural Gas – What is LNG? http://www.nrcan.gc.ca/energy/natural-gas/5679
[5] *HNS Convention*. (2010). International Maritime Organization
[6] LNG Canada TERMPOL Submission, Chapter 1, Section 2.1-2.2, page 10
[7] Presentation to the TRC, September 11, 2014

approximately 26 mtpa of LNG, requiring 350 LNGC vessel calls at the Project terminal annually.[8] All analyses presented in LNG Canada's TERMPOL submission are based on the full build out scenario.

LNG Canada's marine terminal will be the former Eurocan marine terminal, which is one of the three pre-existing deep sea marine terminals at Kitimat. The terminal will be able to accommodate LNGCs between 125,000 cubic meters (m^3) (approximately 70,000 deadweight tonnes [DWT]) and 265,000 m^3 (approximately 130,000 DWT) powered by LNG boil-off gases or bunker fuel. LNGCs transiting to and from the Project terminal will use the existing defined shipping routes on BC's north coast.[9]

Existing deep-sea marine traffic in Kitimat Arm will increase from 56 vessel calls in 2013 to approximately 758 vessel calls per year in 2021 (63 vessel calls per month), depending on market demand. This number includes LNG Canada's 350 carriers and vessels from three other proposed projects: Douglas Channel Energy, Northern Gateway, and Kitimat LNG.[10]

LNGCs calling at the LNG Canada marine terminal will be owned and operated by LNG Canada's venture partners. If ever partners' vessels are not available, LNG Canada will charter vessels from the open market. When operating in waters under Canadian jurisdiction, LNGCs will have to comply with Canada's regulatory regime for safe vessel operations. In both Canadian and international waters, the requirements and responsibilities for safe vessel operation, and the monitoring and enforcement of those requirements, are well established through Canadian legislation, which implements international conventions. LNGCs will also have to comply with LNG Canada's own vessel acceptance process and terminal procedures.

1.2 TERMPOL PROCESS AND REVIEW REPORT

TERMPOL refers to the Technical Review Process of Marine Terminal Systems and Transshipment Sites and is set out in Transport Canada's Technical Publication TP 743, *TERMPOL Review Process 2001*.[11]

TERMPOL is a voluntary review process, in which proponents proposing to build and operate marine terminal systems for bulk handling of oil, chemicals and liquefied gases can participate. It focuses on the marine transportation components of a project (i.e., when a vessel enters Canadian waters, navigates through channels, approaches berthing at a marine terminal, and loads and unloads oil or gas). The intent is to improve, where possible, those elements of a proposal which could, in certain

[8] LNG Canada TERMPOL Submission, Chapter 4, Section 3.4.1, page 57
[9] LNG Canada TERMPOL Submission, Chapter 1, Section 2.2, page 11
[10] LNG Canada TERMPOL Submission, Chapter 4, Section 3.4.1, Table 4-3-N, page 59
[11] The Technical Publication was revised in 2014 to clarify the scope and intent of TERMPOL and can be found at the following link: http://www.tc.gc.ca/eng/marinesafety/tp-menu-515.htm. However, the LNG Canada submission was completed and received by the TRC prior to the publication of the new TERMPOL Review Process (TRP) and therefore follows the 2001 process.

circumstances, threaten the integrity of a vessel's hull while navigating and/or during cargo transfer operations alongside the terminal.

Through the TERMPOL Review Process, a proponent works with a TERMPOL Review Committee (TRC) chaired by Transport Canada. Committee members represent federal departments and authorities with relevant expertise or responsibilities. The Committee reviews and provides a report on the proponent's TERMPOL submission. The report:

- contains technical feedback and TRC perspectives; and
- may propose improvements to enhance the marine safety of a project and to address any site-specific circumstances.

The success of the TERMPOL Review Process depends largely upon the proponent following the procedures described in the *TERMPOL Review Process 2001* guidelines TP 743 (Review Guidelines), and the quality of the data and analysis it submits to the TRC. The proponent is responsible for ensuring that the surveys and studies meet the highest industry and international standards.

While TERMPOL report findings and recommendations are not binding, the proponent may choose to adopt as many of them as they see fit. Recommendations cannot reduce the regulatory requirements of the *Canada Shipping Act, 2001* (CSA, 2001) and all other applicable legislation. The proponent or any vessel servicing an approved project will have to comply with any and all applicable legislation and regulations as amended from time to time. Transport Canada and other agencies may use a TRC's work and report to help identify the need for regulatory improvements or special measures.

A TERMPOL report should not be interpreted as a statement of government policy, or as the government endorsing the project under review. The TERMPOL Review Process is not a regulatory instrument. No approvals or permits are issued as a result of the TERMPOL Review Process.

This TERMPOL report examines the marine transportation and terminal procedures proposed by LNG Canada. The review process takes into consideration:

- Studies, surveys and technical data LNG Canada provided in support of the Review Guidelines
- Current and anticipated national and international regulatory frameworks to ensure safe vessel operations
- Current marine transportation regimes/activities along the proposed shipping route

1.3 SCOPE OF TERMPOL

The Review Guidelines set out a maximum possible scope of assessment for vessel safety and the risks associated with vessel manoeuvres and operations. From the

guidelines, a proponent, in consultation with the TRC, selects the most appropriate scope for the project, taking into consideration existing shipping activities and unique circumstances.

The TRC and the proponent agree upon an appropriate geographical scope. This review:

- focuses on vessel safety and vessel operation safety in Canadian waters along the proposed shipping routes to and from the LNG Canada marine terminal to the western point of Dixon Entrance. It examines Project LNGC characteristics, the proposed route, navigability, other waterway users, and the marine terminal operations associated with Project LNGCs.
- does not address the natural gas receiving and LNG production facility or the supporting infrastructure and facilities including the power supply, water supply, and waste collection.

The report also examines the marine transportation operations within the context of the existing marine regulatory regime, programs and services; and considers new measures that may be in effect once the project begins operations. The appraisal gives federal government departments, agencies and the proponent an opportunity to address new or changing issues, concerns, or priorities related to the project's marine transportation components.

As set out in the Review Guidelines, LNG Canada submitted the studies, surveys, and technical data identified in Table 1 for TRC review and analysis. LNG Canada chose to combine studies into chapters for conciseness and to avoid duplicating content. More information on the grouping of studies is in Appendix 2. The chapters are presented as follows:

Table 1 LNG Canada Studies and Surveys Submitted to the TERMPOL Review Committee

Chapter	TERMPOL Survey/Study Number	TERMPOL Survey/Study Title
1	3.1	Introduction
2	3.5, 3.6, and 3.12	Route Analysis, Approach Characteristics and Navigability Survey; Special Underkeel Clearance Survey; and Channel Manoeuvring and Anchorage Elements
3	3.7	Transit Time and Delay Survey
4	3.2, 3.3, and 3.4	Origin, Destination and Marine Traffic Volume Survey; Fishery Resources Survey; and Offshore Exercise and Offshore Exploration and Exploitation Activities Survey
5	3.9	Ship Specifications
6	3.10, 3.11, and 3.13	Site Plans and Technical Data; Cargo Transfer and Transshipment Systems; and Berth Procedures and Provisions
7	3.16	Port Information Book

Chapter	TERMPOL Survey/Study Number	TERMPOL Survey/Study Title
8	3.17	Terminal Operations Manual
9	3.8 and 3.15	Casualty Data Survey; General Risk Analysis and Intended Methods of Reducing Risks
10	3.18 and 3.20	Contingency Planning; and Hazardous and Noxious Liquid Substances

Two studies were omitted, as they do not apply to the Project:

- (3.14) Single Point Mooring Provisions; and
- (3.19) Procedures and Oil Handling Facilities Requirements.

The results of the TRC's review are in the 'Analysis' section of this report. They are divided into the following four sections:

1. vessel information,
2. route information,
3. terminal operations, and
4. LNG/oil spill preparedness and response.

The TERMPOL Review Process does not replace the safety, security, and environmental requirements of any Acts and/or Regulations in effect and modified from time to time, nor is it a process to approve or reject the Project. LNG Canada must obtain any such approvals from the appropriate regulatory authorities by following their own specific processes.

As such, the British Columbia Environmental Assessment Office conducted a substituted environmental assessment of the Project in accordance with the Substitution Memorandum of Understanding with the Canadian Environmental Assessment Agency (CEAA) under the Canadian Environmental Assessment Act, 2012 (CEAA, 2012). Positive conditional Provincial and Federal decisions were announced on June 17, 2015 to allow the Project to proceed. A number of permits are required from the Provincial government, including an LNG facility permit with the BC Oil and Gas Commission. Federally, an export license was granted by the National Energy Board in February 2013. A *Navigation Protection Act* authorization will be required from Transport Canada for the Project to proceed.

2. METHODOLOGY

LNG Canada formally requested a TERMPOL review in a letter to Transport Canada on December 6, 2013. Once Transport Canada accepted the request, LNG Canada and the TRC met to establish an appropriate scope for the surveys and studies to be completed, as discussed in Section 1.3. LNG Canada then prepared its submission and provided its completed TERMPOL surveys, studies, technical data, analysis and other information related to the marine transportation components of the Project to Transport Canada and the TRC by March 27, 2015.[12]

Transport Canada then invited the TRC to review LNG Canada's TERMPOL submission. TRC members include:

- Transport Canada
- Canadian Coast Guard
- Canadian Hydrographic Service
- Environment Canada
- Pacific Pilotage Authority

Together, these member departments and authorities are responsible for delivering the Government of Canada's comprehensive regulatory framework to help ensure Canada's marine transportation is safe, secure and environmentally responsible:

- Transport Canada has a lead role in regulating shipping.
- The Canadian Coast Guard and the Canadian Hydrographic Service, Environment Canada, and Pacific Pilotage Authority Canada are responsible for providing critical programs and services for safety and environmentally responsible marine transportation.

The British Columbia Coast Pilots Ltd. (BC Coast Pilots), the British Columbia Oil and Gas Commission (BC OGC), and Natural Resources Canada provided input, as needed.

TRC participants reviewed and analyzed LNG Canada's proposal and studies from the perspective of their respective mandates, regulatory authorities, responsibilities, and expertise. Following a thorough review, the five relevant authorities completed and approved the TERMPOL report. Overall, this report represents the appropriate authorities' analysis of the marine transportation elements of the vessels and LNGC operations that could be associated with the Project.

The TRC based the analysis and commentary in this report on the information, documentation, and technologies available at the time it was written. Appropriate authorities may need to re-evaluate some aspects of this analysis if there is a

[12] LNG Canada provided a partial submission on February 27, 2015. The remainder of the submission (Chapter 9, and Volumes 2 and 3) was received on March 27, 2015. See Appendix 2: List of Documents Submitted for TERMPOL.

substantial delay in the start of operations or if LNG Canada makes changes to the proposed Project.

This report:

- applies specifically to the proposed Project and the associated marine transportation to and from the proposed marine terminal.

- contains a number of recommendations and findings.
    - Recommendations propose suggested actions to LNG Canada,
    - Findings highlight observations about the Project or actions that may be undertaken by appropriate authorities.

This report should be read in conjunction with the *TERMPOL Review Process 2001* guideline (TP 743).

3. ANALYSIS

This section reviews the measures LNG Canada has proposed to address risks associated with the Project and to further enhance marine safety. LNG Canada will take some of the measures, while others involve enhancements to the current marine safety regime.

This section also contains:

- An overview of LNG Canada's risk assessment results, which take into account the study described in the *TERMPOL Review Process 2001* (TP 743) as the "General Risk Analysis and Intended Methods of Reducing Risks"
- A more detailed analysis of:
  1. Vessel information
  2. Route information
  3. Terminal operations
  4. LNG/oil spill preparedness and response

Section 3.2.4 discusses measures LNG Canada assessed quantitatively to determine their ability to reduce the risk of an incident or spill.

The TRC's analysis of other LNG Canada proposed safety enhancements that were not quantitatively assessed to determine their effectiveness, are discussed throughout the 'Analysis' section.

The TRC also assessed measures LNG Canada has committed to take as part of their application for an Environmental Assessment Certificate (EAC) that have marine safety and navigation implications. These are discussed throughout this section of the report as well.

Refer to Appendix 6 for a list of risk mitigation measures LNG Canada has committed to take, in their TERMPOL submission and EA application.

Project LNGCs and their operations will have to fully comply with all applicable Canadian and international laws and regulations. Examples include:

- The CSA, 2001, which is the principle law that governs safety in marine transportation and protects the marine environment from vessel-source pollution in Canada. It implements several international conventions in whole or in part, and seeks to balance vessel safety and marine environment protection with the need for maritime commerce.
- The *Pacific Pilotage Regulations* under the *Pilotage Act,* which establish mandatory pilotage areas along Canada's West Coast.

The TRC based this analysis on the assumption that, if the Project should proceed, LNG Canada will keep all commitments, follow all protocols, strategies, rules, and its own requirements as described in its submission. The 'safety enhancements,' it

proposed and committed to, as well as its proposals to regulators, were important considerations in the TRC's assessment of the Project's safety elements.

Recommendation 1: LNG Canada should notify the appropriate authorities if it wishes to alter any Project commitments, operational parameters, or characteristics, so the authorities can review impacts to safety as a result of the changes.

Finding 1: The TRC recognizes that timelines for implementing the recommendations outlined in this report will have to be discussed between LNG Canada and the appropriate authorities.

Risk Assessment Results

LNG Canada conducted a quantitative risk assessment to determine the impact of the Project on cargo spill risk, and to identify mitigation measures if required. All results discussed in this section are from the risk assessment LNG Canada prepared and submitted. LNG Canada divided the route into two areas for the purposes of the assessment:

- Outer Waters – from Canada's territorial limit, through Dixon entrance, to Triple Island
- Inner Waters – from Triple Island, through Principe and Douglas Channels, to the marine terminal at the Port of Kitimat

Based on a full build out scenario (26 mtpa), average LNGC size of 158,000 m^3, and a project lifespan of up to 40 years, LNG Canada analyzed the risks of five worst-case credible scenarios:

1. Two-ship collision
2. Ship grounding (powered grounding or drift grounding)
3. Ship striking the marine terminal berth structures
4. Fire or explosion
5. Foundering in Dixon Entrance

In calculating the frequency of all incident types, LNG Canada assumed:

- LNGCs will be escorted by one close escort tug while in the compulsory pilotage area,
- environmental operational limits will exist for marine terminal operations, and
- LNG Canada will vet LNGCs calling at the terminal.

Risk assessment results indicate the highest frequency incidents to be:

- Drift grounding in the Outer Waters (1 in 299 years), if no tug is available at Triple Island
- Collisions (1 in 518 years) and powered groundings (1 in 564 years) in the Inner Waters

LNG Canada evaluated four collision and grounding scenarios that could lead to a release of cargo or bunker fuel in Inner Waters. LNG Canada assumed the credible worst case volume for either type of spill to be one tank (47,000 m^3 of LNG or 2,500 m^3 of oil). Results indicate grounding in Inner Waters to be the most likely event to occur and result in a credible worst case release of cargo (estimated to occur one in every 3,730 years) or fuel (estimated to occur one in every 7,320 years).

In support of the Quantitative Risk Analysis (QRA), LNG Canada:

- Held a hazard identification (HAZID) workshop to identify hazards, the most likely locations for the hazards to occur, and potential mitigation measures for each[13]
- Travelled the route by water from Prince Rupert to Kitimat to better understand navigational challenges

LNG Canada assessed the risk of a spill from an LNGC during loading/unloading operations based on QRAs and incidents at other terminals. Risks at the terminal were assessed using Shell's proprietary Quantified Risk Assessment Tool SHEPHERD, which calculates the risks of a given project to identify areas of concern and to assist in terminal layout. LNG Canada submitted the terminal QRA information to the BC Oil and Gas Commission on March 9, 2015 as a requirement for the Part 2 LNG Facility Permit.

The following sections discuss LNG Canada's proposed mitigation measures to reduce the increases in risk of a loss of containment due to the Project, and the TRC's consideration of these measures.

[13] LNG Canada TERMPOL Submission, Chapter 9, Section 6.2.1-6.3, pages 12-13

3.1 VESSEL INFORMATION

Under the proposed Project, vessels from 125, 000m^3 to 265, 000m^3 will be able to call at the Project marine terminal; the respective overall lengths of the vessels are approximately 274m to 345m. However, LNG Canada has stated that the largest vessels currently planned for operation at the Project terminal are 177,000m^3 with an overall length of 298m.

The LNG Canada terminal will be able to accommodate two basic design types for LNGCs. While distinctly different, both maintain extremely cold cargo tank temperatures.

1. The Kvaerner-Moss spherical tank type is typically used for vessels up to 140,000m^3, as there are challenges to developing large capacity spherical tanks while limiting the vessels' external dimensions to meet port capacity. Moss tanks are susceptible to high winds, which can impact vessel stability and be a major factor to overcome when berthing.
2. The Membrane tank type is less susceptible to high winds, as it has less of an above main deck profile. This is why membrane tanks are more commonly used for larger vessels over 140,000m^3 up to 265,000m^3, and are being used more often for smaller vessels as well. However, membrane type vessels should not travel when the tanks are between 10% and 80% full, as LNG can slosh in the tanks and damage the membrane.[14]

LNG Canada states that the world LNG fleet consists of 425 vessels, of which nearly a quarter are moss-type and three quarters are membrane type. While the Project's joint venture Partners will own and operate the LNGCs calling at the Project marine terminal, many of these vessels are committed to other projects, which may create the need for Partners to charter from the open market or acquire new vessels.

The proposed scale of the LNG Canada operations suggest that new-build vessels will likely be the membrane-type because they can accommodate larger volumes of LNG compared to the moss-type. Table 2 provides the specifications for all of LNG Canada's Partners' proposed carrier fleets. LNG Canada's design vessel specifications are in Appendix 3.

[14] LNG Canada TERMPOL Submission, Chapter 5, Section 2, pages 7-15

Table 2 LNG Canada LNGC Fleet Dimensions

Joint Venture Partner	Capacity (m^3)	DWT	Gross Tonnage	Length (m)	Breadth (m)	Draught (m)
SHELL	170,000	86,000	109,000	290	45	12.0m
	215,000	107,000	136,000	315	50	12.0m
KOGAS	165,000	82,000	104,000	286	43	11.9m
MITSUBISHI	150,000	85,000	100,000	288	44	11.5m
CNPC	130,000	71,000	85,000	286	41	11.8m

Data obtained from LNG Canada

LNG Canada:

- indicates that in 2013,
  - about 60% of the global LNGC fleet was less than ten years old and 16%, more than 20.
  - seven LNGCs with an average age of 40 years were decommissioned.
- expects 107 LNGCs will be built and delivered by 2017.

LNGCs are large vessels with a relatively shallow draft, large air draft, and surface areas susceptible to wind loading. An LNGC's hull form is also relatively fine, which allows it to operate at higher speeds. While traveling, LNG Canada states that the average LNGC service speeds are about 20 knots, with:

- full manoeuvring speed when approaching coastal waters being roughly 12 to 14 knots;
- effective 'dead slow' ahead speed about six knots[15]; and
- the minimum speed required to maintain steerageway being about four knots through the water.[16]

While most LNGCs were historically steam–powered, they are now moving towards either:

- Slow speed engines fueled by low sulphur diesel oil or low-pressure gas;
- Duel fuel diesel electric plants powered by either boil-off gas or boil-off gas plus heavy fuel oil; or
- Gas turbine electric power with waste heat recovery, utilizing boil-off gas or boil-off gas with intermediate fuel oil

Industry best practice stipulates circumstances during a vessel's voyage, where:

- the engines should be ready for immediate manoeuvre; and
- the engine room needs to be manned and the crew ready for potential adjustments to the vessel's speed (i.e. stand-by mode).

The TRC notes that in these circumstances, the crew needs to be at full attendance at the manoeuvring stations (i.e., the bridge, engine control room, and steering gears). LNGCs should be prepared and ready to respond quickly, if necessary:

[15] LNG Canada TERMPOL Submission, Chapter 5, Section 2, pages 6-7
[16] LNG Canada TERMPOL Submission, Chapter 3, Section 2, page 5

- At least one hour before arriving at the pilot boarding station to ensure the vessel is in full manoeuvrable condition and if any unforeseen situations arise, action can be taken to mitigate an incident
- It is important to man the engine room at specific times to maintain schedule and allow for berthing at the terminal as close to the estimated time of arrival as possible, as discussed further in the 'Anchorages' portion of 3.2.2
- Manning the engine room is also required to ensure the vessel can depart unexpectedly in the case of an emergency while loading/unloading

Recommendation 2: Project LNGCs' engines should be ready for immediate manoeuvre; the engine room should be manned with crew in full attendance, in the following situations:

- *At least one hour before arriving at the pilot boarding station*
- *When the vessel is in the compulsory pilotage area*
- *During transfer of cargo*

Canada will require all LNGCs calling at the Project terminal to comply with Canadian, international, and LNG Canada safety and environmental protection requirements, as discussed in further detail below.

Canadian Requirements Including International Conventions

LNGCs and their operations must comply with the safety and environmental protection requirements of international conventions and, while in Canadian waters, with Canada's marine safety regulatory regime. Canadian and international requirements address such areas as:

- safe vessel design and construction;
- safe manning,
- crew qualifications and training;
- working conditions;
- safety management systems,
- radio communications equipment and equipment for safe navigation including:
  - Electronic Chart Display; and
  - Information Systems and Automatic Identification Systems (AIS);
- voyage planning;
- vessel reporting; and
- rules to prevent collisions.

Administrations[17] certify and regularly inspect vessels trading internationally (including LNGCs), that fly their flags, as set out in the relevant international conventions. The International Convention for the Safety of Life at Sea (SOLAS) is the main international convention on the safety of vessels. Each vessel's administration, or the organization the administration authorizes, must carry out

[17] "Administration" means the government of the state whose flag the vessel is entitled to fly.

inspections and surveys according to the Convention, and issue the appropriate certificate. The Convention sets out what is covered by each survey and certificate. The initial and renewal surveys include a complete inspection to confirm that inspected items comply with the regulatory requirements, are in satisfactory condition, and are fit for the vessel's intended service.

The construction of an LNGC also needs to comply with the appropriate International Maritime Organization (IMO) codes and conventions, as per the *Vessel Pollution and Dangerous Chemicals Regulations*:

- For newer vessels built after October 1, 1994 the 1993 edition of the *International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC)* is applicable
- For LNGCs built between July 1986 and September 1994, the 1983 edition of the *IGC* applies
- For any LNGC built between October 1976 and June 1986, the *Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (GC)* is applicable

The TRC notes that while most LNGCs will fall under the 1993 edition of the IGC, the other codes will still apply to older vessels in service.

The IGC applies to liquefied gas carriers of all sizes, including those under 500 gross tonnage, carrying liquefied gases with a vapour pressure over 2.8 bars absolute at a temperature of 37.8°c. IGC requirements include but are not limited to:

- cargo containment construction materials;
- cargo pressure and temperature control;
- environmental control;
- fire protection and extinguishment;
- personnel protection; and
- capacity limits for cargo tanks.[18]

If an LNGC meets the specified requirements, Transport Canada or a Classification Society (on behalf of Transport Canada) will issue the LNGC a Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, which is valid for five years.

LNGCs must also comply with all shipping related IMO conventions adopted into Canadian legislation, such as:

- SOLAS;
- the International Convention for the Prevention of Pollution from Ships (MARPOL); and
- the Standards for Training, Certification and Watchkeeping (STCW) Convention.

According to MARPOL Annex 1 Regulation 1(4), LNGCs must:

[18] For a complete list of requirements refer to the IGC Code.

- be treated in the same manner as oil tankers, so must have an International Oil Pollution Prevention Certificate.
- must have a Shipboard Marine Pollution Emergency Plan (SMPEP), which incorporates the Shipboard Oil Pollution Emergency Plan (SOPEP) discussed further in Section 3.4 under 'International Guidelines'.

In addition, classification societies (such as Lloyd's Register, the American Bureau of Shipping, DNV-GL, etc.), are organizations with the expertise and capabilities to inspect, verify and certify that vessels are built, maintained and operated in a way that meets established and recognized rules, regulations and standards to ensure vessel safety.

Further, Canada has several measures in place applicable to LNGCs, which help ensure large vessels entering Canadian waters comply with international and Canadian requirements and do not pose an undue risk to safety or the environment, including Canada's Port State Control program, which verifies foreign vessel compliance with Canadian requirements and applicable international conventions. Before a foreign vessel may enter Canadian waters, Port State Control officers make use of international databases to review a vessel's safety and inspection record.

It is Transport Canada's policy to inspect every foreign tanker vessel calling at a Canadian port on its first visit to Canada and at least once a year thereafter. Canada considers LNGCs as tankers for inspection purposes, making them subject to this policy. Transport Canada targets vessels more than 12 years old for a more detailed or expanded inspection, which includes, among other things:

- Confirmation of watertight/weather tight condition
- Structural condition (exterior as well as inside ballast tanks)
- Emergency systems
- Propulsion machinery
- Pollution prevention measures

Transport Canada uses a number of enforcement mechanisms to ensure that vessels meet standards and comply with the regulations. For example, the department may detain vessels with significant safety deficiencies until issues are rectified.

Through the Flag State Control program, Transport Canada inspectors also conduct inspections of Canadian flagged vessels.

<u>Finding 2:</u> If the Project is approved, federal authorities with jurisdiction in marine safety, such as Transport Canada, will increase compliance inspections.

<u>Finding 3:</u> If the Project is approved, federal authorities with jurisdiction in marine safety, such as the Canadian Coast Guard, will increase vessel traffic monitoring.

LNG Canada Criteria

LNG Canada indicates it will require vessels nominated to call at the Project terminal to receive positive vetting approval from Shell's Marine Quality Assurance team[19] and a satisfactory ship-terminal compatibility assessment by LNG Canada's Marine Operations Team before receiving clearance to load at the terminal.

1. Project vessels must be positively vetted under Shell's Marine Control Framework, which is composed of Shell specific standards as well as industry standards such as the Oil Companies International Marine Forum (OCIMF).

Other sources of information that contribute to the Framework include:

- Information from the Ship Inspection Report Programme (SIRE),
- Terminal staff visits,
- Shell's Marine Technical Advisor network,
- Classification Societies,
- P and I clubs[20], and
- Port State Control

These sources also help populate Shell's Group Marine Assurance System (GMAS).

GMAS is a computerized database application Shell uses to manage and communicate quality assurance information for vessels calling at its terminals worldwide. GMAS contains information such as:

- vessel tombstone data,
- inspection dates,
- inspection findings,
- certification issues,
- approved documents and plans,
- relevant expiry dates, and
- next SIRE inspection windows.

Shell's Marine Quality Assurance Team will use Shell's GMAS to vet vessels and provide an approval to LNG Canada's marine operations team if the team identifies no issues. If issues do arise, the team will examine vessel information in greater detail to determine applicability and a resolution.

LNG Canada states vessels must be SIRE inspected and vetted.[21]

[19] The Marine Quality Assurance Team has replaced the Ship Assessment for Employment (SAFE) team referenced in LNG Canada's TERMPOL Submission.

[20] P and I clubs refers to Protection and Indemnity clubs which serve the purpose of protecting its members against large marine insurance claims.

[21] LNG Canada TERMPOL Submission, Chapter 5, Section 2.8, page 16 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

Finding 4: LNG carrier vetting and the Ship Inspection Report Programme (SIRE) process are generally accepted tools that terminals and LNG companies use to verify compliance and enhance safety.

2. LNG Canada's Marine Operations team has stated it will conduct a ship-terminal compatibility assessment based on information the LNGC operator provides in a self-completed pre-arrival Terminal Questionnaire.[22] The assessment will ensure that vessel specifications are compatible with the terminal specifications and standards. LNG Canada will grant clearance for an LNGC to call at the terminal following a positive assessment.

Finding 5: LNG Canada's commitment to vet LNG carriers is an industry best practice that can help achieve safety objectives that are above minimum regulatory requirements.

Ballast Water Requirements

The proposed Project will involve LNGCs up to 177,000m^3 in size calling at the Port of Kitimat; and in all likelihood, arriving ballasted with sea water. The vessels must comply with Canada's *Ballast Water Control and Management Regulations*, including the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*.

Vessel Security Requirements

Vessel security requirements are administered through national and international regulatory frameworks beyond the scope of the TERMPOL Review Process. All vessels must comply with national legislation and international frameworks for vessel and terminal security such as the *Marine Transportation Security Regulations*.

Automatic Identification System (AIS)

Vessels of 300 gross tonnes or more engaged on an international voyage, and domestic vessels of 500 gross tonnes or more (other than fishing vessels), must be fitted with an AIS.[23] Project vessels will be required to be fitted with AIS., which:

- automatically provides information, including the vessel's identity, type, position, course, speed, navigational status and other safety-related information to AIS-equipped shore stations, other vessels, and aircraft.
- improves a vessel's situational awareness and greatly enhances the traffic-monitoring capabilities of the Canadian Coast Guard's AIS-equipped Marine Communications and Traffic Services centres, which are discussed in further detail in Section 3.2.1.

[22] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 17
[23] Navigation Safety Regulations, SOR/2005-134, s. 65, http://laws-lois.justice.gc.ca/eng/regulations/sor-2005-134/page-11.html#h-41

The Government of Canada's World Class Tanker Safety System initiative is considering a proposal to amend regulations to extend AIS carriage requirements to a greater number of vessels; this will enhance vessel monitoring by Canadian authorities and by other ships navigating nearby.

LNG Canada indicates that it supports appropriate government agencies encouraging all vessels to be fitted with AIS and initiatives to increase voluntary use of AIS by vessels not required to do so under existing regulations.[24]

Finding 6: As part of the Government of Canada's actions to modernize Canada's navigation system, the TRC supports a review of existing AIS carriage requirements by Transport Canada, in collaboration with the Canadian Coast Guard, to determine whether they should apply to a greater number of vessels.

[24] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 18

3.2 ROUTE INFORMATION

3.2.1 OVERALL ROUTE

Chapter 2 of LNG Canada's TERMPOL submission includes a description of the proposed route. A route overview is in Appendix 4.

LNG Canada indicates that Project vessels will use the Northern Route to arrive at the terminal. LNGCs will:

- Arrive from the Pacific Ocean to enter the marine route through Dixon Entrance, the gateway to the Canadian ports of Prince Rupert, Stewart, and Kitimat.
- Take on a pilot in the vicinity of the Triple Island pilot boarding station before traveling south to Browning Entrance and into Principe Channel.
- At the south point of Principe Channel, transit through Otter Passage, Squally Channel, Lewis Passage, and then across Wright Sound.
- Head north in Douglas Channel and enter Kitimat Arm to reach the Project marine terminal at the Kitimat Port.

When leaving Kitimat, LNGCs will follow the reciprocal route.

LNG Canada has stated it will use a passage plan and electronic navigation equipment to follow the best possible route, accounting for traffic, as well as weather and other navigational hazards that may be encountered. LNG Canada indicates that Project vessels will travel along the center of the channels along the proposed route, unless there is a navigational safety reason not to.[25]

Canadian Hydrographic Service Charts

The Canadian Hydrographic Service produces nautical charts and navigational products. These hydrographic surveys capture water depths, geographical features, hazards to navigation, man-made and natural features that aid navigation, tides, currents and water levels, and sea bottom characteristics.

Mariners consider these charts and surveys to be the 'road maps' that help them travel safely from port to port. The TRC suggests that charts for the Project area be updated to include precautionary notes to indicate the presence of LNGCs. The Canadian Hydrographic Service has agreed to work with Transport Canada on developing the precautionary notes.

Finding 7: The Canadian Hydrographic Service will work with Transport Canada to develop precautionary notes on charts for mariners regarding the presence of LNGCs and any associated documentation that may be required in the North Coast Sailing Directions.

[25] LNG Canada answers to questions from the TERMPOL Review Committee received June 9, 2015

Based on the numerous proposals for increased traffic in northern British Columbia and through funding provided in support of a World Class Tanker Safety regime, the Canadian Hydrographic Service is updating navigation charts and tools for the area. Specifically, it is:

- Conducting multibeam surveys to update existing charts and create new ones where needed, including the approaches to Kitimat.
- Creating 25 news charts, 19 of which have been completed and released.
- Conducting tidal surveys in areas along LNG Canada's proposed route, including Kitimat, Hartley Bay, and Bonilla Island. Data will help develop tidal predictions and aid in current modeling.

Pilotage

Pilotage involves licensed marine pilots boarding vessels in specific areas to navigate through difficult waterways to avoid local hazards. Pilots provide extensive expertise and knowledge of a local waterway for vessels travelling to and from Canadian ports.

All geographic areas of the country fall under the jurisdiction of one of four Pilotage Authorities:

- the Atlantic Pilotage Authority,
- the Great Lakes Pilotage Authority,
- the Laurentian Pilotage Authority, and
- the Pacific Pilotage Authority.

Each is responsible for setting requirements for, and providing marine pilotage services in their respective areas. They regulate the requirements for certain classes of vessels, including LNGCs, which must take a pilot on board that has local knowledge before entering a compulsory pilotage area.

The *Pacific Pilotage Regulations* under the *Pilotage Act* govern pilotage activities in Canada's western waters. The Pacific Pilotage Authority is a federal Crown corporation whose mandate is to administer marine pilotage service in Canadian waters off the BC coast.

As per the *Pacific Pilotage Regulations*, every ship over 350 gross tonnes that is not a pleasure craft, as well as all pleasure crafts over 500 gross tonnes, must use pilotage services except for ferries and certain government vessels. This means that all Project vessels will be subject to compulsory pilotage between the LNG Canada marine terminal and the Triple Island Pilot boarding station, which represents a majority of the route in Canadian waters.

Proposed enhancements to pilotage requirements are discussed in Section 3.2.4.

LNG Canada indicates in its TERMPOL submission that slow steaming, to delay pilot pickup from the pilot boarding station, may be needed if large seas and swells

prevent safe pilot boarding from Triple Island.[26] Delaying pilot boarding if required by poor weather conditions will form part of a Traffic Management Plan the BC Coast Pilots are developing. Further details of the plan are in Section 3.2.3.

The Pacific Pilotage Authority anticipates transitioning to helicopter boarding for pilot transfer in the area, with 75 to 80 percent of transfers occurring via this method once the system is fully in place. Once helicopter boarding is implemented, slow steaming will not be required as often but may be needed due to weather conditions or operational requirements.

The Pacific Pilotage Authority prefers helicopter transfer of pilots over the boat launch method, as it is more efficient and reduces transfer time to and from the vessels from 1.5 hours via boat to 12 to 14 minutes for the same distance via helicopter. Helicopter boarding will allow vessels to maintain transit speed and increase the safety and efficiency of boarding the marine pilots onto the LNGCs in adverse weather conditions.

Along the northern route, the TRC denotes that helicopter transfer of pilots will ideally occur about 10 miles west of Triple Island, allowing vessels destined for Kitimat to use a more direct route to the terminal. A helicopter service provider has recently been selected. Operational limits on helicopter transit, such as fog restrictions, wind speed, and sea conditions, will be determined in consultation with the helicopter service provider, the BC Coast Pilots, and the Pacific Pilotage Authority.

Helicopters will meet Pacific Pilotage Authority and IMO/International Chamber of Shipping (ICS) requirements, including being Category ‘A’, twin engine certified. Marine pilots must have appropriate equipment and training for helicopter boarding and helicopter pilots should have the necessary training for safely landing passengers on moving vessels. LNG Canada has indicated its willingness to support the development of helicopter boarding limits, as requested by the Pacific Pilotage Authority.[27]

<u>Finding 8:</u> The TRC notes efforts by the Pacific Pilotage Authority and BC Coast Pilots to use helicopter transfer of pilots to Project vessels will be subject to operational limits (to be determined) and the ICS Guide to Helicopter/Ship Operations as well as Transport Canada’s Guidelines Respecting Helicopter Facilities on Ships (TP 4414).

The TRC asserts that the venting of boil-off gases should not occur during pilot boarding operations, especially during helicopter transfers. Such venting must also be avoided when in proximity to land where ignition sources are possible. Similarly, a helicopter in the immediate vicinity of the LNGC represents a direct ignition source.

[26] LNG Canada TERMPOL Submission, Chapter 2, Appendix 2, page 3
[27] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 19

<u>Recommendation 3:</u> LNG Canada should ensure that no venting of boil-off gases occurs while pilots are boarding the LNGCs. The venting of the gases should especially be avoided when helicopter transfers are taking place.

Placing a smart buoy between Triple Island and the helicopter boarding location, such as near Rose Spit, can help provide real-time weather condition information to support helicopter boarding of marine pilots. This is discussed further in Section 3.2.3. Weather conditions and considerations that may impact operation of Project vessels are further discussed in Section 3.2.2.

LNG Canada also proposes to work with the Pacific Pilotage Authority to finalize pilotage practices for Project vessels transiting the proposed route, including:

- Protocols for when two pilots should be on the bridge
- Protocols for where and when no passing of large liquid bulk carriers and, possibly, other large vessels should take place
- Training for pilots to familiarize them with the handling characteristics of LNG carriers (e.g. windage) and tug escort procedures including routine escort and emergency manoeuvres[28]

The Pacific Pilotage Authority and the BC Coast Pilots have begun discussions on pilotage requirements for LNG vessels travelling to and from Kitimat. The TRC notes the length of time it takes to transit the route, up to 18.5 hours, requires a sufficient number of pilots to be on board to accommodate shift changes. When vessels are in-product and tethered to an escort tug, two pilots will be on the bridge, as is required by standard operating procedures. Tethering will occur in certain areas at the discretion of the pilots and the Master of the vessel, such as from the berth to Nepean Rock and Ceswar Point to Wheeler Channel. Escort tugs and tethering are discussed further in section 3.2.4. Passing restrictions are also being considered and are discussed in the same section.

<u>Finding 9:</u> Two pilots will be required on the bridge while LNGCs are in-product and tethered to an escort tug. Tethering will occur in certain areas of the vessel's transit at the discretion of the pilots and as determined necessary during escort tug simulations.

Pilots have a high rate of success in safely operating and guiding vessels. The Pacific Pilotage Authority places a priority on continuous improvement of pilotage techniques, spending between $500,000 and $1,000,000 annually on training, and will ensure pilots receive appropriate training for:

- Project vessel handling
- related escort tug procedures, and
- helicopter boarding procedures.

[28] LNG Canada TERMPOL Submission, Chapter 9, Section 8.3, page 27

Escort Tug Program

The TRC finds that escort tugs can enhance safety. Tugs can be untethered or tethered to a vessel along certain portions of a route. In an emergency, they can help steer and stop tanker vessels to reduce the probability of collision, grounding, or other incidents that could result in a loss of containment of cargo.

While there are currently no specified escort tug requirements in northern BC, it is expected that requirements will be harmonized with those for vessels on the south coast that are in-product and greater than 40,000 Summer Dead Weight Tonnes.[29]

Section 3.2.4 discusses LNG Canada's proposed enhancements to the tug escort regime.

Finding 10: The Pacific Pilotage Authority, in consultation with the BC Coast Pilots, should develop escort tug requirements for BC's north coast similar to what has been established for BC's south coast with respect to in-product vessels greater than 40,000 Summer Dead Weight Tonnes.

Canadian Coast Guard's Marine Communications and Traffic Services

Vessel Traffic Services (VTS) zones exist along Canada's east and west coasts as far as the limit of its territorial sea. Shipping in the zones is monitored by the Canadian Coast Guard Marine Communications and Traffic Services (MCTS).

The Prince Rupert MCTS will monitor vessel traffic along the proposed route . Under the CSA, 2001, vessels of 500 gross tonnes or more must report information about the vessel and its intended route, including pollutant cargoes and defects, to an MCTS officer 24 hours before entering Canadian waters. Vessels are not allowed to enter unless they receive clearance from an MCTS officer. The MCTS can direct a vessel it believes to be in violation of Canadian regulations, including international conventions, to not enter Canadian waters or, if already in Canadian waters, to leave.

In addition to the reporting requirements, LNG Canada indicates that it will use Canadian Coast Guard MCTS to provide notice of planned arrival times at Triple Island, and encourages Aboriginal groups and stakeholders to consider these times when planning their routing and scheduling to support a safer marine route.[30] The TRC notes pilot boarding times can be found on the Pacific Pilotage Authority's website and supports marine users capitalizing on existing communication channels to increase awareness of Project vessel movements.

[29] See Pacific Pilotage Authority Notice to Industry May 8, 2015

[30] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.1, page 16 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

Once in Canadian waters, all large vessels, including LNGCs, are subject to vessel reporting requirements and must check-in regularly at specified calling-in points.[31] LNG Canada has stated further calling-in points may be needed along the route. Specifically, LNG Canada indicates that Otter Channel and Lewis Passage could benefit from a review, as there are currently no calling-in points in the area, yet vision can be limited due to geography. [32]

The TRC notes calling-in points are developed for all marine traffic and it is premature to determine the need for calling-in points at specific locations without confirmation that traffic will increase. The Canadian Coast Guard completed a calling-in point review for the north coast in 2012, and did not identify the need for additions along the proposed route. However, should one or more of the projects be implemented in northern BC, the need for modification of calling-in points may be evaluated by the Canadian Coast Guard, the BC Coast Pilots, and the Pacific Pilotage Authority.

Finding 11: The TRC has not identified a need for further calling-in-points at this time; however, if one or more projects proposed in northern BC proceed, an evaluation of calling-in points may be completed by the Canadian Coast Guard, the BC Coast Pilots, and the Pacific Pilotage Authority.

As discussed in Section 3.1, vessels of 300 tonnes gross tonnage or more engaged on an international voyage and domestic vessels of 500 tonnes gross tonnage or more (other than fishing vessels) must be fitted with AIS. LNG Canada indicates that there are dead zones for AIS at certain points along the route. [33] The Canadian Coast Guard is enhancing the existing system by installing a VHF remote control radio tower on Porcher Island. The new site will provide better coverage for VHF radio communications and AIS capabilities in the northern portion of Principe Channel. Lastly, LNG Canada states that it will work with the Canadian Coast Guard to assess the need for adding radar to BC's north coast as future traffic increases and to supplement information received from existing calling-in points and AIS.[34]

Finding 12: AIS coverage along the proposed route is being enhanced by the Canadian Coast Guard.

The TRC notes that GPS coverage can also be problematic along the route. The BC Coast Pilots currently use satellite positioning receivers that use GPS and WAAS systems, but are moving towards using receivers that use multiple global positioning satellite systems for navigation. This will enhance safe navigation for all large commercial vessels.

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[31] Vessel Traffic Services Zones Regulations, SOR/89-98, s. 6. http://lawslois.justice.gc.ca/eng/regulations/SOR-89-98/page-2.html#h-6
[32] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 17
[33] LNG Canada TERMPOL Submission, Chapter 9, Section 6.3, Table 9-6-B page 15
[34] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 18

E-Navigation

In recognition of the increased number of energy export projects being proposed across the country (including the west coast), the Government of Canada is taking several measures to contribute to a world-class tanker safety system; this includes modernizing Canada's marine navigation system. [35] E-navigation tools will provide accurate, real-time information and data on navigational hazards, as well as weather and ocean conditions to vessel operators and marine authorities to minimize the potential of collisions and accidents.

Aids to Navigation

The Canadian Coast Guard provides aids to navigation to help fulfill its mandate and meet advertised levels of service. Specifically, the Canadian Coast Guard provides aids to navigation where the volume of traffic and the degree of risk justify them as set out in program directives and the "Methodology for the Design and Review of Short Range Aids to Navigation Systems". The Canadian Coast Guard conducts reviews using national standards to determine the aids to navigation requirements for safe and efficient navigation in the area, in consultation with mariners.

The Canadian Coast Guard is currently conducting a Level of Service Review in northern British Columbia, due to proposed energy export projects increasing the potential for more vessels to use northern shipping routes. The review began in 2013, and is divided into three phases. It includes routes proposed for use by LNG Canada and is based on vessels identified in its TERMPOL studies. Routes include Douglas Channel, Browning Entrance, Principe Channel, and Dixon Entrance. The Phase I review is now complete and indicates a requirement for improving existing aids and installing new aids to support the increased size and volume of vessels along northern shipping routes. The Canadian Coast Guard refurbished thirty two fixed aids to navigation in the summer of 2015. It is in the process of designing new installations and planning refurbishment of aids based on the review's findings.

LNG Canada indicates that the list of aids to navigation identified in Phase I and provided in chapter 2, Appendix 2 of its TERMPOL Submission will meet its needs for shipping traffic associated with the Project. The list is inclusive of the aids requested by the BC Coast Pilots for the area.

Finding 13: The Canadian Coast Guard is enhancing aids to navigation along the Northern route, given the potential for a larger number and size of vessels using the route.

Fishing Activities

Commercial, recreational, and traditional fishing activities take place throughout the coastal waters of BC and along the proposed route.

[35] Further information can be found at: http://news.gc.ca/web/article-en.do?nid=847489

Direct interactions between Project-related vessels and other marine users, including fishing vessels, are reasonably expected to occur along the shipping route. A suite of safety measures are in place along the proposed route that guide interactions between vessels to avoid collisions and contribute to marine safety. Specifically, the *Collision Regulations* set out rules vessels must follow to prevent collisions while in Canadian waters and are familiar to both national and international mariners, as they follow the *Convention on the International Regulations for Preventing Collisions at Sea*. Rules include actions to take in head-on situations, crossing situations, and overtaking situations. All mariners must follow these "rules of the road".

Additional rules are also outlined in the *Fisheries Act*, Section 24, which includes rules related to vessels' use of fishing nets and prohibits using nets in a manner or place that obstruct boats and vessel navigation.

As part of a campaign to raise marine awareness, LNG Canada has committed to conducting at least two safe-shipping workshops targeted towards other waterway users to promote safe navigation around shipping traffic before Project operations begin. The workshops will be open to First Nations, community representatives, pleasure craft and fishing boat operators, government, and the public.[36]

Further, to minimize the likelihood of incidents with smaller vessels, such as fishing vessels, LNG Canada will:

- Increase communication with the local marine communities by providing workshops on Project operations. This will include information on how LNG Canada will manage Project shipping and how it may accommodate fishing activities.
- Publish locations of vessels associated with Project operations subject to availability of data.
- Increase pilots', LNGC masters' and crewmembers' level of cultural and environmental awareness by including information on local considerations in the Port Information Handbook, which is discussed further in Section 3.3.3.[37]

Finding 14: The TRC supports LNG Canada's actions to enhance the local marine community's awareness of Project operations.

LNG Canada also proposes:

- that the Project vessels should avoid interfering with fishers where possible, and when safe to do so; and
- a traffic management plan be developed to minimize interactions with high concentrations of small vessels along the route.[38]

[36] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.3, page 17 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[37] LNG Canada TERMPOL Submission, Chapter 9, Section 8.3, pages 27-28
[38] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.3, page 17 and Chapter 9, Section 8.3, Table 9-8-F, page 28

The TRC notes that LNG Canada, as the terminal operator, has committed to tracking fisheries openings along the route, determining potential conflicts and passing that information on to Project vessels. Terminal operators can obtain the necessary information by joining the fisheries notification process coordinated by the Department of Fisheries and Oceans.[39] The BC Coast Pilots receive these notices and post them to their website.

The Pacific Pilotage Authority and the BC Coast Pilots work to manage piloted traffic with consideration to weather conditions and concentration of local vessels is further discussed in Section 3.2.3.

Finding 15: The TRC supports LNG Canada's commitment to limit interactions of Project vessels and small vessels where possible by tracking and communicating potential conflicts between the location of fisheries openings and routes being used by Project vessels.

The TRC notes, marine pilots using helicopters have the flexibility of transferring to and from vessels at alternate locations when the concentration of smaller vessels warrants so, such as during fisheries openings.

Other Activities in the Area

The Project marine route intersects with a 'Haida Gwaii Sub-Surface Operations' military exercise area. Dixon Entrance and Hecate Strait are within the waters surrounding Haida Gwaii, and considered 'Special Operations Areas' used mainly for submarine activity. Typically, there is only one week per year when non-military vessels must avoid the areas. Vessels receive daily broadcasts of Notices to Shipping on exercise details and any precautions they must take. In general, the military exercise areas will not impede shipping to and from BC's north coast.[40]

There is a moratorium on offshore exploration in the Pacific Ocean waters off BC, so LNG Canada does not expect Project vessels to encounter any offshore exploration activities. BC's first offshore wind energy project has received environmental approval to build a large energy wind farm off the east coast of Haida Gwaii. However, the location does not conflict with the Project's proposed route. Any aquaculture or fish farms along the route are in sheltered deep waters and do not intersect with the proposed route. There are two aerodromes near the proposed route, one in Douglas Channel and the other at the head of the Kitimat Arm; special measures will not be required for safe landing and takeoff of seaplanes while LNGCs are transiting.[41]

[39] http://www-ops2.pac.dfo-mpo.gc.ca/fns-sap/index-eng.cfm?CFID=13639523&CFTOKEN=52201009
[40] LNG Canada TERMPOL Submission. Chapter 4, Section 2.4, page 12-15
[41] Ibid

3.2.2 NAVIGABILITY AND VESSEL OPERATIONS

The Port of Kitimat

The Port of Kitimat is currently a private port. Given that Canada expects that the expansion of its energy exports to increase tanker and carrier traffic in the area, on March 18, 2013, the Government of Canada announced its intention to designate the Port of Kitimat as a public port as part of the World Class Tanker Safety regime. This will enhance safety and environmental protection on designated waters.

As there are no federal lands under the administration of the Minister of Transport at Kitimat, any designation will apply only to the navigable waters. Once designated, the *Canada Marine Act*, the *Public Ports and Public Port Facilities Regulations*, as well as Practices and Procedures for Public Ports will apply. The *Canada Marine Act* covers activities such as:

- Monitoring ships about to enter or within the waters of the port
- Establishing traffic control provisions
- Requiring ships to have the capacity to use specified radio frequencies
- Requiring information to be given by ships about to enter the port or within the port for the purpose of obtaining a traffic clearance

Transport Canada is in the process of determining port boundaries. Next steps include consulting within the federal government and then with external users and stakeholders.

Channel Width Requirements

The TERMPOL guidelines indicate that one-way channel width should be at least four times the design vessel's breadth and two-way channel width should be at least seven times the design vessel's breadth. LNG Canada indicates Project vessels could be between 125,000m^3 to 265,000m^3, with a beam of 47.2 meters to 53.8 meters. This means that TERMPOL guidelines would require a one-way channel width of approximately 188.8 meters to 215.2 meters and a two-way channel width requirement of approximately 330.4 meters to 376.6 meters. Although LNG Canada expects project vessels to reach only up to 177,000m^3, the TRC has identified that the maximum size LNGCs (265,000 m^3) will still meet channel width guidelines as the narrowest channels along the route, Emilia Island Narrows and Dixon Island Narrows, are 1600 meters wide.

Channel Depth Requirements

The TERMPOL guidelines indicate a vessel's underkeel clearance (UKC) should be 15% of its maximum permissible draught, or meet requirements established and published by the appropriate government authority for a specific waterway.

LNG Canada provided maximum draught estimations for Project vessels transiting in open ocean, coastal waters, and marine channels. The estimations take into account dynamic vessel motions, vessel squat, sag and hog. Draught calculations and minimum depths required to meet the 15% UKC guideline are provided in Table 3.

Table 3 Minimum Water Depth Needed for Largest Design LNGC's Maximum Loaded Draught of 12.2m (in-Product) Along Proposed Marine Routing

Proposed Marine Routing	Total Cumulative Draught* (m)	15% UKC (m)	Minimum Water Depth needed with 15% UKC applied (m)	Minimum Charted Depth (MLLW**) along proposed Design Vessel Route (m)
Open Ocean	42.2	6.33	48.53	180 (15 NM due west of Forrester Island)
Coastal Waters	22.7	3.4	26.1	36 (Learmonth Bank)
Marine Channels	13.7	2.06	15.76	35 (Browning Entrance)

*Total Cumulative Draught = maximum Loaded draught + maximum estimated dynamic ship motions + maximum estimated squat + maximum estimated sag + maximum estimated trim
**MLLW = Mean Lower Low Water

LNG Canada indicates minimum charted depths along the marine access route are 35 meters or above, which surpasses the depths needed for the largest LNGCs to transit coastal waters and marine channels.[42] Maximum charted depths reach several hundred meters.[43]

LNG Canada notes Project vessels should avoid Learmonth Bank, near open ocean and Dixon Entrance, because it can have shoaling depths of 36 metres or less depending on weather. They should use deep water channels to the north and south instead.[44] The TRC supports this measure.

<u>Finding 16:</u> Project vessels should avoid Learmonth Bank when possible due to its shoaling depths. They should use deeper channels to the north and south instead.

The TRC acknowledges that depth guidelines are met along all portions of the proposed route, except in the vicinity of the Project terminal. However, the Pacific Pilotage Authority and the BC Coast Pilot guidelines only require 10% UKC of the vessel's maximum permissible draught at a terminal. LNG Canada has committed to ensuring its berth layout will accommodate at least 10% UKC for its vessels. As such, the water depth near the terminal can be a minimum of 15.07 meters. A description on dredging activities at the terminal and acceptable UKCs is discussed in Section 3.3.1.

[42] LNG Canada TERMPOL Submission, Chapter 2, Section 5, page 11-12
[43] LNG Canada TERMPOL Submission, Chapter 2, Section 7.1.12.1, page 41
[44] LNG Canada TERMPOL Submission, Chapter 2, Appendix 2, page 3

Vertical Clearance Restrictions

The TRC finds that there are no vertical clearance restrictions along the proposed route.

Safe Operating Speeds and Transit Windows

LNG Canada estimates safe operating speeds for LNGCs will vary from four[45] knots to 19.5 knots; [46] depending on the location, weather conditions, marine mammal presence, and subject to the safe navigation of Project vessels as determined by the Master of the vessel with advice received from BC Coast Pilots onboard.

LNG Canada proposes Project vessels will travel from eight to ten knots in areas with high whale populations between the northern end of Campania Island and the southern end of Hawksbury Island from July through October. LNG Canada identified this as a mitigation measure under the environmental assessment process to address times when Project vessels may use the waterway at the same time as predicted periods of high use by marine mammals.[47]

The TRC supports speed reductions in the area when high concentrations of whales are present, but notes that the following are needed:

- A consistent definition of what constitutes a 'high concentration' of whales
- A method for monitoring whales in the area to determine concentration levels and a way to translate that information into spatial data that ships' electronic navigation equipment and the portable pilot units can identify

Programs have been launched to provide monitoring information in support of navigation safety, such as Ocean Networks Canada's Smart Oceans program which will enhance marine safety by monitoring and providing alerts on marine mammals in Kitimat and Douglas Channel, among other areas.[48] Transport Canada has also contracted Green Marine to provide information on underwater noise generated by shipping, its effects on marine life, and to identify potential solutions.[49]

Recommendation 4: LNG Canada should identify sources of data to monitor concentrations of whale populations and discuss with the BC Coast Pilots and the Pacific Pilotage Authority concentration limits that could require adjustment to Project vessel speeds or routes.

[45] LNG Canada TERMPOL Submission, Chapter 3, Section 2, page 5
[46] LNG Canada TERMPOL Submission, Chapter 5, Section 2, page 6-7
[47] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.3, page 17 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[48] http://www.oceannetworks.ca/smart-ocean-backgrounder-oct-2014
[49] http://www.green-marine.org/2015/07/27/transport-canada-and-green-marine-team-up-to-address-underwater-noise/

During transit, LNG Canada states project vessels will maintain safe operating distance from other marine craft.[50] The TRC notes that safe operating distances will have to take into account *Collision Regulations* and good seamanship practices. LNG Canada indicates Project LNGCs will maintain safe operating distance by maintaining a proper lookout using sight and hearing, electronic navigation to determine if course or speed alterations are required, and radio communication when appropriate.

The route is approximately 159 nautical miles in total. Transit to the LNG Canada terminal from the Triple Island pilot boarding station in Hecate Strait, while in-heel, will take about 17 hours. The reciprocal in-product route will take about 18.5 hours. The estimated average speed of the in-heel or ballasted passage will be 9.35 knots, with a maximum speed of 14 knots through Hecate Strait. The average speed of the in-product route will be 8.59 knots with a maximum speed of 12.5 knots.[51] The TRC notes that while on the pilotage route, the LNGCs will be escorted by escort tugs, which dictate a maximum possible LNGC speed of 14 knots due to the operational restrictions of the tugs.

The TRC does not have any concerns with the proposed speed profiles, but notes that it will be up to the discretion of the pilots, at the time of a given transit, to determine appropriate speed profiles for safely guiding vessels. The speed profiles listed in Table 4 are simply guidelines for each segment along the marine route. Further details are provided in Appendix 5. LNG Canada will list a complete overview of the in-heel and in-product speed profiles in the Port Information Book.

Table 4 Proposed In-Heel and In-Product Safe Speed Profiles

Route Section	Distance (Nautical Miles)	In-Heel Speed for the Leg (Knots)	In-Product Speed for the Leg (Knots)	Average Duration of In-Heel Route (Hours/ Minutes)	Average Duration of In-Product Route (Hours/ Minutes)
Hecate Strait	52.2	14	12.5	3h – 44m	4h – 10m
Principe Channel	22.3	10	10	2h – 14m	2h – 14m
Nepean Sound	14.8	10	10	1h – 29m	1h – 29m
Otter and Squally Channels	9.5	8	7	1h – 11m	1h – 21m
Lewis Passage	8.7	8	7	1h – 5m	1h – 15m
Wright Sound	4.3	8	6	0h – 32m	0h – 43m
Douglas Channel	36.0	8	8	4h – 30m	4h – 30m
Kitimat Arm	11.2	5	4	2h – 15m	2h – 48m
Total	159.0	Average of 9.35 knots	Average of 8.59 knots	17h – 00m	18h – 30m

Data obtained from LNG Canada TERMPOL Submission Chapter 3, Section 2.2

[50] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.3, page 17 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[51] LNG Canada TERMPOL Submission, Chapter 3, Section 2, pages 8-10

Finding 17: The TRC does not have concerns with the speed profiles LNG Canada proposes for in-heel and in-product vessels.

Anchorage

Along the shipping route there is one recognized anchorage that meets TERMPOL guidelines. Anger Anchorage is located off of Principe Channel at the junction of Petrel Channel. It is an approved anchorage for larger vessels and has water depths of 44 meters to 90 meters. The anchorage covers an area of 2.8 kilometers (km) by 1.8 km and is available in the unlikely event that anchoring is required.

LNG Canada states there will be no planned anchoring of Project LNGCs along the route due to concerns about accumulation of boil-off gas, unless required to do so by the BC Coast pilots or as a result of unplanned conditions.[52] As an alternative to anchoring, the TRC notes that Project vessels can use the escort tug to help maintain vessel position, if needed.

Weather and Sea Conditions

An LNGC's crew considers a number of factors when dealing with poor weather conditions and rough seas, including:

- The vessel's performance characteristics
- The shipping route's navigation characteristics
- Long-term weather forecasts
- Real-time weather
- Vessel owner requirements
- Terminal operator requirements
- Pilot and Vessel Traffic Services advice and guidance

LNG Canada will use these factors to establish standard operating procedures for their LNGCs in the region, and BC Coast Pilots will consider them when developing its Traffic Management Plan. Both are discussed further in section 3.2.3.

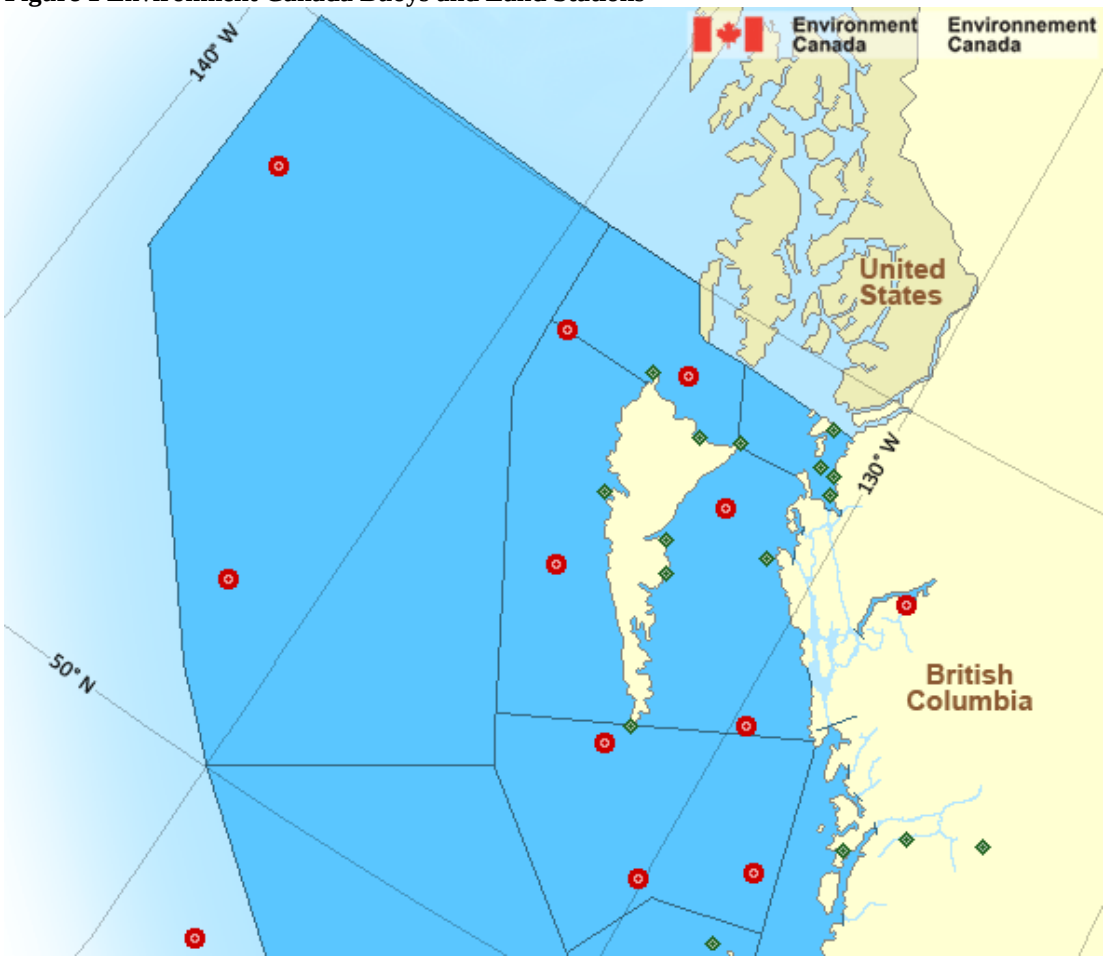
Environment Canada, in partnership with the Department of Fisheries and Oceans and the Canadian Coast Guard, has established a system of moored meteorological buoys and coastal weather stations to provide information on weather conditions in Canadian waters, based on the following guiding principles:

- Meet a minimum requirement of one data point (buoy or coastal automatic weather station) per marine forecast region
- Integrate with U.S. National Weather Service Buoy Network
- Feasible location, taking into account water depth, currents, weather, etc.
- Position to correspond with grid points for meteorological modelling

[52] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.3, page 17 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

The buoys and weather stations monitor weather conditions on open ocean areas and major straits, as well as selected higher-traffic channels and sounds. Based on data gathered, Environment Canada provides regularly updated information on current conditions and forecasts on its website. Along the proposed route, there is a buoy and several coastal observation stations at North Hecate Strait and a buoy at Nanakwa Shoal in Douglas Channel, as marked in Figure 1 below. [53]

Figure 1 Environment Canada Buoys and Land Stations



Legend: Buoy Land Station

As part of the federal government's World Class Tanker Safety initiative, Environment Canada will receive targeted funding to improve marine monitoring infrastructure. Starting in 2015, Environment Canada will deploy new meteorological buoys in major coastal shipping or port areas in Canada. Environment Canada will determine locations based on its guiding principles and assist marine pilots and port authorities in the safe movement of vessels through Canadian waters.

[53] Location of all buoys and weather stations for the Pacific North Coast can be found at http://weather.gc.ca/marine/forecast_e.html? mapID=01&siteID=06200 under the *Weather Conditions* tab

The improvements in marine monitoring infrastructure will also likely benefit LNG shipping. Any increased monitoring in the channels off the West Coast should be coordinated with the World Class Tanker Safety initiative to maximize the benefits. LNG Canada supports future assessments of meteorological and ocean monitoring requirements on the BC North Coast.

LNG Canada indicates that while there can be heavy winds along the route, winds diminish as they travel from the open ocean to the BC coast. Squally Channel is exposed to heavy weather, especially during southeasterlies. Nepean Sound can be exposed to strong winds from the southwest through to the west.[54] LNG Canada's Marine Operations Department will use direct observations from tug and ship crews and weather information from various sources to monitor weather in the region.

LNG Canada has also committed to providing appropriate meteorological and ocean monitoring equipment at its terminal.[55]. It will use data gathered to inform decisions on scheduling and arrival times at Triple Island as well as berthing and unberthing operations.

Finding 18: LNG Canada's commitment to provide enhanced weather monitoring at the Project terminal will contribute to the safe passage of Project vessels in Canadian waters.

In addition to safe navigation practices and use of navigational equipment onboard, establishing weather and environmental restrictions on vessel operations can help ensure vessels do not exceed safe operating limits and take undue risks as conditions deteriorate. LNG Canada will rely on the pilots' knowledge to navigate safely in areas of strengthened winds.[56]

The TRC notes that Pacific Pilotage Authority and the BC Coast Pilots will establish operational limits for LNGCs. For example, high winds can impact the manoeuvrability of an LNGC, so the BC Coast Pilots propose that if winds are higher than a yet to be determined threshold, in-heel LNGCs may not enter Dixon Entrance. Pilots will then wait for more favourable conditions before boarding Project vessels. Pilots can use the MCTS Continuous Marine Broadcast service and Environment Canada weather information to anticipate conditions for when Project vessels approach Dixon Entrance. If LNGCs are at berth, pilots in consultation with the master of the vessel, will determine if they should delay departure.

Recommendation 5: LNG Canada should support the Pacific Pilotage Authority and the BC Coast Pilots in developing operational limits for LNGCs.

[54] LNG Canada TERMPOL Submission, Chapter 2, Appendix 2, page 4 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[55] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 20
[56] LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

Further work by the Pacific Pilotage Authority and the BC Coast Pilots to manage piloted traffic in the area considering weather conditions and concentrations of local vessels is discussed in Section 3.2.3.

3.2.3 MARINE TRAFFIC CONSIDERATIONS AND ADDITIONAL TRAFFIC CONTROLS

LNGCs calling at the Port of Kitimat will interact with marine traffic transiting the BC coast. Fishing vessels, tugs, cargo ships, passenger vessels, and recreational vessels all use the waters near the proposed shipping route. LNG Canada had marine traffic studies done for the Project, which identified and counted the vessel traffic in the area. The existing and potential future marine traffic that will interact with the Project LNGCs along the proposed route was quantified. Marine network focal points in existing routes that were analyzed include:

- Triple Island;
- Caamano Sound and the Outside Passage;
- Wright Sound (Douglas Channel South) and the Inside Passage; and
- the Kitimat Approaches and Kitimat Harbour.

The studies obtained vessel traffic data for 2012 and 2013 (including variations in seasonal traffic) from AIS data for the BC North Coast; records from the Pacific Pilotage Authority on piloted movements from the Triple Island and Pine Island pilot stations; and from other sources.[57]

Existing deep-sea marine traffic in the Kitimat harbour is expected to increase from 56 vessel calls in 2013 to approximately 758 vessel calls per year in 2021 (63 vessel calls per month). The forecast for future vessel traffic is based on an assessment of the number of terminal expansions or upgrades and new facilities being proposed at the time the study was prepared. Forecasts were generated for Kitimat and Triple Island. In addition to the Project's anticipated 350 LNGC's, other projects accounted for in the calculations include Douglas Channel LNG, Northern Gateway, and Kitimat LNG.[58]

The TRC notes existing traffic past Triple Island is higher than traffic through Douglas Channel and up to Kitimat Arm. As such, the increase in traffic from the Project could have the most noticeable impact in Douglas Channel and Kitimat Arm. However, marine traffic calling at the Port of Kitimat has historically withstood volumes higher than current levels. Between 1978 and 2008, several terminals were in operation and the average (mean) number of vessels calling at the Port of Kitimat was 200 per year. In 1993, the year with the highest number of calls, had 279 vessels call at the Port of Kitimat.[59]

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[57] For a complete list of the other sources of data refer to Chapter 4, Section 3.1.3 of the LNG Canada's TERMPOL submission, page 20

[58] LNG Canada TERMPOL Submission, Chapter 4, Section 3.4.1, Table 4-3-N, page 59

[59] LNG Canada TERMPOL Submission, Chapter 4 , Appendix 1, page 1

LNG Canada has committed to supporting passage planning by LNGCs that avoids areas of increased marine use, when safe to do so. They will work with the Pacific Pilotage Authority and the BC Coast Pilots to assess pilot boarding locations and passage plans for the proposed route.[60] The Pacific Pilotage Authority and the BC Coast Pilots, in consultation with stakeholders, are developing a Traffic Management Plan that will guide movement of piloted vessels in the region. The plan will take into account weather conditions and local vessel traffic considerations, and may include the following:

- Vessels staying a sufficient distance offshore if:
    - Rescue towing support is not available due to weather
    - Until weather allows for pilot boarding
    - Unable to conduct tethered escort
- No arrival or departure of vessels if weather is outside stated parameters
- Re-routing of vessels if conflicts with fisheries in an area to reduce interactions with fishing vessels

To support the Traffic Management Plan, the BC Coast Pilots suggest a smart buoy should be installed at the Triple Island pilot station, as sea conditions are an important factor in assessing pilot boarding conditions. The buoy should meet IMO standard 289 and provide real-time information on:

- Wind speed direction
- Average wind
- Wave heights/swells
- Period and direction of swells
- Trends
- Barometry

<u>Finding 19:</u> BC Coast Pilots, Canadian Coast Guard, and Environment Canada should further investigate the installation of a smart buoy at Triple Island .

In addition, as a condition of LNG Canada's Provincial Environmental Assessment Certificate (EAC), LNG Canada will develop a Marine Activities Plan to help manage impacts from traffic related to LNG Canada's marine operations on other waterway users. The Plan may also be required as a Term and Condition of the Transport Canada Navigation Protection approval for the Project terminal.

<u>Recommendation 6</u>: LNG Canada's Marine Activities Plan should consider and align with the Pacific Pilotage Authority and BC Coast Pilots' Traffic Management Plan for the region.

[60] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 19

3.2.4 PROPOSED MITIGATION MEASURES

If the Project proceeds, the risk of incidents and spills will increase due to the greater number of vessels that will transit the waterway. To address the increase, LNG Canada proposes two primary mitigation measures and numerous secondary measures. The two primary measures are quantitatively assessed for effectiveness and include:

1. Having tug escort from Triple Island to the Project terminal for both in-heel and in-product vessels
2. Identifying mitigations for drift grounding in the Outer Waters as part of a tug operations plan

As stated in the beginning of Section 3, collisions and powered groundings are the most likely incidents to occur in Inner Waters. Drift groundings in the Outer Waters are the most likely incident to cause a release of cargo or fuel.

LNG Canada estimates that one close escort tug for LNGCs in the compulsory pilotage area will reduce the frequency of groundings in the Inner Waters by 50%. Following full mission simulations with the Pacific Pilotage Authority and the BC Coast Pilots, LNG Canada has determined that a close escort tug will brake and steer the LNGC if a loss of power or steering occurs. Tethering, at the discretion of the Master and the BC Coast Pilots, could also decrease hazards. While tethering escort tugs to the LNGC could be warranted in some areas, LNG Canada states that further analysis is required before this can be proposed as a mitigation measure. Tethering of tugs is discussed further below.

To reduce the risk of drift grounding in Outer Waters, LNG Canada examined the effectiveness of having an escort tug with towing capabilities on stand-by near Triple Island at certain times of the year for in-product LNGCs transiting Dixon Entrance. Results estimate that placing a tug at Triple Island could reduce the frequency of drift groundings in the Outer Waters from one in 299 years to one in 2,670 years. Further mitigation of drift grounding may be achieved by routing approaches to Triple Island away from close proximity to Rose Spit at the northeast end of Haida Gwaii based on weather conditions, although impacts on spill frequency have not been assessed.

A) Quantitative Risk Assessment Mitigation Measures

In March 2015, LNG Canada, along with BC Coast Pilots and Transport Canada, conducted simulations to determine the ability of an escort tug accompanying a project vessel to manage emergency scenarios. Results indicated the selected 92-tonne bollard pull tug is adequate to manage the emergency scenarios assessed. Tethering the tug to the vessel was also shown to be more effective in responding to emergency scenarios in certain narrow areas of the vessels' route.[61]

[61] MITAGS-PMI. (2015). *Kitimat Waterway LNG Transit Simulation*

Based on the results of the Quantitative Risk Analysis and tug simulation results, LNG Canada proposes the following risk mitigation measures.

Tug escort from Triple Island to the Project terminal for both in-heel and in-product vessels, with tethering in certain locations:

LNG Canada proposes mandatory tug escort in compulsory pilotage waters for in-heel and in-product LNGCs. The TRC supports LNG Canada using one escort tug, provided it is capable of rescue towing and is the appropriate size and power. LNG Canada has stated that the largest vessels currently planned for operation at the Project terminal are 177,000m^3 and proposes the following tug specifications, subject to further analysis:

- Escort tug with a minimum 92-tonne bollard pull
- Meets Canada's Near Coastal Class 2 Voyage requirements (crewing and inspection)
- Classed with one of the Recognized Organizations: American Bureau of Shipping (ABS), Bureau Veritas (BV), ClassNK (NK), DNV-GL (formerly Det Norske Veritas and Germanischer Lloyd), Korean Register (KR), Lloyds Register (LR), or RINA Services, S.p.A. (RINA)
- With length greater than 35m long
- Cruising speed capable of 14 knots to maintain station with an LNG Carrier in transit
- Manoeuvrable but at the same time an efficient hull form for long transits and minimal wake
- Firefighting capability
- Oil spill response capability
- Live-aboard accommodation for all crew
- Space for extra crew and their equipment/baggage and small stores for the LNG carrier[62]

The TRC confirms these specifications to be appropriate for escorting vessels up to 177,000m^3. However, if larger vessels call at the Project terminal, these tug escort specifications may not be appropriate and will have to be re-examined. The Pacific Pilotage Authority and the BC Coast Pilots will develop standards for escort and rescue towing for the north coast that will be vetted by industry and apply to Project operations. Requirements should take the tug simulation findings into account as outlined in the *Kitimat Waterway LNG Transit Simulation.*[63]

<u>Recommendation 7:</u> LNG Canada should ensure tugs used for Project operations meet appropriate specifications to assist Project LNGCs in emergency situations and

[62] LNG Canada TERMPOL Submission, Chapter 9, Section 2.2, pages 5-6. Note LNG Canada corrected the estimated bollard-pull from 100 tonnes to 92 tonnes in communication to the TRC on September 4, 2015.
[63] MITAGS-PMI. (2015). *Kitimat Waterway LNG Transit Simulation*

take into account the findings and conclusions of the Kitimat Waterway LNG Transit Simulation Study.

Further, LNG Canada identifies that tethering of tugs may be required along certain portions of the route such as Wright Sound, Lewis Passage, and Otter Channel.[64]

The BC Coast Pilots have examined the route and determined that tethering is not required for vessels in-heel, but will be required for vessels in-product in narrow areas such as from the berth to Nepean Rock and from Ceswar Point to Wheeler Island. Load cells will be needed on the tugs to measure pulling forces on the line when tethered to the vessel. LNG Canada states locations where tethering is needed will be determined by Full Mission Bridge Simulations and in consultation with the Pacific Pilotage Authority, the BC Coast Pilots, and the tug provider.[65]

Recommendation 8: LNG Canada should ensure escort tugs are equipped with load cells to measure the line forces created by the tugs.

Recommendation 9: LNG Canada, in consultation with the Pacific Pilotage Authority, the BC Coast Pilots, and the tug provider(s), should conduct full mission bridge simulations to determine where along the route in-product Project LNGCs will require tethered escort.

LNG Canada has indicated three harbour tugs and three escort tugs will be available 24 hours a day for Project operations. At least three tugs will be available near Kitimat for berthing. Escort tugs will be capable of assisting with berthing if needed.[66] Availability of berthing tugs is further discussed in Section 3.3.2.

Mitigations for drift grounding in the Outer Waters:

LNG Canada has committed to identifying appropriate mitigations for drift groundings in the Outer Waters, which will be reflected in a draft tug operations plan it will submit to the TRC at least six months before starting operations.[67]

LNG Canada has not explicitly committed to having an escort tug on stand-by near Triple Island examined in Chapter 9 of its TERMPOL submission as mitigation, however an escort tug will be required to be at Triple Island in time to provide an escort to the inbound loaded LNGC. Regardless, the TRC notes that escort tugs should have appropriate rescue capabilities, including towing equipment for emergency towing and an appropriate render recover winch. Project vessels should be rigged to quickly and easily allow for connection to towing gear.

[64] LNG Canada TERMPOL Submission, Chapter 2, Section 8.5.2, page 51
[65] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 16
[66] LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[67] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 17

Finding 20: The TRC acknowledges that LNG Canada has identified the risk of groundings in the Outer Waters and agrees that further consideration is warranted.

Recommendation 10: LNG Canada should ensure that escort tugs accompanying vessels to and from Outer Waters have appropriate rescue towing capabilities for the largest Project vessels proposed for use.

Recommendation 11: LNG Canada should submit its draft tug operations plan to Transport Canada, the Pacific Pilotage Authority, the Canadian Coast Guard, and the BC Coast Pilots six months before Project operations begin.

B) Other new measures

LNG Canada proposes the following measures to further enhance safety, although their effectiveness was not assessed as part of the Quantitative Risk Assessment.

Passing and one-way traffic restrictions:

LNG Canada indicates Project vessels will only be able to pass other large commercial vessels along wide, straight sections of the route. LNG Canada's risk assessment results identified certain areas of higher risk for collisions with large vessels, namely, Otter Channel and the entrance to Wright Sound, where pilots should manage passing. The TRC agrees certain points of the route warrant one-way traffic, allowing for mid-channel passage to maximize safety, but should only occur if another large vessel will not be encountered.

Pilots will manage passing situations through bridge to bridge communication and not overtake other deep sea vessels in unsafe and narrow areas, which could include Emilia Island, the bend at Blackfly, Lewis Pass, and where Principe Channel and Dixon Entrance converge.

Finding 21: One-way traffic restrictions are supported along certain portions of the route and will be managed by pilots on an as-needed basis through bridge to bridge communications.

Operational limits:

LNG Canada also states that operational procedures with defined limitations are being developed in conjunction with the BC Coast Pilots and other stakeholders where appropriate, and may be employed for:

- Pilot boarding
- Transit with escort tug
- Berthing (with harbour tugs)
- Loading

- Unberthing (with harbour tugs)[68]

Further work between the Pacific Pilotage Authority, the BC Coast Pilots, and LNG Canada is required to establish standard operating procedures and operational limitations for pilot boarding by boat and helicopter. LNG Canada has indicated that it can support the development of these limits, as requested by the Pacific Pilotage Authority.[69]

Finding 22: The Pacific Pilotage Authority has previously established operating rules for tankers transiting BC's southern route through a Notice to Industry. The Pacific Pilotage Authority should also develop operating rules for the northern route for LNGCs transiting in the compulsory pilotage waters from Triple Island to the terminal in Kitimat.

Recommendation 12: LNG Canada should work with the Pacific Pilotage Authority and the BC Coast Pilots to establish standard operating procedures and operational limitations, and provide this information to Project vessel operators through the Terminal Operations Manual.

Training for pilots and tug providers:

Lastly, LNG Canada has committed to developing a training program with the Pacific Pilotage Authority, the BC Coast Pilots, and the escort and harbour tug provider to support communication between masters of tugs assigned to Project vessels and the BC Coast Pilots. The training plan will aim to familiarize tug masters and pilots with:

- Communication protocols
- Tug operational plans
- Emergency procedures
- Areas along the route where other marine users may be encountered, to enhance awareness

The TRC agrees that strong communication between tug masters and LNGCs will be essential. The STCW, in particular *Regulation VIII/2*, outline requirements for watchkeeping arrangements and principles for masters and all watchkeeper personnel. Compliance will ensure safe continuous watch or watches appropriate to the prevailing circumstances and conditions are maintained on vessels at all times. The BC Coast Pilots have been conducting simulator training with pilots, apprentice pilots, and tug masters for a number of years to ensure appropriate bridge management. Any training program developed to enhance communication between masters and watchkeeping personnel should be in line with guidance reflected in the STCW Code Section A-VIII/2.

[68] LNG Canada TERMPOL Submission, Chapter 2, Section 8.5.1, page 51
[69] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 19

Recommendation 13: LNG Canada should work with the Pacific Pilotage Authority, the BC Coast Pilots, and the tug provider(s) to develop a training program to support communication between the tug masters and the pilots. The training program should be in line with guidance reflected in the STCW Code section A-VIII/2.

3.2.5 GAS CLOUD DISPERSION RISKS AND MITIGATIONS

The TERMPOL Review Guide recommends including gas cloud modelling in proponents' risk analysis. The TRC asked LNG Canada to complete gas cloud modeling along the shipping route and at the terminal; however LNG Canada provided a justification for why modelling was not necessary for the proposed Project, which is summarized below.

LNG Canada outlines the hazards of exposure to LNG as follows:

- LNG is cryogenic, so materials not designed to withstand such cold temperatures can fracture and skin can burn.
- Exposure to high concentrations of natural gas (1% to 3% oxygen) can lead to asphyxiation.
- Natural gas is flammable and can ignite between the lower flammability limit (LFL) and the upper flammability limit (between 5% to 15% concentration of natural gas) if an ignition source is present.[70]

Sandia National Laboratories found that the most significant impacts to public safety and infrastructure from an accident occur within approximately 250 meters of an LNG spill, with lower impacts occurring beyond approximately 750 meters for near-shore operations.[71] Based on these parameters, LNG Canada identifies that the following four conditions would need to be present for a community along the proposed marine route to come into contact with natural gas above the LFL concentrations:

1. A large amount of LNG would need to be released in a short amount of time
2. An LNGC would need to be in close proximity to the community
3. A natural gas cloud could not come into contact with an ignition source before reaching the community
4. Winds would likely need to be still or moving slowly in the direction of the community

To date, there has not been a major spill of LNG or oil from an LNGC anywhere in the world. Collisions and groundings are the only two credible scenarios that could lead to a release of cargo over a short period of time; however, the frequency of such incidents occurring between Triple Island and the Port of Kitimat (Inner Waters) is respectively 0.000134 and 0.000268 per year. If the probability of either incident occurring in the Inner Waters was evenly distributed along the marine access route,

[70] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 6

[71] Sandia Report. (2004). Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water, pages 22-23.

the annual frequency of an LNG release occurring in close proximity to a community would be approximately 1 in 190,000.

Since the hazards of a collision or grounding are not the same at all points along the Inner Waters, LNG Canada states the probability of an LNG release being near to Hartley Bay or to Kitimaat Village (the areas along the route with higher population levels) will be lower. Furthermore, neither community is adjacent to the highest collision or grounding hazards.[72]

According to the *Liquefied Natural Gas Facility Regulations* under British Columbia's *Oil and Gas Activities Act*, if the annual frequency of exceeding a given number of fatalities is less than 1 in 10,000 the risk is considered to be tolerable.[73] Using these regulations as a guideline, LNG Canada determined the level of risk associated with the release of LNG near communities in the Inner Waters as tolerable.

The Sandia Report states that the likelihood of a gas cloud fully extending, especially in a near-shore populated area where there are many ignition sources, is very low. There is a better chance that the gas cloud would ignite before reaching a community, and then burn back to the gas source away from the public. LNG Canada states that at this point responders could manage and extinguish the fire according to approved firefighting techniques for LNG fires.

The Sandia Report also finds that the hazard zone area of a gas cloud will extend downwind from the spill and not in a uniform circle. LNG Canada explains that the prevailing winds in Douglas Channel and Kitimat Arm tend to be parallel to the marine channels. Therefore, the frequency of optimal conditions required for a gas cloud to disperse towards a community is low. For these reasons, LNG Canada did not complete the modelling of natural gas dispersion for this Project.

LNG Canada states that risk can be mitigated by reducing the frequency of incidents and the severity of the consequences; reducing the frequency of incidents or eliminating them altogether being essential to the Project. This is why LNG Canada commits to managing hazards to safe navigation and to have emergency response plans and resources available at the marine terminal.

An assessment of the worst case credible scenario of 53,200m^3 of LNG or 2,500m^3 of bunker fuel was included in LNG Canada's Environmental Assessment Application and a conditional Environmental Assessment Certificate (EAC) was granted on June 17, 2015. This confirms that the Project risks are acceptable to the

[72] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 7

[73] Liquefied Natural Gas Facility Regulations. BC Oil and Gas Activities Act. B.C. Reg. 146/2014. Schedule 2, Section 4 (4). http://www.bclaws.ca/civix/document/id/complete/ statreg/146_2014

BC Environmental Assessment Office, pending LNG Canada meets a list of conditions outlined in Schedule B of the EAC.[74]

[74] EAC Schedule B can be found at: http://a100.gov.bc.ca/appsdata/epic/documents/p398/d39101/1434642582673_wfwdVCkNJLyPstWRWR66gV2MDTsh9kynQdjr3H51N2Xnvmf9yJXh!-14610924!1434641485535.pdf

3.3 TERMINAL OPERATIONS

LNG Canada will undertake the mitigation measures discussed below to help reduce the risk of a spill at the Project terminal.

LNG Canada will regularly communicate:

- information on Project activities to marine users, including recreationalists, commercial tourism operators, and commercial recreational and aboriginal (CRA) fishers, Transport Canada, the Department of Fisheries and Oceans, and relevant stakeholders.
- tug and LNGC schedules to minimize interactions with fisher and recreational boaters, thus making other waterway users aware of approximate times when Project vessels will be in Kitimat Harbour.[75]

LNG Canada will heavily monitor and tightly control Project vessel arrival times at the terminal so they arrive as close to their scheduled time as possible. Pilots will communicate regularly with the terminal as they near the terminal to confirm berth availability. If a berth is unavailable, LNG Canada stipulates that LNGCs will make necessary adjustments to modify estimated arrival times, which could include being put in a holding pattern in deep water while escorted by an attendant tug.[76] In the unlikely event that LNGCs have already entered Douglas Channel and a berth is not available, Project vessels will head back down the channel. They will not anchor near the terminal, as discussed in Section 3.2.2.

<u>Finding 23:</u> The TRC supports Project vessels entering a 'holding pattern' in Douglas Channel in the unlikely event a berth is unavailable at the Project terminal.

The TRC requested that LNG Canada provide further detail on the quantitative risk analysis (QRA) at the terminal including gas cloud modeling and vapour dispersion estimates. LNG Canada provided a QRA and Facility Siting Summary Report that concluded that gas cloud modeling would not alter the results of the risks analysis or mitigation measures to be implemented at the terminal. Although LNG Canada's risk analysis did not include risks associated with loading/unloading,[77] they will be considered during the Front-End Engineering Design (FEED).[78]

<u>Recommendation 14:</u> LNG Canada should provide the Pacific Pilotage Authority and the BC Coast Pilots with a copy of its FEED risk assessment on loading/unloading before Project operations begin.

[75] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.1, page 16
[76] LNG Canada TERMPOL Submission, Chapter 9, Appendix 4, page 51
[77] Ibid.
[78] LNG Canada TERMPOL Submission, Chapter 9, Section 6, page 11

LNG Canada assessed the accident-potential at the terminal during berthing/unberthing and determined it can mitigate risks with harbour tugs. Navigational simulations demonstrated that tugs can control the LNGCs when berthing, but they may damage the vessel during the process.[79] Berthing tugs are discussed further in Section 3.3.2. LNG Canada found the risk of an LNGC grounding near the terminal to be negligible given the number of berthing tugs involved.

3.3.1 MARINE TERMINAL

LNG Canada has submitted plans and development studies outlining its commitment to design the proposed marine terminal to meet the applicable standards, codes, and industry best practices. The full list of relevant codes and standards are listed in LNG Canada's TERMPOL Submission.[80]

The TRC notes management and environmental concerns about the location and construction of the marine terminal are outside the authority and scope of the TERMPOL review, with the exception of two issues:

- The terminal must meet all Federal, Provincial and local spill planning, preparedness and response requirements, which are discussed further in Section 3.4.
- The marine terminal must meet Canadian security requirements. Before operations may begin at the Project marine terminal, the terminal operator must comply with national, including international, regulatory frameworks for marine terminal security.

The LNG Canada Project terminal will be required to complete the Pacific Pilotage Authority's 'new terminal checklist' before operations begin, as part of pilotage requirements for new terminals. The checklist's purpose is to ensure all new terminal/loading areas in compulsory pilotage areas on the west coast have taken the necessary steps to ensure that maximum sized vessels proposed for Project operations can safely negotiate approaches to and from the Project terminal. Eight months before the first ship arrives, LNG Canada will be required to identify whether:

- Bathymetry plans for terminal/loading areas and approaches are available
- Adequately scaled charts for the terminal/loading areas and approaches are available
- Plans of the proposed facility and safe pilot access to and from the vessel are available in electronic format as e-navigation charts suitable for loading to a portable pilot unit
- Simulations are required to determine approach plans for docking and undocking and whether a training program will be required for pilots to learn docking procedures
- Weather and current patterns for the area are documented

[79] LNG Canada TERMPOL Submission, Chapter 9, Appendix 4, pages 51-52
[80] LNG Canada TERMPOL Submission, Chapter 6, Section 5, pages 12-13

Six months before the first ship arrives, LNG Canada will have to identify whether it undertook analysis of tug requirements and whether there will be any special requirements for tug procedures due to weather or currents. Three months before the first ship arrives, LNG Canada will have to identify if:

- navigation aids for approaches are sufficient
- the Project dock is adequately lit,
- as-built plans have been supplied, and
- any restrictions were identified as a result of simulations.

Recommendation 15: LNG Canada must complete and submit the Pacific Pilotage Authority's new terminal checklist within identified timelines.

Recommendation 16: LNG Canada should incorporate safety checklists outlined in the most current version of the SIGTTO publication "Liquefied Gas Handling Principles on Ships and in Terminals" into their operational procedures.

Recommendation 17: LNG Canada, in conjunction with those responsible for the fleet of tugs, should develop a training program for all individuals involved with terminal operations. The training program should include criteria from clauses 13.2 to 13.6 of the CSA Z276-15 and NFPA 59A standards regarding the minimum standards for safe operations and maintenance of LNG terminals and for personnel training.

LNG Canada indicates that dredging will be required around the terminal.[81] LNG Canada will need to obtain the appropriate permits from Environment Canada and Transport Canada for planned dredging work. Dredge volumes will be confirmed during the FEED phase of the Project. Dredging will allow Project vessels to have a minimum UKC of 10% at low tide in the berth basin, which is below TERMPOL guidelines but has not been identified as a concern by the BC Coast Pilots. A lower UKC impacts the manoeuvrability of a vessel and can result in the need for greater tug assistance. As noted in Section 3.3.2, three to four harbour tugs will assist Project vessels as they near the terminal and during berthing.

If dredging occurs, the TRC notes:

- the Canadian Hydrographic Service will re-survey the area around the Project terminal and provide updated navigational charts.
- LNG Canada will provide notification and information to the Canadian Hydrographic Service on terminal and berth locations for incorporation in the charts.

The BC Coast Pilots have identified to the Canadian Hydrographic Service the need for 1:25,000 scale e-navigation charts around the terminal, which the Canadian Hydrographic Service will produce should the Project proceed.

[81] LNG Canada TERMPOL Submission, Chapter 6, Section 2.2, page 7

Finding 24: New nautical charts may be required as a result of proposed dredging work around the terminal.

LNG Canada is proposing control zones around their marine terminal and berthed LNGCs. The control zones aim to manage two distinct risks and include:

1. A 200 meter radius around the loading manifold during loading operations.[82] This zone aims to ensure that ignition sources do not come into close proximity with methane gases. The 200 meter radius was derived using consequence and frequency data consistent with the *Shell Global Solutions* analysis.[83]
2. A zone around the marine terminal during construction and operations as a safety and security measure.[84] This zone will have a broader parameter designed to reduce interactions between LNGCs and other traffic and increase safety to the boating public while Project activities are underway.

The TRC acknowledges that other countries use control zones around LNG marine terminals. Additional work is required to review the concept in Canada with the aim of developing a national approach while considering the specific circumstances at each terminal. It should be noted that the TRC does not support moving exclusion/control zones around vessels while in transit.[85]

Finding 25: The TRC recognizes the need for further work from the appropriate authorities to review the issue of control zones for LNG terminals with the aim of establishing an approach that takes into account the specific circumstances of each marine terminal.

Recommendation 18: LNG Canada should provide details on the justification, location, size and management of their proposed control zones to the appropriate authorities and work with them to review the issue of control zones in Canada.

3.3.2 BERTHING AND MOORING PROCEDURES

Before the master or a pilot, brings a vessel into a berth, they must be confident that the facility is suitable for the vessel. LNG Canada submitted information describing:

- The berthing facility and its location; and indicated the facility has sufficient water depth and area for manoeuvrability for Project vessels.
- Appropriate environmental and marine conditions for Project LNGCs, which will be confirmed during the detailed design phase.

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[82] LNG Canada TERMPOL Submission, Volume 2, Appendix 2, page 1

[83] LNG Canada TERMPOL Addendum 1 to Chapter 9, LNGC QRA and Facility Siting Summary Report Prepared for CFSW LNG Constructors, page 9

[84] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.1, page 16

[85] For further information on the TRC's rationale, refer to the TERMPOL Review Process Report on the Trans Mountain Expansion Project, pages 27-31.

In defining the structural components of the marine terminal, LNG Canada states that quick release hooks are standard equipment for marine terminals handling bulk liquids. They can safely and efficiently secure the LNGCs to the berth and in an emergency, can allow the quick release of the mooring lines, even when under full tension.[86]

While an LNGC is in berth, open lines of communication are needed between vessel crew, terminal operators, tug crew, and all other parties involved in loading or unloading of cargo.

Tugs

LNG Canada plans to have three harbour tugs and three escort tugs available 24 hours a day for Project operations. At any given time there will be at least three tugs available for berthing the LNGCs at Kitimat; escort tugs will replace harbour tugs as operational requirements warrant. Full mission bridge simulations using 65-tonne bollard pull tugs demonstrated that the largest design LNGC can be safely berthed/unberthed with as few as three harbour tugs.

Additional tugs will provide redundancy and assist in contingency planning/scheduling purposes as operational availability of any tug is not 100%. All tugs will have periodic inspections and planned maintenance throughout their lifespan in Prince Rupert or Vancouver; resulting in the need for occasional substitution by other tugs.[87]

LNG Canada will conduct further simulations and trials to determine operational requirements for berthing tugs, and use the results to develop standard operating procedures, in consultation with the BC Coast Pilots and tug operators.

Recommendation 19: The number and size of berthing tugs should be based on the findings and conclusions of further berthing tug simulations to be conducted with the Pacific Pilotage Authority and the BC Coast Pilots and actual berthing trials of LNGCs. LNG Canada should distribute the results of berthing and manoeuvring simulations as well as mooring and docking plans to Transport Canada upon completion.

The TRC agrees that 65-tonne bollard pull tugs will suffice for Project vessels 177,000m^3 and below. Load cells will be needed on tugs to measure the pulling forces on the line. The BC Coast Pilots may require further full mission bridge simulations with LNG Canada and tug operators, as well as training for pilots specific to LNG vessels once Project vessel berthing and docking tug specifications have been confirmed. The simulations will help:

- determine whether a four tug configuration will be required rather than the three tug configuration proposed by LNG Canada; and

[86] LNG Canada TERMPOL Submission, Chapter 6, Section 2.4.3, page 8
[87] LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

- confirm the operational limits to include in the Traffic Management Plan the Pacific Pilotage Authority and the BC Coast Pilots will develop.

Recommendation 20: LNG Canada should ensure berthing tugs are equipped with load cells to measure the line forces created by the tugs.

Further consultation with the Pacific Pilotage Authority and the BC Coast Pilots is required to determine operational limits for berthing, loading, and unberthing. LNG Canada will provide operational limits to the TRC at least 60 days before operations begin.

Recommendation 21: LNG Canada should work with the Pacific Pilotage Authority and the BC Coast Pilots to develop operational limits for berthing tugs.

LNG Canada will provide a draft tug operations plan to the TRC at least six months before operations begin.

LNG Canada states the tug providers will be responsible for ensuring that tugs are available and properly maintained. It is expected that escort tugs will be capable of assisting in berthing and docking operations.[88] Tug providers will also be responsible for providing tug berthing facilities, as they will not exist at the terminal. The TRC notes that once LNG Canada selects the tug operator(s), a suitable location for tugs should also be identified by LNG Canada near the Project berths.

Recommendation 22: LNG Canada should ensure the availability of adequate tugs and crew on standby at the terminal to allow for safe arrival and departure of LNGCs at all times. The TRC suggests that LNG Canada establish operating procedures stipulating that LNGCs be ready to sail at any given time when they are at the terminal.

Navigational Aids

LNG Canada indicates navigational and berthing aids are needed for Project activities at the Project terminal, and include:

- Lighted buoys, fixed berth lights and sector(s). Locations and detailed specifications will be developed during FEED.
- Soft lighting to be mounted on the outer vertical face of the terminal wharf, to be visible from seaward.

The pilots support a sector light on the inner berth to assist in berthing and mooring procedures. LNG Canada is proposing to install two sector lights at the terminal, including one on the inner berth, to guide LNGC's to the berth in low visibility. Refer to Appendix 7 for a technical drawing of navigation aids proposed at the terminal.

[88] LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015

Transport Canada is the authority responsible for approving the proposed aids under its Navigation Protection Program, and will do so based on advice from the Canadian Coast Guard. The Canadian Coast Guard and BC Coast Pilots will advise on berthing aids and marking structures through the Transport Canada Navigation Protection Marine Referral Process. LNG Canada has stated its support for any aids needed at the terminal for safety purposes.[89]

Finding 26: BC Coast Pilots support LNG Canada's proposed navigational and berthing aids at the terminal, which Transport Canada will review.

Turning Basin

LNG Canada has identified that ballasted Project vessels will need to make a 180 degree tug-assisted turn in order to berth port side for loading and to allow for a straight departure from the berth once the LNGC is loaded, or in case of an emergency. [90] Based on a maximum Project vessel overall length of 300 meters, TERMPOL guidelines indicate that a turning basin will have to be 750 meters in diameter. Vessels will turn in the approach from the navigational lane to the berth. The TRC notes LNGCs will have to conduct the turn before entering the berth because there will not be adequate room to conduct a turn beside the terminal.

Starboard-side berthing may be considered in certain situations, depending on meteorological conditions and advice from pilots. If so, arrival and departure approaches will be reversed.[91]

Recommendation 23: LNG Canada should ensure Project LNGCs execute a turn before entering the berth if they will load with the port-side of the vessel to the berth face.

Finding 27: The TRC has no concerns with the turning basin proposed for Project vessels.

3.3.3 CARGO TRANSFER OPERATIONS

While in Canadian waters, vessels transferring LNG must comply with Canadian *Vessel Pollution and Dangerous Chemicals Regulations*.

As discussed in Section 3.3.2, LNG Canada's engineering team will develop operational limits for loading operations and for when loading must be suspended

[89] LNG Canada TERMPOL Submission, Chapter 4, Section 2.5.1, page 16 and LNG Canada answers to TERMPOL Review Committee questions received June 9, 2015
[90] LNG Canada TERMPOL Submission, Chapter 6, Section 2.3, page 7
[91] Ibid

during the detailed design phase of the Project. LNG Canada will provide the limits to the TRC at least 60 days before operations begin.[92]

LNG Canada states it will, either independently or with a group managing Kitimat Harbour, prepare a Port Information Book that will outline Project specific risk mitigation measures Project vessels must follow (e.g., reduced speeds and use of escort tugs). LNG Canada has committed to consulting relevant authorities in preparing the book and providing a draft to the TRC no less than six months before operations begin.

LNG Canada will prepare and provide a Terminal Operations Manual to the TRC before completing terminal construction and starting operations.

Recommendation 24: LNG Canada should provide draft copies of its Port Information Book and Terminal Operations Manual to Transport Canada, the Canadian Coast Guard, and the Pacific Pilotage Authority for information at least six months before terminal operations begin as there may need to be changes made in the final 6 months.

Recommendation 25: LNG Canada should ensure its Port Information Book and Terminal Operations Manual are available to LNG shippers and their agents in time for them to understand and fully comply with their contents.

The TRC requested further information from LNG Canada on how cargo transfer risks will be assessed and spills considered during loading operations. LNG Canada responded by noting that industry best practices to reduce risk have been incorporated into:

- Vessel and marine terminal design and associated equipment technologies
- LNG cargo handling policies, procedures, best practices and industry guidelines; and
- Qualified personnel training and competency

Further, LNG Canada affirms there will be a two-stage emergency shutdown (ESD) system connected to the ESD on the LNGC at the ship/shore interface of the loading system on the berth.

- The first stage will automatically stop all transfer of liquid if pre-set parameters are exceeded; this system will be strategically located and can be operated manually.
- The second stage will prevent mechanical damage by activating the emergency release system (ERS) in the loading arms if there is excessive ship movement and the loading arms are over-extended.

A further backup system will be in place in case excessive surge pressures in the loading system result from the rapid closure of the ESD/ERS valves. The integrity of

[92] LNG Canada TERMPOL Addendum 1 to Chapter 9, page 19

the loading system will be maintained by setting adequately high pressure ratings and providing surge protection by diverting the LNG loading flow to a jetty drain drum if need be.[93] ESD procedures will be included in the Terminal Operations Manual.[94]

[93] LNG Canada TERMPOL Submission, Chapter 6, Section 8.6, page 22
[94] LNG Canada TERMPOL Submission, Chapter 8, Section 1, page 4

3.4 LNG /OIL SPILL PREPARDNESS AND RESPONSE

This section discusses regulatory requirements, best practices and LNG Canada's actions to address two key pillars in Canada's approach to dealing with ship-source spills:

1. *Preparedness and response* involves preparing for and responding to marine incidents quickly and effectively.

2. *Liability and compensation* focuses on ensuring that the shipowner is held liable, and in the event of a ship-source spill, that there is adequate compensation to cover clean-up costs and any damages as a direct result of the spill.

LNG Spill Preparedness and Response Regulations and Frameworks

Canada's LNG spill preparedness and response regime is being developed and will be informed by existing regulations and international frameworks.

The Emergency Management Act outlines the responsibilities of the Federal Government and the Ministry of Public Safety and Emergency Preparedness during an emergency.[95] The Ministry is responsible for:

- leading emergency management in Canada by coordinating emergency management activities amongst government institutions, provinces, and any other pertinent entities.
- establishing policies, programs and other measures for emergency management plans and for providing advice to government institutions on the subject.

Once the Ministry has selected a lead agency for emergency response to ship-source pollution, it will also analyze and evaluate the agency's emergency plans and procedures.

As of 2004, Transport Canada became the lead regulatory agency for the preparation and response to ship-source oil pollution spills. Transport Canada is also responsible for the design and regulation of an HNS regime and for making sure the necessary resources are in place to establish the national response capacity for:

- Ship pollution response plans
- Handling facility pollution response plans
- Monitoring response organization exercises
- Enforcement and compliance

Federal agencies provide assistance in the event of a spill, with a designated lead for every type of environmental emergency. The CSA, 2001, along with the *Oceans Act*,

[95] Emergency Management Act, section 3 and 4. http://laws-lois.justice.gc.ca/PDF/E-4.56.pdf

grant the Canadian Coast Guard legislative authority as the lead federal response agency accountable for ensuring an appropriate response to all vessel-source and unknown source pollution incidents in waters under Canadian jurisdiction. The Canadian Coast Guard is transitioning to an internationally recognized Incident Command System, which allows it to respond more effectively to an incident and integrate its operations with key partners, including the US Coast Guard.

When the polluter is:

- known and is willing and able to respond, the Canadian Coast Guard will advise the polluter of its responsibilities under the CSA, 2001, and assume the role of Federal Monitoring Officer (FMO) when it is satisfied with the polluter's intentions and plans.
- unknown, unwilling or unable to respond, the Canadian Coast Guard will assume the overall management of the incident as On-Scene Commander (OSC).

In all cases, Canadian Coast Guard Environmental Response will ensure an appropriate response.

Other departments assist the Canadian Coast Guard as required. For example, Environment Canada can convene the Environmental Emergencies Science Table to provide consolidated, consensus-based environmental advice on protection and clean-up priorities for OSC consideration and to the Responsible Party for action. The Science Table, which builds upon and replaces the former Regional Environmental Emergencies Team model, brings together relevant experts in the field of environmental protection such as:

- response agencies,
- all levels of government,
- Aboriginal representatives,
- local communities,
- industries,
- environmental non-government organizations, and
- academic institutions.

The Tanker Safety Expert Panel Phase 2 Report (TSEP 2) reviewed preparedness and response requirements for ship-source releases of HNS. It:

- concluded that opportunities exist to enhance Canada's prevention, preparedness, and response framework; and
- recommends Canada establish an HNS program to augment its preparedness and response to an HNS release. An HNS program should be designed to foster capacity across industry to prepare for and respond to ship-source incidents and releases of HNS between land-based facilities and vessels.[96]

[96] Tanker Safety Expert Panel. (2014). A Review of Canada's Ship-Source Spill Preparedness and Response: Setting the Course for the Future, Phase II Requirements for the Arctic and for Hazardous and Noxious Substances Nationally, page 3

> The Panel's recommendations will serve to inform the Government in its policy work and the planning of further actions to continue implementing a world-class tanker safety system across the country.[97]

International Guidelines

The International Maritime Organization (IMO) focuses on improving safety at sea and preventing pollution from vessels. As mentioned in Section 3.1, Canada is a signatory to several of the IMO's international conventions pertinent to preparedness and response that all LNGCs operating in Canadian waters must adhere to, such as SOLAS, MARPOL, and the International Safety Management (ISM) Code.[98]

- SOLAS outlines the requirements for fire protection, fire detection, and fire extinction as part of a vessel's contingency plans.
- MARPOL aims to prevent pollution of the marine environment by ships from operational or accidental causes.
- The ISM Code establishes an international standard for the safe operation of ships and pollution prevention. It dictates three emergency preparedness measures required onboard vessels, including:
  - Identifying potential emergency shipboard situations and establishing procedures for response
  - Establishing programs for drills and exercises to prepare for emergencies
  - Ensuring the safety management system incorporates measures to allow the vessel's crew to respond at any time to hazards, accidents, and emergency situations involving its ship

The IMO has also established the Protocol on Preparedness, Response, and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol) as an addition to the International Convention on Oil Pollution, Preparedness, and Co-operation (OPRC Convention). Its intent is for ships carrying HNS and HNS handling facilities involved in handling activities to or from a ship to be subject to preparedness and response programs similar to those in place for oil incidents. Though Canada has not yet ratified the Protocol, it sets out a framework to be used for establishing a national program for HNS preparedness and response.[99]

The Society of International Gas Tanker and Terminal Operators (SIGTTO) issues publications that serve as industry best practices in addition to IMO requirements. For example, the IMO and SIGTTO have published guidelines on creating a single Shipboard Marine Pollution Emergency Plan (SMPEP) for gas carriers, namely the

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[97] http://news.gc.ca/web/article-en.do?nid=959979

[98] For a complete list of IMO conventions to which Canada is a signatory refer to the LNG Canada TERMPOL Submission, Chapter 1, Section 5: The Existing LNG Carrier Regulatory Regime.

[99] International Maritime Organization. (2000). OPRC-HNS Protocol

Guidelines for the Development of SMPEP's of Oil and/or Noxious Liquid Substances (Resolution MEPC.85 [44], as amended by resolution MEPC.137 [53]).

Further, the International Chamber of Shipping has published the Tanker Safety Guide (Liquefied Gas) that serves as industry guidance on the safe operation of chemical tankers and outlines the properties of LNG, precautions, hazards, and emergency procedures.

Domestic Frameworks

At the domestic level, Canada has a number of existing requirements for reducing the risk of HNS releases at sea. Canada's *Environmental Response Arrangements Regulations* under the *CSA, 2001* require that gas carriers have an arrangement with a certified response organization for at least the total amount of oil carried by the vessel, as either cargo or fuel, as well as a declaration of pollution insurance coverage. These are discussed further below.

The TRC notes that:

- since LNG Facilities are not classified as Oil Handling Facilities, the *Environmental Response Arrangements Regulations* of the *CSA, 2001* do not apply to shore-based LNG terminals and operations.
- terminal operators must confirm that vessels proposing to call at the terminal meet emergency prevention and preparedness requirements. LNG will do this through its project partners' vetting processes, and by association, the LNG Canada terminal as discussed in section 3.1.

LNG Spill Liability and Compensation

The TERMPOL Review Process requests that proponents follow the developments of the HNS Convention and the implementation of national/regional Chemical Response Regimes, if applicable. The 2010 HNS Convention establishes a two-tier compensation system to be paid in the event of an accident involving HNS. Canada amended the *Marine Liability Act* in 2014 to implement the 2010 HNS Convention. These amendments will be given force of law should Canada ratify the Convention and it come into force internationally.

Under the 2010 HNS Convention, depending on the gross tonnage of a vessel, vessel owners, through their insurance coverage, will be strictly liable for between about $18 million to $180 million for damage (including loss of life and personal injury claims) resulting from an HNS incident from their ship and costs for responding to an HNS spill. An international HNS Fund will provide an additional tier of compensation up to a maximum of about $450 million, including any amount paid by the vessel owner and their insurance coverage.

Oil Spill Preparedness and Response Regulations and Frameworks

Since LNGCs have petroleum products in the form of bunker fuel on board, an oil spill is a possibility and Canada's National Marine Oil Spill Preparedness and Response Regime will apply. The Regime ensures that Canada is prepared for and can respond to oil spills from vessels and oil handling facilities. The Regime took effect in 1995, based on the 'polluter pays' principle and is a partnership between government and industry. It is governed under the CSA, 2001, Part 8 and its regulations and standards. As mentioned, Canada, as an active member of the IMO, has acceded to a number of international conventions that support the Regime.

Transport Canada, as the lead federal regulatory agency for the National Oil Spill Preparedness and Response Regime is responsible for the following with respect to oil spill response:

- Providing regime management and oversight
- Developing regulations and standards relative to the CSA, 2001, Part 8
- Applying and enforcing regulations relating to the *Response Organization and Oil Handling Facilities Regulations*, Part 2
- Overseeing an appropriate level of preparedness
- Monitoring marine activity levels

The Regime is a partnership between government and industry. Industry, as the creator of the risk, bears the liability and responsibility to respond in the event of a marine incident in Canadian waters and, therefore, is charged with the operational elements of the Regime. Industry carries out its operational role through four industry-funded and Government-certified Response Organizations, which maintain a level of preparedness, according to Canadian regulations and standards, to respond to spills.[100] Prescribed vessels entering Canadian water must have an arrangement with the appropriate Response Organization for spill response, which on the west coast is the Western Canada Marine Response Corporation (WCMRC).

Under the Regime, as a Tier 4 Response Organization, WCMRC must have the capacity to respond to a 10,000 tonne spill within prescribed time standards and operating environments.

In addition, the Regime is built upon the principle of cascading resources, which means that, in the event of a spill larger than 10,000 tonnes, the WCMRC response can be supplemented by the Canadian Coast Guard, by resources from other regions, or internationally through the *International Convention on Oil Pollution Preparedness, Response and Co-operation*.

The Canadian Coast Guard and Environment Canada have roles concerning oil pollution planning and preparedness. For example, the Canadian Coast Guard

[100] Tanker Safety Expert Panel. (2013). A Review of Canada's Ship-source Oil Spill Preparedness and Response Regime – Setting the Course for the Future, page 3

regularly conducts or participates in Emergency Response exercises with partners and stakeholders to ensure rapid response to incidents or potential incidents.

Transport Canada works with stakeholders through a network of six Regional Advisory Councils to address areas of mutual concern and to advise the Minister of Transport on issues related to the Regime. Each Council has seven members, representing people, groups, and companies whose interests could be affected by spills.

Oil Spill Liability and Compensation

Under the *Marine Liability Act*, any person, including the Canadian Coast Guard is able to recover the costs and expenses incurred from the owner of the vessel responsible for the pollution and from the Canadian Ship-source Oil Pollution Fund.

3.4.1 POLLUTION PREPAREDNESS AND RESPONSE DURING TRANSIT

As discussed at the outset of this section, the Government of Canada is in the process of developing a world-class tanker safety system, including identifying opportunities to enhance Canada's prevention, preparedness and response requirements related to HNS.

In addition to future regulatory requirements, LNG Canada states it will require Project vessels to have their own emergency response plans in place for accidents. Emphasis will be on human safety, LNG and oil spill source containment, as well as fire and explosion prevention and protection. While emergency response is the obligation of the LNGC operators, LNG Canada indicates it will also implement its own best practices. For spills at sea, response procedures could include:

- Natural dispersion
- Mechanical containment and recovery
- Shoreline clean-up[101]

LNG Canada affirms that it will have a Marine Emergency Response Plan in place for the Project, which is discussed further in Section 3.4.2. To inform the plan, LNG Canada will

- complete geographical response plans (GRP) site surveys covering the Port of Kitimat and the approaches up Douglas Channel for construction and operational phases of the Project.

[101] Environmental Assessment Certificate Application, section 10 - Accidents and Malfunctions. 10.7.3 – Vessel Grounding or Collision Response Measures. Part 10-45. http://a100.gov.bc.ca/appsdata/epic/documents/p398/d38157/1415048104978_KGyFJXmP1x2sG8wCmyvdfS27j60hvHtwhPJZxGRMqpgdrdszwXMw!-1038573416!1415046831474.pdf

- share the GRP information with the Western Canada Marine Response Corporation (WCMRC) for its database, for the benefit of the organization and coastal communities.

Finding 28: The TRC supports the sharing of GRP information with the WCMRC as a good practice and to promote location-specific awareness in the case of an incident.

Places of Refuge

Transport Canada has put in place the National Places of Refuge Contingency Plan (TP 14707). The Plan establishes a national framework and approach which, with associated regional measures, aims to provide an effective and efficient response to requests from vessels in need of assistance seeking a place of refuge, including vessels at risk of discharging cargo. Transport Canada's Pacific Regional Places of Refuge Contingency Plan complements the national plan by establishing a regional framework to respond to requests for assistance within the region.

Risk-based Response Planning

The TRC notes that the design of the vessels, cargo tanks, materials used, and construction practices make it so that simultaneous, multi-cargo tank cascading damage release of LNG is extremely improbable, though possible. In the unlikely event that this does occur, it is not expected to increase the hazard distances from a spill or pool fire but could increase the duration of a fire.[102]

Escort tugs used for Project operations will be equipped with fire suppression equipment. Tug crews will be trained in firefighting and other emergency procedures.[103]

3.4.2 POLLUTION PREPAREDNESS AND RESPONSE AT THE TERMINAL

Preparedness and response capabilities at the terminal fall under land-specific regulations. LNG Canada will develop appropriate contingency plans in the event that an LNG/oil spill occurs, which are discussed in this section.

Currently, the *Liquefied Natural Gas Facility Regulations* section 8 under the *BC Oil and Gas Activities Act* is the only legal requirement for contingency plans. The BC Oil and Gas Commission's LNG Facility Permit Application and Operations Manual provide further detail on the expectations for developing such plans. The new

[102] United States Department of Energy. (2012). Liquefied Natural Gas Safety Research. A Report to Congress. http://energy.gov/sites/prod/files/2013/03/f0/DOE_LNG_Safety_Research_Report_To_Con gre.pdf

[103] LNG Canada TERMPOL Submission, Chapter 10, Section 2.2, page 11

Emergency Preparedness and Response for Petroleum and Natural Gas Systems (CSA Z246.2) provides as additional guidance.

As per the *Liquefied Natural Gas Facility Regulations*, an LNG facility permit holder must develop a safety and loss management program before operations begin. This needs to be done to the satisfaction of the BC OGC, comply with CSA Z276, and include the development of an emergency response plan.[104] LNG Canada indicates it will have an Emergency Response Plan for the Project. The plan will incorporate a specific marine plan that will cover marine oil spill response and marine rescue response for the waters adjacent to the terminal as well as along the proposed marine route.

As there are different types of vessels with different response needs during the construction and operational phases of the project, LNG Canada will develop a two-part plan.

- Part One will be for the construction phase where an assortment of domestic tugs, barges and dredge vessels and international heavy lift ships will be utilized.
- Part Two will be for the operational phase where regularly scheduled LNGCs with escort and berthing tugs will be utilized.

In addition to LNG Canada's TERMPOL Submission, a study on Accidents and Malfunctions in their application to the Environmental Assessment Office also outlines measures for preparedness and response.[105] LNG Canada states that it will use the Hazards and Effects Management Process (HEMP), a method of systematic hazard analysis used to identify, assess, control hazards, and recover any effects caused by an accident or malfunction; this system is a means to keeping risks as low as reasonably practicable (ALARP).

LNG Canada affirms it will include the emergency procedures to follow at the terminal in both the Port Information Book and the Terminal Operations Manual. LNG Canada will produce these documents and provide them to every LNGC nominated to load at the LNG Canada terminal. Most LNGCs will be returning to load many times and will therefore receive updated versions of these publications from the loading masters when they are available.

LNG Canada Terminal Contingency Plans

LNG Canada will establish a terminal contingency plan to make sure that an emergency response process is in place with appropriate measures to respond to any accident or incident that may occur due to operations at the terminal. LNG Canada

[104] Liquefied Natural Gas Facility Regulations. BC Oil and Gas Activities Act. B.C. Reg. 146/2014. Part 4. Division 1. http://www.bclaws.ca/civix/document/id/complete/ statreg/146_2014

[105] Accidents and Malfunctions. http://a100.gov.bc.ca/appsdata/epic/documents/p398/d38157/1415048104978_KGyFJXmP1x2sG8wCmyvdfS27j60hvHtwhPJZxGRMqpgdrdszwXMw!-1038573416!1415046831474.pdf

indicates that its relationship with various spill response organizations, who respond internationally, will be an additional specialist resource in the case of an accident. LNG Canada confirms that its terminal contingency plan will meet the requirements of:[106]

- Canadian Standards Association CSA-Z276-07 LNG – Production, Storage, and Handling
- *Environmental Emergency Regulations of the Canadian Environmental Protection Act*
- *Liquefied Natural Gas Facility Regulation*
- *Spill Reporting Regulations* under BC's *Environmental Management Act*

The TRC notes LNG Canada should reference the most current version of CSA-Z276, at present CSA-Z276-15, for contingency plan requirements at the facility.

<u>Recommendation 26:</u> LNG Canada should refer to the most current version of CSA-Z276 for facility contingency planning requirements.

Industry best practices that will also serve as a reference for establishing the plans include:[107]

- ICS/OCIMF/SIGTTO (1999) A Guide to Contingency Planning for the Gas Carrier Alongside and Within Port Limits. Witherby Seamanship International Ltd. Publications, Third Edition.
- SIGTTO (2003) LNG Operations in Port Areas. Witherby Seamanship International Ltd. Publications, First Edition.
- SIGTTO (2001) A guide to Contingency Planning for Marine Terminals Handling Liquefied Gases in Bulk. Witherby Seamanship International Ltd. Publications, Second Edition.

LNG Canada will develop its terminal contingency plan and distribute it to Transport Canada and the TRC six months before operations begin, and exercise the plan before the start of operations. The plan will include:

- a description of accident types
- potential incidents, and emergencies
- reporting and communication procedures
- a description of available resources such as equipment and personnel
- a plan for remedial action to any resultant damage
- the location of an Emergency Operations Centre
- a training program
- a contingency plan exercise program

[106] LNG Canada TERMPOL Submission, Chapter 10, Section 2, pages 9-10
[107] LNG Canada TERMPOL Addendum 1 to Chapter 9, Table 5, page 17

Recommendation 27: LNG Canada should engage with the communities along the route and near the terminal to raise general understanding of LNG and its production as well as its emergency preparedness plans.

Recommendation 28: LNG Canada should submit draft emergency plans to the relevant authorities, including Transport Canada, for review six months before operations begin.

Finding 29: The TRC notes that if the Kitimat Port becomes a public port, the designated port authority will have input into the development of contingency plans.

LNG Canada indicates that all LNGCs calling at the Project marine terminal will have their own specific contingency plans developed by their owners/mangers and approved by their respective flag states.

LNG Canada will make all LNGCs calling at the Project terminal aware of the emergency procedures outlined in the Project terminal contingency plan at the pre-loading meeting held between the ship's crew and the LNG Canada terminal operations team. LNGC crews need to understand the plan as certain emergency scenarios may require the vessel to act or even leave the berth. LNG Canada notes that action would only be taken once the LNGC's engines have been readied, standby tugs mobilized, and loading has been safely stopped.[108]

LNG Canada indicates it will confirm LNGCs calling at the Project terminal meet emergency prevention and preparedness requirements under the CSA, 2001 through its vetting programs.[109]

Harbour tugs used for Project operations will carry fire suppression equipment. LNG Canada states one tug will remain on standby in, or close to the berth basin while Project vessels are berthed and other tugs will be stationed nearby in the tug harbour and be capable of responding in case of an emergency. Harbour tug crews will be trained in firefighting and other emergency procedures.

[108] For a more detailed description of the LNG Canada terminal contingency plan refer to the TERMPOL Submission, Chapter 10, Section 2, pages 10-11

[109] LNG Canada TERMPOL Submission, Chapter 10, Section 2, page 6

4. CONCLUSION

The focus of the TERMPOL Review Process is on marine safety and accident prevention to help ensure that LNG Canada can carry out the marine transportation components of its Project within acceptable risk levels consistent with Canada's regulatory regime, safety standards, and industry best practices.

If the Project goes ahead, the TRC will expect LNG Canada to fully implement its commitments detailed in the information submitted for the TERMPOL Review Process. However, if at any time the Project's operational parameters or characteristics change, or LNG Canada needs to adjust its commitments, relevant authorities may need to conduct further review and analysis.

Canada has numerous measures in place to make sure that vessels entering into Canadian waters comply with international and domestic requirements and are not a risk to safety or to the environment. Further to the existing Canadian marine laws and regulations, including international frameworks, LNG Canada's proposed safety measures and recommendations from the TRC will provide for safer shipping in support of the proposed Project.

Through Shell's extensive vetting and acceptance process, LNGC operators will have to follow LNG Canada's additional safety enhancements. As the terminal operator, LNG Canada has authority to grant or deny permission for vessels to berth. This is a significant tool to compel vessels to comply with their vetting process and terminal procedures.

The proposed route provides the required clearances for adequate vessel manoeuvrability and allowances for LNGCs to safely navigate. Channel depth and width requirements are exceeded for the largest possible LNGC that could be accommodated by the Project. The Canadian Hydrographic Service is currently updating charts for northern BC, including approaches to Kitimat, to ensure the most accurate information is available for safe navigation. LNG Canada should make note of any updates.

While the TRC does not consider the overall increase in marine traffic levels to be an issue, it does support additional measures to promote shared safe use of the Project's preferred shipping route. Many of the measures go beyond regulatory requirements, and include:

- Having an escort tug between Triple Island and the Project terminal for in-heel and in-product vessels while in compulsory pilotage waters
- Identifying mitigations for drift grounding in Outer Waters as part of a tug operations plan.
- Passing and one-way restrictions limiting passing of other large commercial vessels to wide, straight sections of the route as determined by the BC Coast Pilots

- Operational limits for: pilot boarding by boat or helicopter; transit with escort tug; berthing/unberthing (with harbour tugs); and cargo loading
- Training for pilots and tug Masters focused on:
  - communication protocols;
  - tug operational plans;
  - emergency procedures; and
  - areas along route where other marine users may be encountered

The LNG Canada marine terminal will attain safe operations through compliance with regulations and LNG Canada's own terminal requirements. The TRC recognizes the utility of LNG Canada's proposed control zones around the terminal and berthed LNGCs, although further work is required before such a concept could be implemented in Canada outside of a designated Port.

Work is underway to build Canada's preparedness and response regime for hazardous and noxious substances, including LNG. Relevant authorities are working towards standardizing procedures in response to the anticipated development of an LNG export industry and related increase in marine traffic.

The completion of each TERMPOL review contributes to strengthening the oversight of marine safety in Canadian waters. Current work on developing standardized pilotage and tug requirements for BC's north coast will contribute to a consistent approach for projects the TRC reviews in the future.

Any project poses some degree of risk; however, after reviewing LNG Canada's studies and its commitments, the TRC has:

- not identified any regulatory concerns for the LNGCs, LNGC operations, the proposed route, navigability, other waterway users or the Project marine terminal operations.
- established several findings and recommendations in response to LNG Canada's submission and has proposed actions for LNG Canada to undertake. In conjunction with LNG Canada's commitments, this will provide for a higher level of safety for LNGC operations adequate for the potential increase in traffic.

A complete list of the findings and recommendations is included in Appendix 1.

APPENDICES

APPENDIX 1 LIST OF FINDINGS AND RECOMMENDATIONS

RECOMMENDATIONS:

Recommendation 1: LNG Canada should notify the appropriate authorities if it wishes to alter any Project commitments, operational parameters, or characteristics, so the authorities can review impacts to safety as a result of the changes.

Recommendation 2: Project LNGCs' engines should be ready for immediate manoeuvre; the engine room should be manned with crew in full attendance, in the following situations:

- *At least one hour before arriving at the pilot boarding station*
- *When the vessel is in the compulsory pilotage area*
- *During transfer of cargo*

Recommendation 3: LNG Canada should ensure that no venting of boil-off gases occurs while pilots are boarding the LNGCs. The venting of the gases should especially be avoided when helicopter transfers are taking place.

Recommendation 4: LNG Canada should identify sources of data to monitor concentrations of whale populations and discuss with the BC Coast Pilots and the Pacific Pilotage Authority concentration limits that could require adjustment to Project vessel speeds or routes.

Recommendation 5: LNG Canada should support the Pacific Pilotage Authority and the BC Coast Pilots in developing operational limits for LNGCs.

Recommendation 6: LNG Canada's Marine Activities Plan should consider and align with the Pacific Pilotage Authority and BC Coast Pilots' Traffic Management Plan for the region.

Recommendation 7: LNG Canada should ensure tugs used for Project operations meet appropriate specifications to assist Project LNGCs in emergency situations and take into account the findings and conclusions of the Kitimat Waterway LNG Transit Simulation Study.

Recommendation 8: LNG Canada should ensure escort tugs are equipped with load cells to measure the line forces created by the tugs.

Recommendation 9: LNG Canada, in consultation with the Pacific Pilotage Authority, the BC Coast Pilots, and the tug provider(s), should conduct full mission bridge simulations to determine where along the route in-product Project LNGCs will require tethered escort.

Recommendation 10: LNG Canada should ensure that escort tugs accompanying vessels to and from Outer Waters have appropriate rescue towing capabilities for the largest Project vessels proposed for use.

Recommendation 11: LNG Canada should submit its draft tug operations plan to Transport Canada, the Pacific Pilotage Authority, the Canadian Coast Guard, and the BC Coast Pilots six months before Project operations begin.

Recommendation 12: LNG Canada should work with the Pacific Pilotage Authority and the BC Coast Pilots to establish standard operating procedures and operational limitations, and provide this information to Project vessel operators through the Terminal Operations Manual.

Recommendation 13: LNG Canada should work with the Pacific Pilotage Authority, the BC Coast Pilots, and the tug provider(s) to develop a training program to support communication between the tug masters and the pilots. The training program should be in line with guidance reflected in the STCW Code section A-VIII/2.

Recommendation 14: LNG Canada should provide the Pacific Pilotage Authority and the BC Coast Pilots with a copy of its FEED risk assessment on loading/unloading before Project operations begin.

Recommendation 15: LNG Canada must complete and submit the Pacific Pilotage Authority's new terminal checklist within identified timelines.

Recommendation 16: LNG Canada should incorporate safety checklists outlined in the most current version of the SIGTTO publication "Liquefied Gas Handling Principles on Ships and in Terminals" into their operational procedures.

Recommendation 17: LNG Canada, in conjunction with those responsible for the fleet of tugs, should develop a training program for all individuals involved with terminal operations. The training program should include criteria from clauses 13.2 to 13.6 of the CSA Z276-15 and NFPA 59A standards regarding the minimum standards for safe operations and maintenance of LNG terminals and for personnel training.

Recommendation 18: LNG Canada should provide details on the justification, location, size and management of their proposed control zones to the appropriate authorities and work with them to review the issue of control zones in Canada.

Recommendation 19: The number and size of berthing tugs should be based on the findings and conclusions of further berthing tug simulations to be conducted with the Pacific Pilotage Authority and the BC Coast Pilots and actual berthing trials of LNGCs. LNG Canada should distribute the results of berthing and manoeuvring simulations as well as mooring and docking plans to Transport Canada upon completion.

Recommendation 20: LNG Canada should ensure berthing tugs are equipped with load cells to measure the line forces created by the tugs.

Recommendation 21: LNG Canada should work with the Pacific Pilotage Authority and the BC Coast Pilots to develop operational limits for berthing tugs.

Recommendation 22: LNG Canada should ensure the availability of adequate tugs and crew on standby at the terminal to allow for safe arrival and departure of LNGCs at all times. The TRC suggests that LNG Canada establish operating procedures stipulating that LNGCs be ready to sail at any given time when they are at the terminal.

Recommendation 23: LNG Canada should ensure Project LNGCs execute a turn before entering the berth if they will load with the port-side of the vessel to the berth face.

Recommendation 24: LNG Canada should provide draft copies of its Port Information Book and Terminal Operations Manual to Transport Canada, the Canadian Coast Guard, and the Pacific Pilotage Authority for information at least six months before terminal operations begin as there may need to be changes made in the final 6 months.

Recommendation 25: LNG Canada should ensure its Port Information Book and Terminal Operations Manual are available to LNG shippers and their agents in time for them to understand and fully comply with their contents.

Recommendation 26: LNG Canada should refer to the most current version of CSA-Z276 for facility contingency planning requirements.

Recommendation 27: LNG Canada should engage with the communities along the route and near the terminal to raise general understanding of LNG and its production as well as its emergency preparedness plans.

Recommendation 28: LNG Canada should submit draft emergency plans to the relevant authorities, including Transport Canada, for review six months before operations begin.

FINDINGS:

Finding 1: The TRC recognizes that timelines for implementing the recommendations outlined in this report will have to be discussed between LNG Canada and the appropriate authorities.

Finding 2: If the Project is approved, federal authorities with jurisdiction in marine safety, such as Transport Canada, will increase compliance inspections.

Finding 3: If the Project is approved, federal authorities with jurisdiction in marine safety, such as the Canadian Coast Guard, will increase vessel traffic monitoring.

Finding 4: LNG carrier vetting and the Ship Inspection Report Programme (SIRE) process are generally accepted tools that terminals and LNG companies use to verify compliance and enhance safety.

Finding 5: LNG Canada's commitment to vet LNG carriers is an industry best practice that can help achieve safety objectives that are above minimum regulatory requirements.

Finding 6: As part of the Government of Canada's actions to modernize Canada's navigation system, the TRC supports a review of existing AIS carriage requirements by Transport Canada, in collaboration with the Canadian Coast Guard, to determine whether they should apply to a greater number of vessels.

Finding 7: The Canadian Hydrographic Service will work with Transport Canada to develop precautionary notes on charts for mariners regarding the presence of LNGCs and any associated documentation that may be required in the North Coast Sailing Directions.

Finding 8: The TRC notes efforts by the Pacific Pilotage Authority and BC Coast Pilots to use helicopter transfer of pilots to Project vessels will be subject to operational limits (to be determined) and the ICS Guide to Helicopter/Ship Operations as well as Transport Canada's Guidelines Respecting Helicopter Facilities on Ships (TP 4414).

Finding 9: Two pilots will be required on the bridge while LNGCs are in-product and tethered to an escort tug. Tethering will occur in certain areas of the vessel's transit at the discretion of the pilots and as determined as necessary during escort tug simulations.

Finding 10: The Pacific Pilotage Authority, in consultation with the BC Coast Pilots, should develop escort tug requirements for BC's north coast similar to what has been established for BC's south coast with respect to in-product vessels greater than 40,000 Summer Dead Weight Tonnes.

Finding 11: The TRC has not identified a need for further calling-in-points at this time; however, if one or more projects proposed in northern BC proceed, an evaluation of calling-in points may be completed by the Canadian Coast Guard, the BC Coast Pilots, and the Pacific Pilotage Authority.

Finding 12: AIS coverage along the proposed route is being enhanced by the Canadian Coast Guard.

Finding 13: The Canadian Coast Guard is enhancing aids to navigation along the Northern route, given the potential for a larger number and size of vessels using the route.
Finding 14: The TRC supports LNG Canada's actions to enhance the local marine community's awareness of Project operations.

Finding 15: The TRC supports LNG Canada's commitment to limit interactions of Project vessels and small vessels where possible by tracking and communicating potential conflicts between the location of fisheries openings and routes being used by Project vessels.

Finding 16: Project vessels should avoid Learmonth Bank when possible due to its shoaling depths. They should use deeper channels to the north and south instead.

Finding 17: The TRC does not have concerns with the speed profiles LNG Canada proposes for in-heel and in-product vessels.

Finding 18: LNG Canada's commitment to provide enhanced weather monitoring at the Project terminal will contribute to the safe passage of Project vessels in Canadian waters.

Finding 19: BC Coast Pilots, Canadian Coast Guard, and Environment Canada should further investigate the installation of a smart buoy at Triple Island.

Finding 20: The TRC acknowledges that LNG Canada has identified the risk of groundings in the Outer Waters and agrees that further consideration is warranted.

Finding 21: One-way traffic restrictions are supported along certain portions of the route and will be managed by pilots on an as-needed basis through bridge to bridge communications.

Finding 22: The Pacific Pilotage Authority has previously established operating rules for tankers transiting BC's southern route through a Notice to Industry. The Pacific Pilotage Authority should also develop operating rules for the northern route for LNGCs transiting in the compulsory pilotage waters from Triple Island to the terminal in Kitimat.

Finding 23: The TRC supports Project vessels entering a 'holding pattern' in Douglas Channel in the unlikely event a berth is unavailable at the Project terminal.

Finding 24: New nautical charts may be required as a result of proposed dredging work around the terminal.

Finding 25: The TRC recognizes the need for further work from the appropriate authorities to review the issue of control zones for LNG terminals with the aim of

establishing an approach that takes into account the specific circumstances of each marine terminal.

Finding 26: BC Coast Pilots support LNG Canada's proposed navigational and berthing aids at the terminal, which Transport Canada will review.

Finding 27: The TRC has no concerns with the turning basin proposed for Project vessels.

Finding 28: The TRC supports the sharing of GRP information with the WCMRC as a good practice and to promote location-specific awareness in the case of an incident.

Finding 29: The TRC notes that if the Kitimat Port becomes a public port, the designated port authority will have input into the development of contingency plans.

APPENDIX 2 LIST OF DOCUMENTS SUBMITTED FOR TERMPOL

LNG Canada prepared its submission and provided its completed TERMPOL surveys, studies, technical data, analysis and other information related to the marine transportation components of the Project to Transport Canada and the TRC by March 27, 2015.

LNG Canada chose to combine studies into chapters. The TERMPOL Review Process submission includes three volumes;

- Volume 1 has ten chapters and contains the TERMPOL studies and surveys.
- Volumes 2 and 3 contain supporting documentation.

Volume 1	**TERMPOL Surveys and Studies**	**No. of Pages**
Chapter 1	Introduction	21
Chapter 2	Marine Route Survey	59
	Appendix 1. Underkeel Clearance	1
	Appendix 2. Navigational Constraints	1
	Appendix 3. Climatic Data	1
	Appendix 4. Existing Navigational Aids	1
	Appendix 5. Proposed New and Improved Navigational Aids	1
	Appendix 6. Compulsory Pilotage Area	1
Chapter 3	Transit Time and Delay Survey	10
Chapter 4	Marine Traffic Survey	62
	Appendix 1. Marine Traffic Data	5
Chapter 5	LNG Carrier Specifications	14
Chapter 6	Marine Terminal and Cargo Transfer	20
	Appendix 1. Drawings	2
Chapter 7	Port Information Book	6
Chapter 8	Terminal Operations Manual	4
Chapter 9	Risk Analysis	32
	Appendix 1. Assumptions Regarding Operating Procedures	8
	Appendix 2. Meteorological and Oceanographic (Metocean) Data	3
	Appendix 3. Casualty Analysis (Region and	9

APPENDIX 3 DESIGN VESSELS

Dimensions of Maximum and Minimum Size LNGCs Capable of Berthing at the Proposed LNG Canada Marine Terminal

	125,000 m³ capacity Carrier (Hyundai Greenpia)	**265,000 m³ capacity Carrier (Zarga)**
Length over-all	274 m	345 m
Beam	47.2 m	53.8 m
Loaded Summer Draft	11.77 m	12.22 m
Moulded Depth	26.5 m	27.0 m
Deadweight	71,684 t	129,851 t
Liquid Capacity at 98% full	125,000 m³	265,000 m³
Gross Tonnage	103,764	163,922
Tank Construction	MOSS	Membrane
Speed at Sea	18.5 knots	19.5 knots

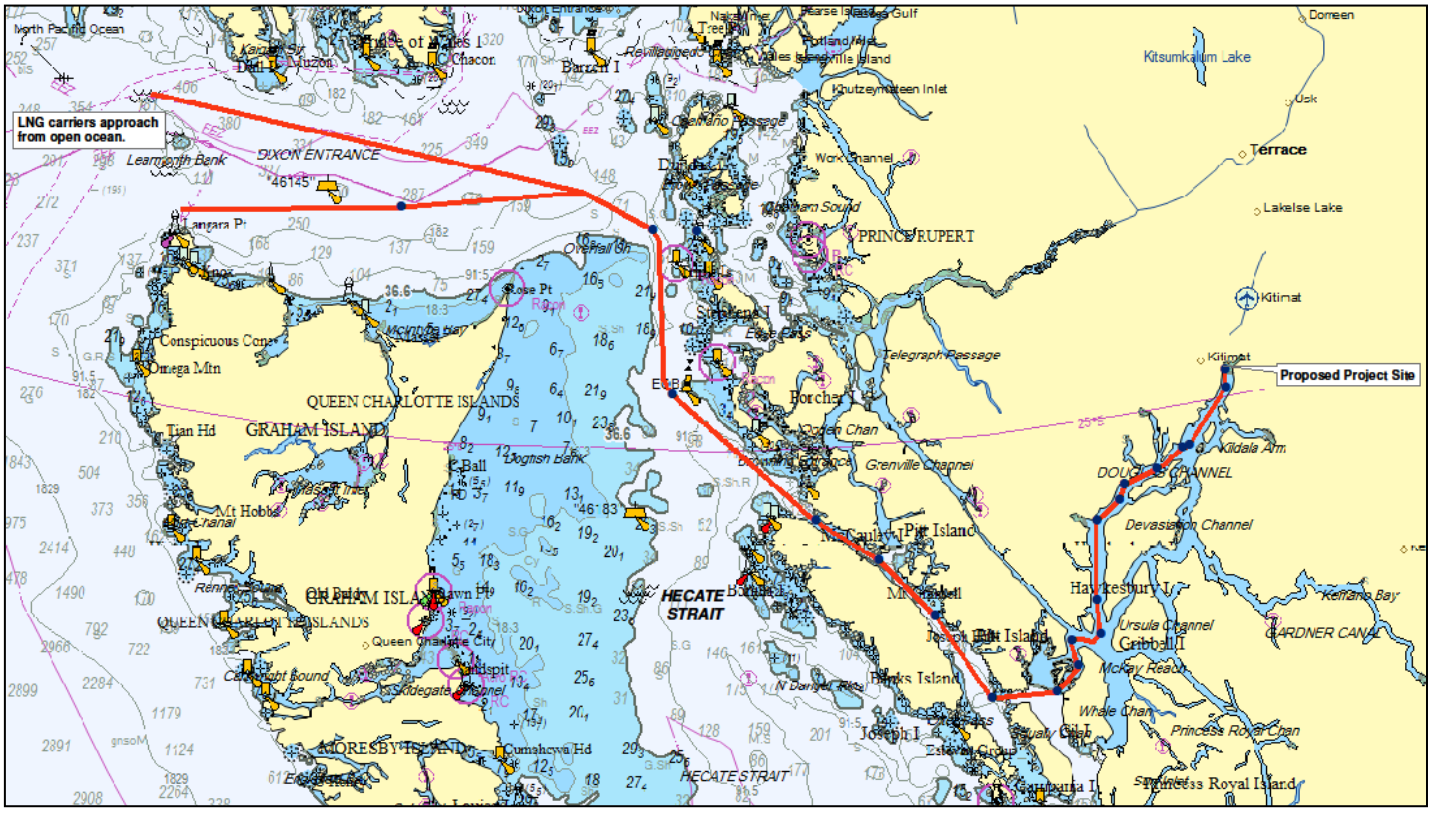
APPENDIX 4 PROPOSED SHIPPING ROUTE

Project vessels will use the Northern Route to arrive at the terminal. LNGCs will:

- Arrive from the Pacific Ocean to enter the marine route through Dixon Entrance.
- Take on a pilot in the vicinity of the Triple Island pilot boarding station before traveling south to Browning Entrance and into Principe Channel.
- At the south point of Principe Channel, transit through Otter Passage, Squally Channel, Lewis Passage, and then across Wright Sound.
- Head north in Douglas Channel and enter Kitimat Arm to reach the Project marine terminal at the Kitimat Port.

When leaving Kitimat, LNGCs will follow the reciprocal route.

LNG Canada Proposed Shipping Route



APPENDIX 5 LNG CARRIER SPEED PROFILES

LNG Canada's Proposed In-Heel Safe Speed Profiles

In-Heel Route Section	Description of Navigation and Vessels Action	Distance (nautical miles)	Speed for the Leg in knots (STW or Average SOG)	Average Duration (hours / minutes)
Hecate Strait Triple Island (pilot boarding) to Keswar Point	Open water, LNG carrier at manoeuvring speed	52.2	14 knots (engine order: full ahead is about 11.5 to 12 knots for an average LNGC)	3 h - 44 m
Principe Channel Keswar Point to Buchanan Inlet	Confined channel that narrows at Dixon Island, LNG carrier meets escort tug	22.3	10 knots (engine order: half ahead is about 9 to 10 knots)	2 h - 14 m
Nepean Sound Buchanan Inlet to Fleishman Point	Open channel, turn into Otter Channel	14.8	10 knots (engine order: half ahead is about 9 to 10 knots)	1 h - 29 m
Otter and Squally Channels Fleishman Point to Blackrock Point	Confined channel into open channel of Squally Channel	9.5	8 knots (engine order: slow ahead is about 7 to 8 knots)	1 h - 11 m
Lewis Passage Blackrock Point to Turtle Point	Confined channel with s-bend formed by Plover Point and Turtle Point	8.7	8 knots (engine order: slow ahead is about 7 to 8 knots)	1 h - 5 m
Wright Sound Turtle Point to Cape Farewell	Open channel possible crossing marine traffic	4.3	8 knots (engine order: slow ahead is about 7 to 8 knots)	0 h - 32 m
Douglas Channel Cape Farewell to Nanakwa Shoal	Confined channels that narrow at Emilia Island	36.0	8 knots (engine order: slow ahead is about 7 to 8 knots)	4 h - 30 m
Kitimat Arm Nanakwa Shoal to LNG Canada (pilot disembarkation)	Confined channel, LNG carrier reduces speed to berth	11.2	5 knots (engine order: dead slow ahead can be anywhere between 4 to 6 knots)	2 h - 15 m
Total		**159.0**	**Average of 9.35 knots**	**17 h - 00 m**

LNG Canada's Proposed In-Product Safe Speed Profiles

In-Product Route Section	Description of Navigation and Vessels Action	Distance (nautical miles)	Speed for the Leg in knots (STW or Average SOG)	Average Duration (hours / minutes)
Kitimat Arm LNG Canada (pilot boarding) to Nanakwa Shoal	Confined channel, LNG carrier increasing speed from berth	11.2	4 knots	2 h - 48 m
Douglas Channel Nanakwa Shoal to Cape Farewell	Confined channels	36.0	8 knots	4 h - 30 m
Wright Sound Cape Farewell to Turtle Point	Open channel with possible crossing traffic, LNG carrier tethers to escort tug in case assistance is required through Lewis Passage	4.3	6 knots	0 h - 43 m
Lewis Passage Turtle Point to Blackrock Point	Confined channel with s-bend formed by Turtle Point and Plover Point	8.7	7 knots	1 h - 15 m
Squally and Otter Channels Blackrock Point to Fleishman Point	Open channel into confined channel with turn at Fleishman Point Vessel untethers tug	9.5	7 knots	1 h - 21 m
Nepean Sound Fleishman Point to Buchanan Inlet	Open channel, LNG carrier increases speed	14.8	10 knots	1 h - 29 m
Principe Channel Buchanan Inlet to Keswar Point	Confined channel, vessel dismisses escort tug after passing Keswar Point and increases speed	22.3	10 knots	2 h - 14 m
N. Hecate Strait Keswar Point to Triple Island (pilot disembarkation)	Open water, LNG carrier increases to full manoeuvring speed before decreasing speed to drop pilot	52.2	12.5 knots	4 h - 10 m
Total		**159.0**	**Average of 8.59 knots**	**18 h - 30 m**

APPENDIX 6 LNG CANADA RISK MITIGATION MEASURES

Following a TRC request for clarification on proposed mitigation measures, LNG Canada provided an addendum to the risk analysis in chapter 9 of the TERMPOL submission, identifying:

- Conditions of its Environmental Assessment Certificate
- Other measures it has committed to as part of its Environmental Assessment Application
- Risk mitigation measures it is has committed to under TERMPOL

The TRC reviewed the measures LNG Canada has committed to under TERMPOL as well as applicable conditions of the Environmental Assessment Certificate.

This table identifies the measures and where they can be found on the report.

Legend:

- Mitigation measures from LNG Canada's submission to the TRC
- Mitigation measures in LNG Canada's Application for an Environmental Assessment Certificate.
- Mitigation measures that were proposed in both the submission to the TRC and the Application for an Environmental Assessment Certificate

LNG Canada Proposed Risk Mitigation Measures

Mitigation Measure	Mitigation Measure Details	Location in Report
So that mariners responsible for LNG carrier and tug navigation understand LNG Canada's expectations with respect to marine hazard mitigation measures including reduced speeds and use of tug escorts, LNG Canada is committed to creating a Port Information Handbook or working with a group managing Kitimat Harbour to create a Port Information Handbook.	LNG Canada will create a Port Information Book. The purpose of this industry standardized document will be to, in addition to its main functions as a guide for visiting commercial vessel operators, also outline unique aspects of the passage along the marine access route, including: • Use of escort tugs. • Reduced speeds for marine mammal protection. • Locations of communities along the route. • Fishing areas and seasons where the areas are used. A sample table of contents for the Port Information Book was provided in the Submission. The Port Information Book is intended to be a technical document to be read by professional mariners and is separate from the MAP described in Condition 17. LNG Canada will consult agencies that are members of the TRC during the completion of the Port Information Book. LNG Canada will provide a draft of the Port Information Book to the TERMPOL Review Committee no less than six months prior to the planned date to commence Operations.	3.3.3
"No go" areas.	Use of safety zones which specify "no go" areas around the marine terminal for the safety of the public marine	3.3.1

Mitigation Measure	Mitigation Measure Details	Location in Report
	traffic, during construction and operation.	
To prevent grounding LNG Canada is committed to ensuring that LNG carriers will be accompanied by an escort tug.	Per Mitigation 7-4-6 in Table 20.0 in LNG Canada's Application for an EAC, a close escort tug will be required for all LNG carrier transits between Triple Island and Kitimat. The close escort may be tethered to the LNG carrier over certain sections of the marine access route. The sections where tethered escort will be used will be determined by additional Full Mission Bridge Simulations and consultation with the Pacific Pilotage Authority and the BC Coast Pilots and the company selected to provide the tug escort service. The Project will be provided with a minimum of three escort tugs with the specifications described in Section 8.5.2 of Chapter 2. LNG Canada will submit a draft tug operations plan to the TRC no less than six months prior to the planned date to commence Operations.	3.2.4
Navigational Aids.	Support federal government in installation of any navigational aids determined to be necessary for safety on the new marine terminal where required.	3.3.2
To ensure safe berthing and unberthing at the marine terminal, LNG Canada is committed to ensuring that LNG carriers will be assisted by harbour tugs.	All LNG carriers will be assisted by up to three harbour tugs with a bollard pull of 65 tonnes or greater while berthing or unberthing at the marine terminal in Kitimat Harbour. LNG Canada will submit a draft tug operations plan to the TRC no less than six months prior to the planned date to commence Operations.	3.2.4
Provide information to the Canadian Hydrographic Service.	Provide notification and information to the Canadian Hydrographic Service to accurately include the appropriate marine terminal information and berth locations on future navigational charts.	3.3.1
To enable communication and understanding between masters of tugs assigned to the LNG Canada project and the BC Coast Pilots, LNG Canada is committed to developing a training program with the Pacific Pilotage Authority.	LNG Canada will work with the Pacific Pilotage Authority and the BC Coast Pilots to develop a training program with the contractor(s) selected to provide escort and harbour tug services. The training will develop a good understanding of communication protocols, typical escort tug and harbour tug operational plans, and emergency manoeuvres and procedures. The training will also emphasize areas of the route where fishing vessels and other marine users may be encountered to increase the environmental awareness of tug masters and pilots. LNG Canada will submit a draft tug operations plan to the TRC no less than six months prior to the planned date to commence Operations.	3.2.4
Develop and implement a MAP.	Develop and implement a MAP in accordance with the applicable federal and provincial legislation and regulations. The MAP will include measures to address potential effects from dredge activities, pile installation (including marine mammal exclusion zone, soft start procedures and considerations of sound dampening	N/A

Mitigation Measure	Mitigation Measure Details	Location in Report
	technologies) and shipping.	
LNG Canada is committed to reviewing appropriate mitigations for drift grounding in the Outer Waters as part of the tug operations plan.	LNG Canada will submit a draft tug operations plan to the TRC no less than six months prior to the planned date to commence Operations.	3.2.4
LNG Carriers will follow speed profile guidelines.	LNG carriers will travel at speeds up to 14 knots. Speeds will vary depending on navigational safety, weather conditions, location, and marine mammal presence, and will be determined based on the judgment of the ship's master who receives advice from the BC Coast Pilots on board. Subject to navigational safety needs, in areas of high whale density between the northern end of Campania Island and the southern end of Hawkesbury Island, LNG carrier will travel at speeds of 8 knots to 10 knots from July through October (recognizing predicted periods of high use by marine mammals).	3.2.2 (*Safe Operating Speeds and Transit Windows*)
To mitigate the consequences from an accident or malfunction at the terminal in Kitimat, LNG Canada is committed to completing an emergency response plan for the terminal.	LNG Canada will complete a response plan for the terminal in accordance with Section 8 (1) of the *Liquefied Natural Gas Facility Regulations* under the Province of British Columbia's *Oil and Gas Activities Act*. Industry best practices will be referenced during the completion of the response plan, including the current version of the following publications: • ICS/OCIMF/SIGTTO (1999) *A Guide to Contingency Planning for the Gas Carrier Alongside and Within Port Limits.* Witherby Seamanship International Ltd. Publications, Third Edition. • SIGTTO (2003) *LNG Operations in Port Areas*. Witherby Seamanship International Ltd. Publications, First Edition. • SIGTTO (2001) *A Guide to Contingency Planning for Marine Terminals Handling Liquefied Gases in Bulk*. Witherby Seamanship International Ltd. Publications, Second Edition.	3.4
Regular communication on Project activities.	Regular communication on Project activities will occur with marine users, including recreationalists, commercial tourism, operators, CRA fishers, TC, DFO, and relevant stakeholders	3.3
To ensure that only LNG carriers meeting Project standards call at LNG Canada's Kitimat marine terminal, LNG Canada commits to assessing all LNG carriers prior to their arrival in Canadian waters for Quality Assurance.	As described in Chapter 5 of the Submission, LNG Canada will do a terminal compatibility assessment of all LNG carriers calling at the LNG Canada terminal which includes vetting through the Group Marine Assurance System (GMAS). This system facilitates effective, consistent assessment and assurance of the risks associated with Shell's and its Venture Partner's shipping and maritime business activities. Additional information collected directly from the LNG carrier operators from their self-completed pre-arrival Terminal Questionnaires, allows LNG Canada to check an LNG	3.1

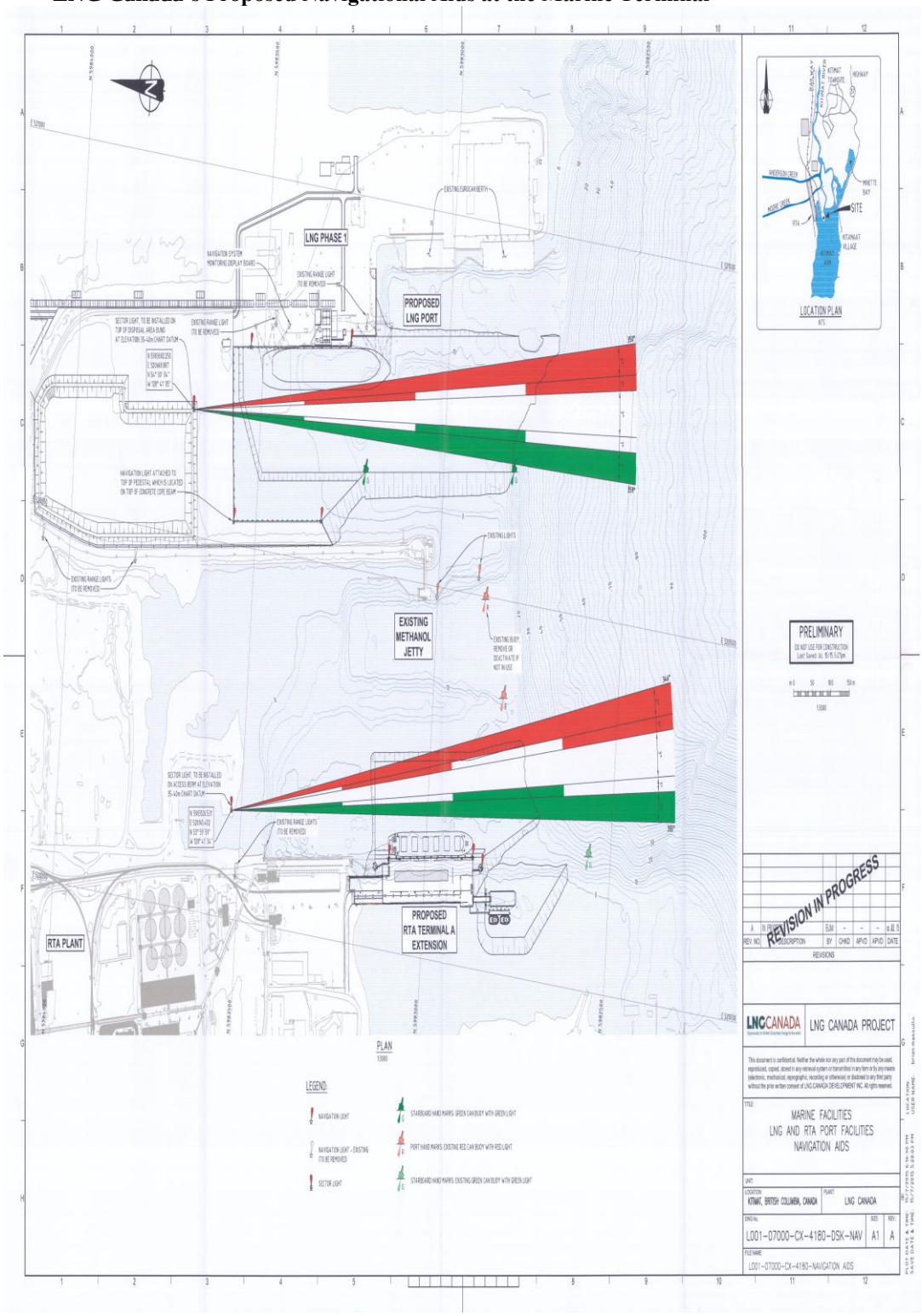
Mitigation Measure	Mitigation Measure Details	Location in Report
	carrier's suitability before it enters Canadian waters and calls at the LNG Canada loading terminal	
LNG Canada will develop a Social Management Plan.	LNG Canada will develop and implement a Social Management Plan to manage potential social effects of the Project and optimize potential benefits.	N/A
To increase awareness of traffic along the marine access route, LNG Canada is committed to working with the Canadian Coast Guard to assess new calling-in-points.	LNG Canada supports the Canadian Coast Guard, Pacific Pilotage Authority and BC Coast Pilots assessing whether additional calling in points are warranted along the marine access route in light of future LNG carrier traffic. For example, Otter Channel and Lewis Passage (which do not afford clear lines-of-sight for marine users in the area due to their geography) do not currently have Calling-in-Points under existing traffic patterns but may benefit from a review in light of the increased LNG carrier traffic in the future.	3.2.1
LNG carriers will use the Coast Guard's Marine Communications and Traffic System (MCTS).	Project-related marine traffic including LNG carriers will use the Coast Guard's Marine Communications and Traffic System (MCTS) to provide notice of planned arrival time at Triple Island, and encourage Aboriginal groups and stakeholders to use the system to plan their routing and scheduling.	3.2.1 (*Canadian Coast Guard's Marine Communications and Traffic Services)*
To increase awareness of traffic along the marine access route, LNG Canada supports the appropriate government agencies encouraging all vessels to be outfitted with AIS.	LNG Canada supports initiatives to increase the voluntary use of AIS by vessels currently not required to be fitted with AIS under the Navigation Safety Regulations under the *Canada Shipping Act, 2001*.	3.1
No planned anchoring for LNG carriers.	No planned anchoring for LNG carriers along the marine access route (unless directed to do so by the BC Coast Pilots due to weather or other unplanned conditions); LNG carriers will only be permitted to enter the marine access route if a berth at the terminal will be available by the time the vessel arrives there.	3.2.2 (*Anchorage*)
To increase awareness of traffic along the marine access route, LNG Canada is committed to working with the Canadian Coast Guard to assess the need for radar to be added to the BC north coast as traffic increases in the future.	LNG Canada supports initiatives by applicable agencies and port authorities to provide radar on the BC North Coast to supplement information obtained from existing calling-in-points and Automatic Identification System (AIS).	3.2.1 (*Canadian Coast Guard's Marine Communications and Traffic Services)*
To manage areas of increased navigational complexity or increased traffic	LNG Canada supports the Pacific Pilotage Authority assessing the need for two pilots to be on the bridge during LNG Carrier passage through identified higher risk sections of the marine access route.	3.2.1

Mitigation Measure	Mitigation Measure Details	Location in Report
density, LNG Canada is committed to working with the Pacific Pilotage Authority to assess the need for two pilots to be on the bridge during passage through important sections of the marine access route.		
To minimize the frequency of accidents and malfunctions, LNG Canada is committed to developing operational limits for the Project's marine operations	LNG Canada will work with the Pacific Pilotage Authority, the BC Coast Pilots and the contractor selected to provide escort tug services to develop operational limits for the safe escort of LNG carriers between the Triple Island pilot boarding station and Kitimat Harbour. Operational limits will also be developed for the safe berthing and unberthing at the marine terminal. Operational limits for when loading will need to be suspended at the marine terminal are to be developed by LNG Canada's engineering team during detailed design. LNG Canada will provide the operational limits described above to the TC no less than 60 days prior to the planned date to commence Operations. LNG Canada will also support the Pacific Pilotage Authority, as requested, to develop operating limits for pilot boarding of LNG carriers by launch and/or helicopter.	3.3.2 3.3.3 3.2.1 3.2.4
To minimize the frequency of encounters between LNG carriers or escort tugs and other marine users, LNG Canada is committed to supporting passage planning by the LNG carriers that avoids areas of increased marine use without adversely affecting navigational safety.	LNG Canada will work with the Pacific Pilotage Authority and BC Coast Pilots to assess pilot boarding locations and passage plans for the marine access route with the goal of avoiding areas of increased marine use to the extent practicable and without affecting navigational safety.	3.2.3
To lower the collision hazard, LNG Canada is committed to working with the Pacific Pilotage Authority to assess areas of the marine access route where passing of LNG carriers and other large	LNG Canada will work with the Pacific Pilotage Authority, the BC Coast Pilots and the contractor selected to provide escort tug services to complete an analysis of where passing should be avoided along the marine access route. Marine safety can be improved by avoiding passing in areas of reduced channel width, limited line-of-sight, increased number of course changes, or increased traffic density. The predicted improvement to marine safety will be compared to the increased numbers of passing encounters along other parts of the marine access route.	3.2.4

Mitigation Measure	Mitigation Measure Details	Location in Report
commercial vessels should be avoided.		
So that marine operations are carried out safely and within operational limits, LNG Canada is committed to supporting future assessments of meteorological and ocean monitoring requirements on the BC North Coast.	So that LNG carriers, tug operators, pilot launch or helicopter service providers, amongst other marine users, receive the meteorological and ocean data they require in a timely manner, LNG Canada supports an assessment of current meteorological and ocean monitoring on the BC north coast. While past monitoring has proven more than adequate for existing operations, certain improvements may be required as new operations are introduced (e.g. as helicopter boarding become more routine). LNG Canada will be installing meteorological and ocean monitoring equipment at the terminal. Data will be made available to the operators of the harbour tugs and BC Coast Pilots for reference while berthing and unberthing at the terminal.	3.2.2

APPENDIX 7 NAVIGATION AIDS PROPOSED AT THE TERMINAL

LNG Canada's Proposed Navigational Aids at the Marine Terminal



REFERENCES

Canada Marine Act, Statutes of Canada (1998, c. 10). Section 56 (1-2). Retrieved from the Department of Justice Canada: http://laws-lois.justice.gc.ca/eng/acts/c-6.7/

Canada Shipping Act, 2001, Statutes of Canada (2001, c. 26). Retrieved from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/C-10.15/

Emergency Management Act, Statutes of Canada (2007, c.15). Section 3 and 4. Retrieved from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/E-4.56/

Environmental Assessment Certificate Application. Section 10.7. Retrieved from the Province of BC website: http://a100.gov.bc.ca/appsdata/epic/documents/p398/d38157/1415048104978_KGyFJXmP1x2sG8wCmyvdfS27j60hvHtwhPJZxGRMqpgdrdszwXMw!-1038573416!1415046831474.pdf

International Maritime Organization. *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, 1983 Edition*. London: International Maritime Organization, 1983.

International Maritime Organization. *Code for Existing Ships Carrying Liquefied Gases in Bulk.* London: International Maritime Organization, 1976.

International Maritime Organization. *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), 1993 Edition*. London: International Maritime Organization, 1993.

International Maritime Organization. Protocol on Preparedness, Response and Co-ordination to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol). London: 2000.

Liquefied Natural Gas Facility Regulations. B.C. Reg. 146/2014. Retrieved from the Province of BC website: http://www.bclaws.ca/civix/document/id/complete/statreg/ 146_2014

MITAGS-PMI. *Kitimat Waterway LNG Transit Simulation* (2015).

Sandia Report. *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*. [Albuquerque, New Mexico]: Sandia National Laboratories, 2004.

Tanker Safety Expert Panel. *A Review of Canada's Ship-Source Spill Preparedness and Response: Setting the Course for the Future, Phase II, Requirements for the Arctic and for Hazardous and Noxious Substances Nationally* (2014).

Transport Canada. *Termpol Review Process 2001 (TP 743)* (2001).

United States Department of Energy. *Liquefied Natural Gas Safety Research: Report to Congress May 2012.* 2012. http://energy.gov/sites/prod/files/2013/03/f0/DOE_LNG_Safety_Research_Report_To_Congre.pdf