BRITISH COLUMBIA ENERGY REGULATOR

Liquefied Natural Gas Facility Permit Application and Operations Manual

VERSION 1.10: July 2025

About the Regulator

The BC Energy Regulator (Regulator) is the single-window regulatory agency with responsibilities for regulating oil and gas activities in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Regulator's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected by ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

Vision, Mission and Values

Vision

A resilient energy future where B.C.'s energy resource activities are safe, environmentally leading and socially responsible.

Mission

We regulate the life cycle of energy resource activities in B.C., from site planning to restoration, ensuring activities are undertaken in a manner that:

- Protects public safety and the environment
- Supports reconciliation with Indigenous peoples and the transition to low-carbon energy
- Conserves energy resources
- Fosters a sound economy and social well-being

Values

Respect is our commitment to listen, accept and value diverse perspectives.

Integrity is our commitment to the principles of fairness, trust and accountability.

Transparency is our commitment to be open and provide clear information on decisions, operations and actions.

Innovation is our commitment to learn, adapt, act and grow.

Responsiveness is our commitment to listening and timely and meaningful action.

Additional Guidance

As with all Regulator documents, this document does not take the place of applicable legislation. Readers are encouraged to become familiar with the acts and regulations and seek direction from Regulator staff for clarification.

The Regulator publishes both application and operations manuals and guides. The application manual provides guidance to applicants in preparing and applying for permits and the regulatory requirements in the planning and application stages. The operation manual details the reporting, compliance and regulatory obligations of the permit holder. Regulator manuals focus on requirements and processes associated with the Regulator's legislative authorities. Some activities may require additional requirements and approvals from other regulators or create obligations under other statutes. It is the applicant and permit holder's responsibility to know and uphold all legal obligations and responsibilities. For example, Federal Fisheries Act, Transportation Act, Highway Act, Workers Compensation Act and Wildlife Act.

Throughout the document there are references to guides, forms, tables and definitions to assist in creating and submitting all required information. Additional resources include:

- Glossary and acronym listing on the Regulator website.
- Documentation and guidelines on the Regulator website.
- Frequently asked questions on the Regulator website.
- Advisories, bulletins, reports and directives on the Regulator website.
- Regulations and Acts listed on the Regulator website.

In addition, this document may reference some application types and forms to be submitted outside of the Application Management System but made available on the Regulator's website. Application types and forms include:

- Heritage Conservation Act, Section 12
- Road use permits
- Water licences
- Master licence to cut
- Certificate of restoration
- Waste discharge permit
- Experimental scheme application
- Permit extension application

Manual Revisions

The Regulator is committed to the continuous improvement of its documentation. Revisions to the documentation are highlighted in this section and are posted to the Energy Professionals section of the Regulator's website. Stakeholders are invited to provide input or feedback on Regulator documentation to servicedesk@bc-er.ca or submit feedback using the feedback form.

Posted Date	Effective Date	Chapter	Summary of Revision(s)
June 23, 2016	June 23, 2016	Various	Sections 1.1, 1.2, 1.4.5: Updated to reflect the launch of Regulator's Application Management System and release of Oil and Gas Activity Application Manual.
November 7, 2016	December 1, 2016	Various	Several changes have been made to this document. Readers are encouraged to review the document in full.
August 8, 2018	September 1, 2018	Various	Various changes have been made to this document. Areas to note include, 1.4.1, 1.4.2, 1.4.5, 3.1.5, 3.3.1.2, 4.1.1, 4.2.2, Appendix A, Appendix D, Appendix F, Appendix K. Readers are encouraged to review the document in full.
Mar. 28, 2022	March 28, 2022	C&E Pg.9	Add paragraph "… work relating to the practice of professional engineering or professional geoscience are expected to accord with the *Professional Governance Act*. "
Oct.20, 2023	Oct.20, 2023	Various	Replace BCOGC with BCER; OGAA with ERAA; new logos, references and associations
June 26, 2024	August 1, 2024	Various	Remove all references to ABA. Several additional changes have been made to this document including, new Appendix (L) was added with guidance for completing the data fields in the LNG facility application through AMS system. Readers are encouraged to review the document in full.
July 2025	July 2025	Various	Notable updates include: Chapter 2.1.6: submission requirements for flaring, incinerating, venting, and relief system design basis. Chapter 3.1: LNG facility site preparation Chapter 3.5: Additional detail on updates to the Regulator Chapter 4.1.2: Added content on pneumatic testing Appendix K: Reference to gas fired appliances and equipment. Other corrections updates throughout.

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Preface

About

The Liquefied Natural Gas Facility Application and Operations Manual is intended to provide a reference document for applicants that wish to construct and operate a Liquefied Natural Gas facility (LNG facility) in British Columbia, as regulated by the Liquefied Natural Gas Facility Regulation (LNGFR). For applicants, the manual provides an overview of the requirements and procedures for applying for and obtaining a permit to construct and operate a LNG facility. For permit holders, the manual provides an overview of the key regulatory milestones and requirements during the construction, operations and site restoration stages of the facility's regulatory lifecycle.

The manual has been prepared to be as comprehensive as possible; however it is not all encompassing and may not cover all situations. Where circumstances or scenarios arise and are not covered by the manual, contact the Regulator for assistance.

Manual Structure

Beginning with pre-application requirements, this document guides the user through application preparation; the Regulator's review and determination process for a LNG facility permit; construction, operations and site restoration. The appendices include documents to reference when compiling information required by the Regulator.

Manual Scope

The manual is limited in scope to the Regulator's application processes and the authorities and requirements established within the ERAA and the LNGFR. Applicants and permit holders may require additional approvals from other regulators or have obligations under other statutes. For convenience the manual attempts to identify other relevant agencies and regulatory processes, however this listing is not exclusive and it is the applicant/permit holder's responsibility to know and uphold all of their legal obligations.

Additional Guidance

Additional Regulator manuals and guidelines are available in the Documentation section of the Regulator's website. The glossary page of the Regulator's website provides a comprehensive list of common terms, Appendix A of this document provides a list of terms specific to this manual, and the Energy Resource Activities Act and its regulations provide the primary source of legal definitions.

Compliance and Enforcement

This document does not replace legislation or affect legislative requirements. All permit holders are ultimately responsible for ensuring they understand and meet all requirements of ERAA and their permits. Should a person not comply with the Energy Resource Activities Act, the Regulator may take compliance and enforcement actions.

For more information regarding the Regulator's Compliance and Enforcement processes, please refer to the Compliance and Enforcement Manual.

All submissions made to the Regulator in support of an application or a regulatory requirement that include work relating to the practice of professional engineering or professional geoscience are expected to accord with the Professional Governance Act, [SBC 2018], c. 47 and the Bylaws of Engineers and Geoscientists British Columbia (EGBC). This includes any requirements relating to authentication of documents.

Chapter 1: LNG Facility Overview

The Liquefied Natural Gas Facility Regulation (LNGFR) regulates Liquefied Natural Gas Facilities within British Columbia. The Regulation is designed to be flexible enough to cover any LNG production facility, whether it is small or large, situated onshore or floating, constructed entirely in British Columbia, or where modules of the facility are constructed and assembled outside of British Columbia and transported to the project site. The LNGFR regulates the permit application process, engineering design, construction process, pre-operation testing, commissioning, operations, and end of facility life.

Some sections of the LNGFR are prescriptive, and other sections provide a choice to applicants/permit holders (for example, to comply with an external standard). The LNGFR allows applicants and permit holders to propose alternative approaches, as long as they are able to demonstrate to the Regulator that the alternative approach meets or exceeds the public safety and environmental protection requirements prescribed by the LNGFR.

1.1 How to Submit an Application for a LNG Facility Permit

Companies proposing to build a LNG facility on Crown or private land must submit a completed Facility Permit Application through the Regulator's Application Management system (AMS). Applicants should refer to the Oil and Gas Activity Application Manual for further information on how to submit an application.

In addition to the LNG facility permit, other authorizations and permits will be required by the Regulator to construct and operate a LNG facility. Regulator staff is available to meet with applicants to identify what additional authorizations and permits are required. Some of these requirements are identified in the sections below.

1.2 Consultation and Notification

Section 22 of ERAA establishes a requirement for consultation and notification before applications for oil and gas activity permits can be submitted. Depending on proximity to the facility being proposed, applicants may be required to consult and/or notify stakeholders and those potentially affected by the proposed LNG facility. Applicants should summarize any consultation with stakeholders in their LNG Facility Permit Application.

For additional guidance on the consultation and notification requirements users should refer to the Regulator's Requirements for Consultation and Notification Regulation and Oil and Gas Activity Application Manual.

1.3 First Nations Consultation

The Regulator, as an agent of the Crown, will fulfill the Crown's obligation to consult with First Nations about any potential adverse impacts of oil and gas activities on First Nations' treaty or aboriginal rights in its decisions. As a result, consultation with First Nations is required as part of the application process for Crown authorizations. Also, in the case where an amendment to an existing permit is under review, First Nations consultation is required.

The permit application materials required under Section 2 of the LNGFR, and maps will be used to consult with First Nations. It is recommended that applicants provide the Regulator with a short, annotated table of contents explaining the different sections of the permit application and the type of information that will be included.

When making a decision on a LNG facility, the Regulator will rely to the degree that it is able, on relevant engagement and consultation undertaken as part of the environmental assessment or other processes by the applicant, or by other provincial or federal agencies. Applicants should provide the Regulator with a summary of any engagement the applicant has had with First Nations related to the proposed LNG facility.

Reference documents regarding the First Nation consultation process and the applicant's role are available on the Regulator's website. Applicants may also refer to the Ministry of Aboriginal Relations and Reconciliation's Building Relationships with First Nations: Respecting Rights and Doing Good Business, and the Environmental Assessment Office's Proponents Guide to First Nation Consultation in the Environmental Assessment Process.

1.4 Related Elements of the Regulatory Environment Regarding LNG Facilities

This document provides guidance on the LNGFR, and the Regulator's legislative authorities regarding the construction and operation of a LNG facility. The Regulator's responsibilities, however, only form a part of a regulatory framework that may apply to the construction and operation of a LNG facility.

While the manual highlights linkages to some relevant agencies and regulatory processes, these areas may be outside of the Regulator's regulatory responsibilities. Other elements of the regulatory framework which an applicant should be aware of include the following.

1.4.1 Environmental Assessment Processes

The process regarding the submission and review of the LNG Facility Permit Application varies depending on the size of the project and whether or not it is reviewable under the BC Environmental Assessment Act and/or the Impact Assessment Act 2019.

- BC Environmental Assessment – The BC Environmental Assessment Act (Reviewable Projects Regulation) establishes thresholds as to whether or not projects are reviewable by the Government of British Columbia. If a provincial environmental assessment is required, an approved Environmental Assessment Certificate is a pre-requisite for the Regulator to make a decision on a LNG Facility Permit Application. However, work can start on a LNG Facility Permit Application while the environmental assessment is underway. Before and during the environmental assessment process there should be dialogue between the applicant and the Regulator (organized by the Regulator's Major Projects and Energy Transition Branch) to ensure the applicant is following the appropriate process.
  There are also two mechanisms in place to streamline the regulatory reviews and ideally shorten the time to permit decisions following the issuance of and Environmental Assessment Certificate: Concurrent Permitting, under the Concurrent Approval Regulation of the Environmental Assessment Act, outlines a process that allows applicants to apply to have other agencies consider applications for provincial permits and authorizations at the same time an environmental assessment is being undertaken, and Synchronous Permitting, in which the Regulator will oversee the review and processing of applications within its jurisdiction in parallel with the environmental assessment process, but will not be able to make a final permitting decision until the Environmental Assessment Certificate is completed.

For more information visit on the provincial environmental assessment process visit the BC Environmental Assessment webpage.

- Federal Impact Assessment – The Regulation Designating Physical Activities establishes thresholds as to whether or not projects are reviewable by the Government of Canada under the Impact Assessment Act, 2019. The Impact Assessment Act, 2019 contains provisions that can reduce overlap between federal and provincial governments' environmental assessment processes. One approach is for the federal Minister of Environment to substitute the environmental assessment process of another jurisdiction (such as British Columbia) for the environmental assessment process that would otherwise be conducted by the Impact Assessment Agency of Canada. For more information refer to the Memorandum of Understanding between the BC Environmental Assessment Office and the Impact Assessment Agency of Canada.

1.4.2 Provincial Crown Land Related Authorizations

Generally, the Regulator is responsible for authorizing investigative activities on Crown land if the proponent holds or has applied for the facility permit, or, for instance, if the proponent intends to apply for a facility permit provided the facility is reviewable under the Environmental Assessment Act (see Section 7.1 of the Energy Resource Activities Act General Regulation for more information).

1.4.3 Marine and Marine Foreshore Authorizations

The authority of the Regulator generally applies to the construction of a near shore floating LNG facility, or a LNG facility on land (whether private or Crown) and extends through to the loading arm that will transfer the liquefied natural gas to a ship for marine transport. The Regulator will review the engineering design and make a permitting decision on the construction and operation of the marine structures that support oil and gas activities. Applicants/permit holders should note that the construction of portions of a LNG facility that requires access to the seabed (for example, pilings for a loading dock) may require additional approvals from a number of agencies, for example:

- for provincially regulated areas, approvals from the Regulator or the Ministry of Forests, Lands, and Natural Resource Operations for water lots or use of the foreshore;
- for federally regulated areas, approvals from a Port Authority or other federal agencies;
- approvals from the Department of Fisheries and Oceans for activities that fall under the Fisheries Act;
- approvals from Environment Canada for the disposal of dredged material at sea (Canadian Environmental Protection Act); and,
- approvals from Transport Canada for the regulation of ocean going vessels or works that may impact marine navigation (Canada Shipping Act, 2001 and Navigation Protection Act).

1.4.4 Other BC Energy Regulator Authorizations

In addition to a LNG facility permit, an applicant may need other authorizations from the Regulator. For instance, the proposed facility may require authorizations for roads, timber harvesting, water allocation, stream crossings, waste discharge and impacts to archaeological sites.

The Regulator authorizes and regulates water use for oil and gas activities, under the Water Sustainability Act. Applicants/permit holders should refer to the Oil and Gas Activity Application Manual and the Water Licence Application Manual for further information. If a change in and about a stream is proposed there should be a dialogue between the applicant and the Regulator (organized by the Regulator's Major Projects and Energy Transition Branch) to ensure that the applicant is following the appropriate process.

The Environmental Management Act regulates the introduction of waste into the environment in British Columbia. The Waste Discharge Regulation identifies the industries, trades, businesses operations and activities that require authorization. Where discharges to the environment are not regulated under the Oil and Gas Waste Regulation, the Regulator has the statutory authority to issue Waste Discharge Permits (including air emissions, effluent discharges, and refuse disposal) under the Environmental Management Act for oil and gas activities.

Under Section 35 of the Energy Resource Activities Act an applicant/permit holder must minimize waste. This requirement applies to the entire project lifecycle, from site run-off during construction to emissions and discharges during operations.

These requirements apply to all stages of the project beginning with the approval of an Energy Resource Activities Act permit and include waste from site run-off or other similar effects during construction to emissions and discharges during operation.

1.4.5 Additional Regulatory Authorities

Other legislation, regulations and/or agencies that can apply to the construction and operation of an LNG facility in B.C. include:

- Local Government Act – Requirements for building safety are described in the British Columbia Building Code. Structures within an LNG facility must comply with the referenced Canadian design and construction standards in the British Columbia Building Code.
- Safety Standards Act – Some aspects of the construction and operation of an LNG facility will need to be permitted under the Safety Standards Act, which is administered by Technical Safety BC.
- Occupational Health and Safety Regulation – While the LNGFR describes a number of public and worker safety standards, worker safety is subject to the Occupational Health and Safety Regulation, which is administered by WorkSafe BC.
- Local Governments and other agencies – LNG facilities may be subject to the regulations or zoning requirements of local governments or other agencies (e.g. federal government, port authorities and First Nations governments). Applicants should ensure they are working closely with land administrators to ensure they are meeting all requirements.

1.4.6 Freedom of Information and Protection of Privacy Act

Applicants/permit holders may be submitting sensitive information to the Regulator as part of the approval processes under the LNGFR. As a public body, the Regulator is subject to the Freedom of Information and Protection of Privacy Act (FOIPPA). FOIPPA is designed to make public bodies accountable by providing the

public with a legislated right of access to government records. Under FOIPPA an organization or member of the public can make a request for access to information possessed by public bodies.

The legislation contains a number of exemptions to requests for disclosure. Under Section 21 of FOIPPA government agencies must withhold from public disclosure commercial or financial information of outside businesses if releasing the information would cause harm to the business. This section of FOIPPA applies if:

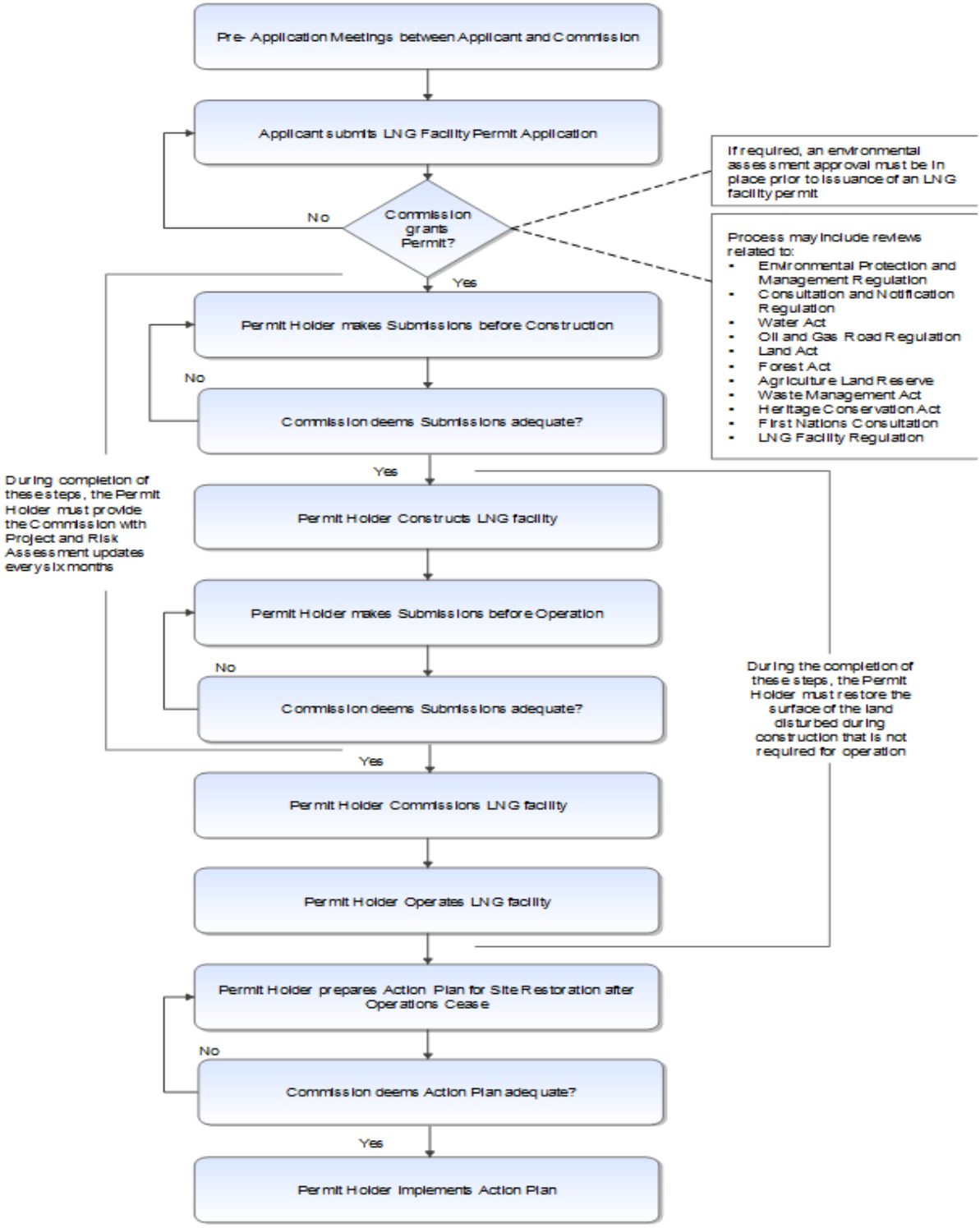
- the information would reveal third party trade secrets, or, the commercial, financial, labour relations, scientific or technical information of a third party, or about a third party;
- the information was supplied in confidence; and,
- disclosure of the information could result in one or more specified harms.

With respect to whether a particular record was supplied, implicitly or explicitly, in confidence, each case must be evaluated on its facts and in light of regulatory provisions guiding the Regulator's handling of records. It is recommended that applicants/permit holders consider issues of confidentiality up front. To initiate such consideration, applicants/permit holders may label information that is considered to be confidential. For more information on the application of FOIPPA refer to the Ministry of Technology, Innovation and Citizens' Services' FOIPP Act Policy and Procedures Manual.

1.5 LNG Facility Regulatory Lifecycle Overview

The following graphic provides an overview of select milestones in the regulatory life cycle of an LNG facility. These milestones are further expanded upon in subsequent chapters of this manual.

Figure 1: LNG Facility Regulatory Lifecycle Review



1.6 LNG Facility Risk Management

The LNGFR requires various safety and risk assessment studies to be carried out at appropriate stages of the project. These studies should follow a process of hazard identification, risk assessment, mitigation and monitoring. The process starts at the application stage of a project with the initial hazard identification study (HAZID), and is refined using other methodologies as more detailed designs are completed. All results of the safety and risk assessment studies conducted during the design and construction stage could be incorporated into a safety case associated with the facility.

The Regulator's approach to decisions regarding the management of risk to the public, environment, and facility is to require the design, construction and operation of the LNG facility to be conducted in a manner that results in a facility's risks to be as low as reasonably practicable (ALARP) and, if the applicant intends to design and site the LNG facility in accordance with a Quantitative Risk Assessment, not to be in the intolerable risk range as defined by Schedule 2 of the LNGFR (see Appendix B).

The concept of ALARP defines how the Regulator measures risk mitigation and gives a goal to the risk management process. Demonstrating ALARP is a critical element to satisfying the Regulator that all safety and environmental risks have been appropriately managed. A design that can demonstrate ALARP will have reduced the risk until the incremental sacrifice (in terms of time, effort, cost, or other expenditure of resources) is grossly disproportionate to the value of incremental risk reduction achieved.

In order to demonstrate ALARP, a systematic analysis of each risk, safety benefits resulting from a mitigation measure and evaluation of the reasonable practicability of the identified mitigation measure must occur. Using accepted codes and standards and good engineering practice during design, construction and operation will assist with demonstrating ALARP. If the LNG facility is designed and sited in accordance with a Quantitative Risk Assessment a detailed analysis for all risks that fall within the range indicated as ALARP in Schedule 2 of the LNGFR (see Appendix B) should be provided.

It is important to note that the Safety and Loss Management Program required under Section 8 of the LNGFR will provide the administrative, maintenance and operating controls that will supplement the risk mitigation provided by the design. Key principles to be included in the application of ALARP are contained in Appendix C.

Chapter 2: Preparing LNG Facility Permit Applications

Under Section 2 of the LNGFR, applicants must apply for a permit to construct and operate a LNG facility and the submission of the application must meet the requirements described in Section 2 of the LNGFR. The applicant must provide engineering information on the proposed LNG facility to the level of detail required by the Regulator, in order for the Regulator to make a decision on the issuance of a LNG facility permit. In addition to the information outlined in Section 2 of the LNGFR, there are other Regulator requirements for any facility permit application. These requirements are described in the Oil and Gas Activity Application Manual and include the following:

- Consultation and notification materials;
- First Nation information and engagement log;
- Scale maps;
- Archaeology information;
- Spatial data; and,
- Construction Plan.

The LNGFR's flexible approach allows applicants to apply for a LNG Facility Permit Application using preliminary information about the project. Applicants can apply for a LNG facility permit at an early stage (e.g. pre-FEED) when complete engineering design information may not be available. If a LNG facility permit has been issued, the permit holder will be required to provide updated information in order to proceed with construction, pre-operation testing, commissioning and operation of the LNG facility.

Where the applicant is also prepared to provide deliverables outlined in the LNGFR required for Leave to Construct at the permit application stage, the Regulator may be able to issue the LNG facility permit and Leave to Construct concurrently.

The LNG Facility Permit Application forms the basis for the Regulator's decision related to the project. As such, the applicant is required to provide sufficient information to enable the Regulator to understand the risks associated with the facility. This information will be used by the Regulator to consider all subsequent submissions (e.g. before construction of a phase of the facility) in the context of the entire project.

Applicants should be familiar with all parts of the LNGFR before developing a permit application package. The Regulator encourages applicants to engage in pre-application meetings with Regulator staff. These meetings are critical to ensure all of the regulatory requirements are understood and that the application package contains the essential information required for the Regulator to make a decision.

Considerations on the Design of LNG Facilities Outside of British Columbia

The Regulator employs a professional reliance model in its regulation of oil and gas activities. If an applicant intends to design all or a portion of a LNG facility outside of British Columbia, they should refer to Appendix D for guidance on how to meet the professional reliance requirement to the satisfaction of the Regulator.

2.1 Application Requirements for a LNG Facility Permit

Under Section 2 of the LNGFR, the applicant must provide the following information to the Regulator when applying for a LNG Facility Permit Application:

2.1.1 Project Description

The project description should provide a concise summary of the project from construction to operation, providing enough detail to assist the Regulator in understanding how and in what quantity gas will be transported to, and processed through, the LNG facility. The project description will also be used by the Regulator for communication to the public.

Any future facility expansion that the applicant would like approved under the permit must be captured in the project description and be consistent with any environmental assessment approval conditions.

Applicants should provide drawings or pictorial representations to assist the Regulator in understanding the proposed facility. For further information on the requirements of a project description refer to Appendix E.

2.1.2 Construction Schedule

The Regulator recognizes that LNG facility construction may occur over an extended period of time meaning that construction and assembly schedules may need to be periodically updated. As a result, only a preliminary construction schedule is required to apply for a LNG facility permit.

The preliminary schedule should be sufficiently detailed to inform the Regulator of the timing of major milestones in the project, including submission dates. This will allow the Regulator to coordinate its activities (for example, submission reviews) based on the applicant's proposed schedule and minimize potential delays to the project.

The schedule should clearly demonstrate periods of time where significant construction is occurring concurrently with the operation of live units (e.g. one LNG train is in operation while a second train is in construction). If concurrent operation and construction is proposed, the Regulator will need to understand how the safety of the facility is being addressed.

Typically, a Level 1 construction schedule supplemented by the following information would meet this permit application requirement:

- Desired date for permit decision;
- Environmental assessment timeline (if applicable);
- Timelines for other permits/authorizations (e.g. Technical Safety BC; Department of Fisheries and Oceans; Transport Canada; Ministry of Forests, Lands and Natural Resource Operations; Port Authorities; First Nations)
- Desired Leave to Construct timeline and phasing strategy;
- Preliminary simultaneous construction and operation strategy (if planned);
- Post-construction site restoration timeline;
- Desire Leave to Operate timeline;
- Expected commissioning gas in date;
- Expected first LNG shipment.

Permit holders will be required to provide updated construction schedules in order to receive a Leave to Construct, and will be required to provide periodic updates to the Regulator under Section 5 of the LNGFR.

2.1.3 Modular Units Built Outside of British Columbia

The applicant may wish to construct certain modules of the LNG facility or floating LNG units (collectively referred to as modular units) outside of British Columbia. As the regulatory reach of the Regulator is limited to British Columbia, the Regulator must ensure that modular units brought into British Columbia are designed and built to the appropriate codes and standards.

Under Section 2 (c) of the LNGFR an applicant must notify the Regulator as part of the permit application that modules of the LNG facility may be built outside of British Columbia. This submission should include the applicant's plans to validate that all required elements of the quality assurance program are documented (per Subsection 3 (1) (f) of the LNGFR). This submission should also demonstrate that the applicant understands the requirements related to compliance verification under Section 6 of the LNGFR.

Under Section 6 of the LNGFR a permit holder may be required to have a third party verify that modules are constructed, assembled and tested in accordance with the quality assurance program referred to in Section 3 (1) (f). Appendix K outlines the expected scope of work for this third party verification.

While the Regulator can require this level of oversight for any module as defined by the LNGFR, the LNGFR does not require third party verification for all modules. The BCER is more likely to require third party oversight of modules constructed outside British Columbia for systems whose failure could result in loss of life, significant property damage, or damage to the environment, customized modules or when the manufacturer has not demonstrated a history of relevant expertise.

As this third party is working on the Regulator's behalf, the Regulator will assess whether the proposed third party is competent and has no conflict of interest that could affect the independence of its assessment of a modular unit. A transparent reporting and communication strategy between the Regulator, applicant and the third party should be discussed at this time. The Regulator will also ensure that the compliance verification plan is to its satisfaction. For example, a firm accredited as a "Type A inspection body" as defined by ISO/IEC 17020 would likely be considered acceptable by the Regulator.

As only preliminary information on the construction of modular units and the use of a third party for verification may be available at the permit application stage, the applicant may finalize its selection of a third party after the LNG facility permit decision has been made. In this instance, it is recommended that the applicant provide information to the Regulator as soon as practicable on the party or parties it intends to use for verification, their qualifications and the likely locations for construction.

Early notification enables the Regulator to review the information in a timely manner and avoid delays in issuing a Leave to Construct. The Regulator will review the information provided and either:

- "Agree" to the proposed third party's/parties' qualifications and independence; or,
- "Object" to any or all of the proposed third party/parties together with reasons substantiating its objections.

The applicant may revert to the Regulator with remedies for qualifying any objected parties.

2.1.4 Plot Plans

The applicant's LNG Facility Permit Application submission must include preliminary plot plans which will be used by the Regulator to understand the general layout of the LNG facility.

The preliminary plot plan is a diagram that will illustrate the surface area and positioning of the facility related equipment and buildings. Updated FEED plot plans are required by the Regulator in the submissions before construction.

The applicant's preliminary plot plan should include:

- a list of major equipment;
- the area of land use under the control of the applicant including, for example, water lot or foreshore use;
- proposed access roads;
- fencing and other access control measures;
- site contours and elevations;
- adjacent facilities to the site that are not affiliated with the LNG facility;
- equipment and building layout;
- key LNG facilities and their hazard planning zone; and,
- impoundment areas with safety separation distances and preliminary design dimensions.

All dimensions should be shown in International System of Units (SI) and at sufficient scale to allow for clear location of all major components of the project.

Examples of key facilities that could be included in the preliminary plot plan are:

- LNG storage tanks;
- gas treatment equipment;
- refrigeration equipment;
- refrigerant storage;
- hazardous material storage;
- process buildings;
- pumps and compressors;
- flare and vent stacks;
- separator pressure vessels;
- heaters;
- raw gas pipeline connections to the plant;
- berths;
- materials/module offloading;
- construction facilities/camps;
- operational facilities/camps;
- marine safety zone for vessels during loading;
- marine security provisions (tug boat pens, heliport, emergency response centers, oil spill response centre, and safe anchorages for LNG carriers).

For floating LNG facilities, in addition to the equivalent marine based layouts for the plot plans and key facilities described above, the following should also be provided:

- location on the water lot or foreshore showing areas for use of the applicant, distances to shore, any in-place infrastructure or property that may be impacted by the operations and marine safety zones around the facility;
- location of storage (onshore, onboard or on a separate floating system);
- location of shore-based support facilities; and,

- configuration and plot plan of the mooring system.

If the facility is floated into location at-shore and grounded for in-place operations, this should be clearly stated.

2.1.5 Process Flow Diagrams

The applicant must submit a process flow diagram (PFD) including utility flow diagrams that shows the relationships between the major components in the system of the facility. The flow diagrams must indicate how the natural gas and process fluids will move from inlets through the facility to outlets, including export and loading processes (e.g. marine vessels, rail loading, truck loading bays, etc.), utilities and storage units.

PFDs form the basis for subsequent information requirements, including FEED piping and instrumentation diagrams (P&ID) that will be submitted to the Regulator before construction begins.

While these diagrams are considered preliminary, they should accurately reflect the proposed process being considered and should include:

- all major equipment;
- storage tanks and other vessels;
- compressors;
- heat exchangers; and,
- interconnecting piping (process, fuel, flare and vent at a minimum).

A preliminary heat and material balance diagram, including flowrates, pressure, temperature and composition should accompany the PFDs.

2.1.6 Flaring, Incinerating, Venting and Relief System Design Basis

The applicant must submit a summary of the flaring, incinerating, venting and relief system design basis and philosophy. The summary should provide sufficient information for the Regulator to understand:

- the best practices, standards and guidelines for flaring and venting the applicant will apply to the design of the project;
- the alternatives considered to minimize flaring, incinerating, and venting, with particular emphasis on normal operations, planned shutdowns, maintenance and startups; and,
- the design elements required to meet measurement and reporting requirements.
- If the design of the LNG loading system includes the ability to accommodate LNG carriers that require de-inerting (removal of either nitrogen or carbon dioxide used to displace oxygen from the storage tanks after any maintenance that occurred), include the following information with the application
    a. The expected frequency of de-inerting operations
    b. The expected amount of vented gas during each de-inerting operation
    c. The expected amount of flared gas during each de-inerting operation
    d. List any other associated air emissions from the de-inerting operation

Note: As per LNGFR Section 18(2)(b), permission to flare for purposes other than emergencies and maintenance must be included in the LNG facility permit. Proponents must detail which permissions are sought (e.g. pilots, flare system purge, LNG carrier cool down & loading, commissioning, start up, de-inerting, etc.) in the LNG facility permit application.

The Regulator's Flaring and Venting Reduction Guideline is available for further guidance. The guideline relies on an objective hierarchy and framework for the management of gas flaring, incinerating, and venting.

The following sections of Flaring and Venting Reduction Guideline (version 5.7) are applicable to LNG facilities:

- Chapter 5 (Notification) is consistent with LNGFR Section 19.
- Chapter 6 (Performance Requirements) is consistent with LNGFR Section 4(3) and Environmental Management Act air discharge requirements.
- Chapter 7 (Venting and Fugitive Emissions) is consistent with LNGFR Section17 & Subsection8(1)(c).
- Chapter 9 (Incineration) is consistent with general engineering design considerations.
- Chapter 10 (Measurement and Reporting) is consistent with LNGFR Section 16.
- Appendix A (Venting Management Guideline Related to Specific Sources) is consistent with LNGFR Section 17 & Subsection 8(1)(c):
    - While the methane regulations do not currently apply to LNG facilities, BCER guidance related to venting and fugitive emissions should be applied where applicable.

Applicants should consider public and environmental concerns, economic alternatives and health impacts when evaluating the opportunity to eliminate or minimize waste gas emissions at a facility.

2.1.7 Design and Safety Studies Relating to Siting

Facility siting is the process of managing risk to people, the environment and property from explosions, fires, and hazardous material releases through equipment and occupied building location and layout. The Regulator expects the applicants to have completed comprehensive design and safety studies when determining siting for the facility.

The applicant must submit relevant studies that demonstrate the considerations taken into account by the applicant in siting the facility. These reports can include relevant drawings or graphics that illustrate issues to be addressed in the facility design and safety plan (for example, plot plans showing risk contours).

CSA Z276 prescribes siting requirements for facility components and spill scenarios that are expected to pose significant risk to people, the environment and property. CSA Z276 also requires evaluation and management of all risks by:

- identifying hazards that can affect process area buildings and equipment;
- evaluating potential consequences of those hazards; and,
- developing means to manage the risks that those hazards initiate.

The facility siting study should consider, but is not limited to, risks associated with:

- forces of nature, including severe weather patterns;
- adjacent activities that could be impacted by a facility emergency or could impact the facility;
- flashing;
- aerosol formation;
- liquid jetting;
- pool formation and flow;
- dispersion of vapours;
- jet fires;

- flash fires;
- explosions;
- fireballs;
- pool fires;
- boiling liquid expanding vapour explosion (BLEVE);
- liquid/water interaction effects;
- radiant heat;
- overpressure; and,
- toxic spills.

2.1.8 Quantitative Risk Assessment Results (if applicable)

If the applicant intends to design and site the LNG facility in accordance with a Quantitative Risk Assessment (QRA) as opposed to using the standard identified in the Regulation (per Subsection 4 (4) of the LNGFR), in accordance with Section 2 (h) of the LNGFR the applicant must submit the results of a preliminary QRA to the Regulator as part of the LNG Facility Permit Application.

A QRA is a formal and systematic approach for identifying potentially hazardous events, estimating the likelihood and consequences of those events and expressing the results of the assessment as risk levels (e.g. to the worker, or public). This approach should assist with selecting engineering and operational options that result in risks that are ALARP and are not considered intolerable as identified in Schedule 2 of the LNGFR (see Appendix B).

Clause 14.3 of CSA Z276 contains requirements for LNG plant siting using QRA as an alternative to the consequence analysis prescribed for siting in Clause 5.4 of CSA Z276.

The preliminary QRA may be based on either preliminary engineering design information for the proposed LNG facility, or on an existing operating facility of similar capacity to the proposed facility. This study should be carried out in accordance with the Terms of Reference for Quantitative Risk Assessment outlined in Appendix F.

2.1.9 Hazard Identification Study Results

The applicant should identify the hazards associated with their processes and the natural hazards on their facilities, including those resulting from climate change. The results of hazard identification studies, including studies of both process hazards and natural hazards should submitted with the LNG Facility Permit Application.

Preliminary HAZID

The applicant must conduct a preliminary HAZID and submit a summary report of the study to the Regulator with the LNG Facility Permit Application. The preliminary HAZID will identify facility hazards that will be factored into the engineering design. The summary report should identify:

- hazards and recommendations identified in the study;

- the methodology used in the study; and,
- participants and their roles in the study.

Subsection 3 (1) (d) (i) of the LNGFR requires that the permit holder submit an updated HAZID prior to construction. The Regulator will review the recommendations identified in the HAZID for resolution prior to construction and may conduct a further review prior to operation.

Hazard Identification

The applicant must provide the Commission with hazard identification study results that document the natural hazards, including climate change, on the facility. It is expected that most facilities would include the seismic and geotechnical studies completed for the proposed LNG facility site with the permit application materials.

A tsunami study must also be provided if the LNG facility will be located in a distant or local tsunami hazard zone. The National Oceanic and Atmospheric Administration publishes a database of historical tsunami and seismic events. Applicants may wish to refer to publications by Natural Resources Canada as a source of information.

Additional studies may be required depending on the site (e.g., flooding, debris torrents, fire).

For further guidance on the preparation of studies refer to Appendix G.

2.2 Completing LNG Facility Activity Details

Liquefied Natural Gas (LNG) facilities are considered as facilities under ERAA. Applicants applying for a facility permit must complete the facility activity tab in the Application Management System (AMS). For further guidance on completing the Facility tab for LNG facility application refer Appendix L.

2.3 LNG Facility Permit Application Review

Once the Regulator has received a completed application it will review the application against the LNGFR and determine whether sufficient detail and content has been provided. The decision regarding whether to issue a LNG facility permit will be completed as expeditiously as possible.

For projects that are reviewable under the BC Environmental Assessment Act, the applicant may submit a LNG Facility Permit Application using the concurrent permitting or synchronous permitting processes described in this manual.

2.4 Permit Amendments

The LNGFR is flexible enough to eliminate or greatly reduce the number of times permit amendments are required. However, a permit amendment will be required where there is a fundamental change in the scope, design, location and/or scale of the project. Higher throughput or storage volumes, for example, may require a permit amendment.

Permit amendments are authorized in accordance with Section 31 of the Energy Resource Activities Act and are also subject to First Nations consultation and to the Requirements for Consultation and Notification Regulation. Permit holders should be aware that permit amendments may also trigger requirements for other regulatory approvals, such as an Environmental Assessment Certificate under the Environmental Assessment Act. Amendments are submitted through the Application Management System(AMS). Application Management system manual provides guidance on submitting an amendment through AMS system.

Chapter 3: LNG Facility Construction

Applicants that have received a LNG facility permit approval are known as the permit holder.

Permit holders must adhere to any applicable conditions in the LNG facility permit or environmental assessment approvals before site preparation, construction or operation. Furthermore, the permit holder may not begin construction of the LNG facility in the province of British Columbia, including construction of foundations and other civil works, until the permit holder has received a Leave to Construct from the Regulator.

Section 3 of the LNGFR outlines the submissions required to receive a Leave to Construct from the Regulator. These submissions are in addition to any pre-construction conditions that may be specified in the LNG facility permit approval.

3.1 LNG Facility Site Preparation

Section 3 of the LNGFR does not apply to LNG Facility site preparation activities. Site preparation may include:

- clearing of land;
- grubbing;
- stripping;
- grading/leveling/retaining walls;
- quarrying;
- soil improvement;
- helipad development;
- pioneer dock;
- establishment of material offloading facilities to support facility construction;
- surface water management systems (e.g. installing ditches, storm water ponds); and,
- fencing.

3.2 Submissions Before Construction

Under Section 3 of the LNGFR a permit holder must not begin construction of any phase of a LNG facility unless all required information has been submitted to the Regulator and the permit holder has received a Leave to Construct. The permit holder may also require authorizations from the landowner before beginning construction. It should be noted that KERMIT requires a Notice of Construction Start to be submitted with actual construction start date.

At a minimum, the Regulator must receive FEED level documents before it will grant the permit holder a Leave to Construct for the phase of construction requested. The BCER must be satisfied that the permit holder has met all applicable permit conditions and LNGFR Section 3 requirements before issuing a Leave to Construct and may request additional information to support the submission review.

It is recommended to provide the required Leave to Construct submissions during design and prior to the start of fabrication. The BCER's reviews may lead to clarifications and feedback on regulatory requirements which could impact the final installation. Many of the required Leave to Construct submissions are updated and revised multiple times throughout detailed design,changes to the design made after the FEED level Leave to Construct submissions should be summarized within the six-month reports respecting changes (see LNGFR Section 5 and Chapter 3.5 of this manual).

It is recommended that permit holders make one complete submission for Leave to Construct. Where required, decisions based on the submitted material may be phased for specific scopes.

Under Section 3 of the LNGFR, the permit holder must submit the following information to the Regulator before a construction phase begins:

3.2.1 Proposed Phase of Construction Scope

The permit holder must submit a description of the proposed phase of construction, which may include necessary drawings and pictorial representations. The description should clearly identify:

- how the proposed phase of construction relates to the overall project; and,
- how the phase of construction relates to other phases of construction.

3.2.2 Engineering Design

The permit holder must submit an engineering design completed in accordance with the design requirements in Section 4 of the LNGFR and other appropriate standards. FEED deliverables/drawings completed by a qualified professional representing the phase of construction for which the permit holder is seeking Leave to Construct are sufficient to meet this requirement. The FEED deliverables/drawings typically will include:

- PFDs;
- material balance;
- P&IDs;
- layout and area drawings for major equipment (e.g. LNG tank, marine structures supporting LNG facility equipment and piping; emergency release system design); and,
- relevant modelling studies (e.g. noise, vapour dispersion, radiant heat flux, electrical area classification etc.).

The Regulator is particularly interested in the aspects of design that drive facility safety, technical and operational integrity and environmental compliance.

3.2.3 Plot Plans

During the application stage, the applicant is required to submit preliminary plot plans to the Regulator. The submissions before construction will include detailed plot plans representing the FEED design. Any significant changes to the preliminary plot plan should be highlighted and explained.

The detailed plot plans should indicate how the facility will be laid out based on the contours of the landbase and should show facility components such as buildings, access roads, access control, fencing, storage tanks, other vessels, layout of equipment and facility piping, etc. If the permit holder is building the facility in phases, the detailed plot plan should clearly indicate which phase of the facility is being constructed, how that phase relates to other facilities and equipment on the site and distances to key features off the site.

3.2.4 Hazard and Safety Study Results

Under Subsection 3 (1) (d) of the LNGFR the permit holder must submit the results of the following studies to the Regulator:

Note: CSA Z276 clause 14 also contains requirements for risk assessment of LNG Facilities, risk assessments conducted as part of the Hazard and Safety studies must also comply with the requirements of CSA Z276.

3.2.4.1 Hazard Identification Study

At the permit application stage, the permit holder provided a preliminary Hazard Identification Study (HAZID) for the proposed facility. The submissions before construction will include the results of the updated HAZID study. The updated study should take into account the FEED deliverables/drawings, should identify any changes made since the preliminary study and any selected prevention or mitigation strategies.

3.2.4.2 Process Hazard Analysis

Permit holders are required to submit a report that summarizes the results of a Process Hazard Analysis (e.g. a Hazard and Operability Study (HAZOP), Failure Mode and Effects Analysis (FMEA) or equivalent study) to the Regulator before construction. The Process Hazard Analysis should be managed by a facilitator who is an expert in process hazard analysis and will chair and drive the review. The facilitator should be an individual with demonstrated experience managing the selected study methodology.

The report should:

- include a statement of purpose and objective;
- identify the methodology (technique used, potential consequence identification, recommendations);
- include process hazard analysis study documents (PFD's showing steady state operating conditions, material and heat balance, process descriptions, material safety data sheet, overall plot plan, P&IDs with nodes and material selection diagrams);
- include a worksheet outlining any exceptions to the results of the process hazard analysis; and,
- document the approach used for safety and the environmental items considered.

The Process Hazard Analysis team should be made up of qualified experts with respect to the process and include members from all relevant disciplines (operations, instrumentation and controls, engineering, maintenance, safety, etc.).

The results and considerations identified by the team should be recorded for remedial action during detailed engineering design or via the loss prevention philosophy, spacing and other control measures.

Further information is available in the Guidelines for Hazard Evaluation Procedures published by the Center for Chemical Process Safety.

3.2.4.3 Safety Integrity Level Study

Permit holders are required to submit the results of a Safety Integrity Level (SIL) study to the Regulator in the submissions before construction. At this stage, the SIL should focus on determining the required safety integrity level based on FEED drawings/deliverables.

A verification SIL study should be completed during detailed engineering to confirm that the safety functions selected provide the required risk reduction. This verification SIL study is required prior to a Leave to Operate and after the Leave to Construct during a regular project update. The facilitator should be an expert in SIL analysis and will chair the review. This expert should be an individual with demonstrated experience managing SIL analyses.

The following references are available for further information on safety integrity levels: ANSI/ISA 84.00.01 P1-P3; IEC 61508 and IEC 61511.

3.2.5 Quantitative Risk Assessment Results (if applicable)

Under Subsection 4 (4) and 4 (5) of the LNGFR, the permit holder may choose to complete the engineering design of the LNG facility in a manner consistent with the results of a Quantitative Risk Assessment (QRA), as opposed to using the standard identified in the Regulation.

Refer to Section 3.3.4 of this document for further guidance on QRA submissions.

3.2.6 Quality Assurance Program Validation

The permit holder must submit a report confirming that all of the elements of a Quality Assurance Program necessary for the construction of the LNG facility or modular units are documented.

The scope of validation should consist of confirming that the quality assurance program meets the following minimum requirements:

- is documented and applicable to the scope of work;
- complies with applicable codes and standards;
- consists of quality planning, control, assurance and continuous improvement processes;
- fully describes how the quality objectives will be managed for the duration of the construction including those for the subcontractors and/or the suppliers; and,
- covers the project quality policy and objectives, quality organization, resource management, information management, codes, standards and specifications, management of change, control of deviations and concessions, and regulatory legislation compliance.

Where a modular unit (or units) is built outside of British Columbia, Subsection 3 (1) (f) of the LNGFR requires that the permit holder submit a report from an accepted third party that an appropriate quality assurance program is in place.

For construction and fabrication activities occurring within British Columbia, a report validating that the quality assurance program is appropriate must be prepared by and signed off by a qualified professional licensed under the British Columbia Professional Governance Act.

In order to satisfy the requirements of LNGFR 3(1)(f), typically the following is provided:

- Cover letter from permit holder indicating senior management commitment to quality assurance and the systems in place to manage quality assurance.
- Quality assurance program overview & documentation signed statement of assurance from P.Eng.

Under Subsection 3 (4) of the LNGFR, the permit holder must maintain an adequate written record of the quality assurance program, and all supporting material. Records can be kept in hard copy or digital form but should be readily available and maintained in a manner that will ensure the document's integrity through the expected life of the project.

3.2.7 Notice of Construction

Under Subsection 3 (1) (g) of the LNGFR the permit holder must submit written notice to the Regulator of the intent to begin construction of the LNG facility. Notice of Construction Start may be submitted for the entire LNG Facility or in phases if a permit holder wishes to complete a phased Leave to Construct. All notices of construction start should be sent via email to Pipelines.Facilities@bc-er.ca. The first Notice of Construction Start must also be submitted within Kermit. Refer to the Regulator's Kermit User Guide; select "NCS (Downstream) for Facility" within Kermit for LNG Facilities.

Notice must be submitted at least 14 days before any phase of construction begins and should include:

- the permit number and any administrative identifier that relates to the facility;
- the permit holder (organization);
- the location and phase / description of construction;
- the lead contact information for the permit holder representative;
- the contact information of the field representative;
- the contact information of the submitter; and,
- Notice of Construction Start date and Proposed construction start date (minimum 14 days after NCS date).

If construction is expected to have impacts on the local community (for example, dust, noise, traffic issues or blasting), the LNG permit holder should consider public notification and mitigation measures.

Under Subsection 3 (2) of the LNGFR the permit holder may not submit a Notice of Construction until the construction schedule and management of change system has been submitted to the satisfaction of the Regulator.

3.2.8 Construction Schedule

Under Subsection 3 (2) (a) of the LNGFR the permit holder must submit an updated construction schedule for the completed LNG facility. Because a Leave to Construct can be issued for separate phases, it is important that the Regulator understand how each phase of construction connects to the overall project. The updated construction schedule will allow the Regulator to track construction progress and, where required, conduct inspections or audits of construction activity.

The permit holder should submit a construction schedule similar to the one submitted during the permit application with any changes highlighted.

The Regulator recognizes that construction scheduling can change over time. Therefore, the permit holder must provide construction schedule updates to the Regulator as part of the regular update process required under Section 5 of the LNGFR.

3.2.9 Management of Change System

Under Subsection 3 (2) (b) of the LNGFR the permit holder must provide a written description of the management of change system that will be used during construction, testing, commissioning and operation of the LNG facility.

During the construction of the project, the management of change process needs to control changes to baseline documents such as: the Basis for Design; Project Execution Plan; Safety and Loss Management Program; Basis for Schedule; and, other key documents. This management of change system should describe how all changes will be tracked during design and construction. This submission should also propose a definition of what changes will be communicated with the Regulator as a part of the regular update process required under Section 5 of the LNGFR.

Changes can occur when modifications are made to the operation or when received equipment does not meet design specifications. More subtle changes can also occur such as changes to codes and standards, key staff, or company organization.

The management of change system should:

- include written procedures for managing change;
- address the basis for each change;
- evaluate potential safety and health impacts for each change;
- define requirements for authorizing changes to be made; and,
- appropriately inform and train affected workers before changes occur.

The Center for Chemical Process Safety Guidelines for Management of Change for Process Safety identifies key components of what would be an acceptable change management system to the Regulator.

3.3 Receipt and Review of Submissions Before Construction

Before a Leave to Construct can be issued, the Regulator must be satisfied with the content of the permit holder's submissions before construction. Generally, this will include a review to ensure that all required material has been submitted, and that the submission contains sufficient detail to allow the Regulator to assess that the permit holder has met the requirements of the LNGFR, current edition of adopted standards (i.e. CSA Z276), permit conditions and this manual.

If the submissions before construction are not to the Regulator's satisfaction, the Regulator will provide feedback and request that the permit holder resubmit required information.

Under Subsection 3 (1) (g) of the LNGFR the Regulator requires 14 days notice of the permit holder's intent to begin construction. The Regulator recommends that permit holders provide the pre-construction submission, or components of the pre-construction submission, well in advance of the 14 day notice period.

On receiving the notice from the permit holder, the Regulator may decide to extend or reduce the 14 day notice period. This decision will be based on the quality, content and complexity of the permit holder's submission. For example, the Regulator may decide to extend the time period when a complex submission requires that the Regulator solicit outside, independent expert advice or when new technologies are being considered.

In order to facilitate the timely review of the submission, permit holders are encouraged to engage in regular communication with the Regulator, obtaining advice before drafting the submission and meeting with the Regulator to discuss the submission as necessary.

3.4 Engineering Design and Facility Siting

Section 4 of the LNGFR defines the engineering and design standards which the applicant/permit holder must comply with when making an application for a LNG facility permit and when completing the design, siting and construction of the facility. Applicant/permit holders making submissions for a LNG facility permit, Leave to Construct and Leave to Operate should clearly identify applicable engineering requirements and standards as outlined in Section 4 of the LNGFR in their submissions.

The engineering and design standards identified in Section 4 of the Regulation are derived from Canadian Standards Association. Applicants/permit holders should comply with other applicable national and international standards if their facility design includes equipment or components that are outside the scope of the standards identified in Section 4 of the Regulation. For instance, EN 1474 can be used to define the requirements for marine transfer systems. The use of alternative standards may trigger the requirement for a Quantitative Risk Assessment (see Section 3.4.4).

Applicants/permit holders should refer to CSA SPE276.1:20 for the design of permanent marine structures associated with LNG facilities.

Applicants/permit holders who propose an alternative to the identified standard must demonstrate that the proposed alternative will result in an outcome that is equivalent to or better than the standards for design, siting, environmental protection and safety prescribed in the LNGFR.

The applicant/permit holder must ensure that the engineering design for the LNG facility meets specific criteria as outlined in the LNGFR as well as any criteria specified in the LNG facility permit and any conditions under a provincial or federal environmental assessment approval.

3.4.1 Engineering Design and Facility Siting Requirements

The applicant/permit holder must ensure that the engineering design and siting for the LNG facility:

- conforms to CSA Z276, as amended from time to time;
- conforms to referenced codes and standards in CSA Z276;
- takes into consideration the results of hazard and safety studies;
- considers the effects of noise and light; and,
- includes LNG tank design fatigue life analysis.

Note: Section 1.1 of the LNGFR adopts CSA Z276 as amended from time to time unless the facility permit indicates otherwise.

3.4.1.1 Hazard and Safety Study Results Utilization

Under Subsection 4 (1) (b) of the LNGFR, the applicant/permit holder must ensure that the results and recommendations of the HAZID, Process Hazard Analysis and SIL study (required under Subsection 3 (1) (d) of the LNGFR) are addressed throughout the engineering design process from FEED to as built design. The Regulator may request a summary description from a qualified professional that outlines how the results of the hazard studies were addressed throughout the engineering design process.

3.4.1.2 Effects of Noise and Light in Engineering Design

Subsections 4 (1) (c) and (e) of the LNGFR requires that the engineering design and siting for the LNG facility take into consideration the effects of noise and light associated with the normal operation of the LNG facility.

It is recommended that the applicant/permit holder conduct a noise impact assessment regarding noise levels on receptors external to the plant boundary. Applicants/permit holders should consider the British Columbia Noise Control Best Practices Guideline or other applicable standards for noise levels protective of receptors in their engineering design (e.g. Health Canada or local government by-laws).

Applicants/permit holders must consider light mitigation measures in the design. CIE 150:2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations could be used for guidance on meeting the requirement for no excessive emanation of light.

LNG facility permits may contain conditions specifically related to noise and light requirements.

3.4.1.3 LNG Tank Design Fatigue Life Analysis

Under Subsection 4 (1) (d) (i) of the LNGFR designs for the LNG storage tank system must include calculations of tank design fatigue life. The applicant/permit holder should undertake an analysis of tank fatigue life based on expected loading cycles to support and justify tank service life.

A summary report that calculates the tank design fatigue life and the critical data elements included in the calculation should be provided by the permit holder prior to Leave to Operate. In some cases, the submission of the tank design fatigue life summary report could be included in Leave to Construct submissions made under Subsection 3 (1) (b) of the LNGFR.

The permit holder should maintain records of the loading cycles experienced during service to ensure the fatigue life is not exceeded without a validated life extension evaluation supported by internal inspection.

3.4.2 Storage Tank Systems

The Regulator expects that a risk assessment be used to aid the selection of the tank system. It should be noted that a risk assessment is a requirement of API 625 (externally referenced in CSA Z276). The risk assessment should be provided to the Regulator along with the permit application information under Section 2 of the LNGFR or before Leave to Construct.

Under Subsection 4 (2) of the LNGFR the storage tank system must:

- conform with CSA Z276,or;
- provide for the safe storage of LNG at a level of protection from failure that meets or exceeds the level of protection provided using CSA Z276 .

3.4.2.1 CSA Z276 Tank Systems

CSA Z276 identifies four atmospheric LNG storage tank types: single containment; double containment; full containment; and membrane. The standard provides design and siting requirements for each tank type.

3.4.2.2 Other Containment Systems

If the applicant/permit holder proposes an alternative storage concept from those identified in CSA Z276, the applicant/permit holder must demonstrate that the proposed approach provides an equivalent or better protection, for matters such as public safety and the environment.

An example of an alternative storage concept would be a LNG carrier that has been re-purposed as a permanent floating storage and offload unit. Applicants/permit holders will be required to conduct a QRA or equivalent engineering assessment within the wider hazards and risk management process to justify selection of the alternative storage concept.

Floating LNG production facilities with integral storage require particular consideration. These storage configurations are differentiated from separate floating storage such as converted carriers, by the proximity of the process and other hazardous operations to the storage tanks which are usually located above the storage tanks on support frames on the deck. Small scale floating LNG facilities might also employ storage tanks that operate at higher than atmospheric pressure and may not have secondary barriers. See Appendix H for more information.

3.4.3 Thermal Radiation Flux from Flaring

CSA Z276 identifies maximum allowable heat flux levels resulting from process fires, but does not explicitly identify allowable heat flux levels from a flare or ignited vent stack. Under Subsection 4 (3) of the LNGFR the applicant/permit holder must ensure a flare or ignited vent stack is sited so that calculated thermal radiation flux does not exceed the allowable thermal radiation flux as defined by Schedule 1 of the LNGFR unless the facility is designed in accordance with a QRA.

Table 1 in Schedule 1 of the LNGFR (see Appendix I) identifies the maximum allowable thermal radiation heat flux in relation to workers, tanks, process equipment and buildings.

Table 2 in Schedule 1 of the LNGFR identifies the maximum allowable thermal radiation heat flux in relation to members of the public outside the facility boundary. The limits of the facility boundary are considered to be the area owned or leased by the applicant/permit holder (or alternately the area controlled by the applicant/permit holder).

The identified maximum allowable heat flux levels have been set to maintain equipment, tank and infrastructure integrity and ensure public and worker safety. The radiation heat flux from a flare or an ignited vent stack should be calculated using an acceptable, validated model (for example, LNGFIRE III).

Thermal radiation contours should be calculated using the wind speed producing the maximum distances, except for wind speeds that occur less than 5% of the time based on recorded data for the area; and the ambient temperature and relative humidity producing the maximum distances, except for values that occur less than 5% of the time based on recorded data for the area.

3.4.4 Quantitative Risk Assessment (if applicable)

If the applicant/permit holder has chosen a different standard than identified in the LNGFR, under Subsection 4 (4) (b) the applicant/permit holder must conduct a QRA that will demonstrate that the risks associated with the proposed design are ALARP and do not fall within the range of intolerable risks as identified in Schedule 2 of the LNGFR (see Appendix B). Under Subsection 4 (4) (a) of the LNGFR the applicant/permit holder must submit a report to the Regulator respecting the QRA, including the identification of key assumptions, input data, methodologies and consequence analyses made or used in carrying out the QRA. Appendix F contains a terms of reference for a QRA.

If the risks identified in the QRA fall within the range indicated as ALARP in Schedule 2, the applicant/permit holder must include in the report an evaluation of the risk reduction strategies, mitigation measures and recommended actions to demonstrate that the completed facility design and siting are ALARP.

Floating LNG production and storage facilities introduce additional considerations over and above land based facilities. These considerations should be appropriately addressed in a QRA to satisfy the Regulator that the proposed facilities are safe to install and operate. For more information about the design considerations for floating LNG facilities and floating storage and offload units, refer to Appendix H.

3.4.5 Maintenance of Records

Under Subsection 4 (6) of the LNGFR the permit holder must prepare and maintain adequate written records relating to the development of the engineering design and siting of the LNG facility. In addition to meeting the record requirements of CSA Z276, this could include all submissions made to the Regulator and all supporting material, including studies, reports and methodologies and standards that were followed and which demonstrate how conclusions were reached.

Records can be kept in hard copy or in digital form but should be readily available and maintained in a manner that will ensure the record's integrity through the expected life of the project.

3.5 Requirement to Provide the Regulator with Updates

Under Section 5 of the LNGFR the permit holder must provide the Regulator with a report every 6 months that identifies changes to the:

a) construction schedule,
b) engineering design for the LNG facility, and
c) risk assessments undertaken respecting the LNG facility.

Updates must begin 6 months after the date of issuance of the LNG facility permit, and will continue until the permit holder provides notice that it intends to begin operations via a Notice of Operations under Section 11 of the LNGFR, or surrenders the permit pursuant to Section 33 of the Energy Resource Activities Act.

Where no construction schedule, design or risk assessment changes occur during the period, the permit holder must still provide notice to the Regulator that there are no changes.

When preparing this update, the permit holder should consider previous and upcoming submission requirements under the LNGFR, to assist the Regulator with preparing for the reviews required prior to a Leave to Construct or Leave to Operate.

The Regulator will focus on the aspects of design that influence:

- facility safety;
- technical and operational integrity; and
- environmental performance & compliance.

Updates Prior to Leave to Construct

Since the LNG facility permit is typically issued based on pre-FEED stage deliverables and drawings, updates prior to Leave to Construct will show how the engineering design is evolving through FEED. The updates also provide an opportunity for the permit holder to identify design changes which may require a permit amendment.

In addition to tracking design evolution, updates at this stage assist in ensuring the BCER is aware of the timing and scope of reviews associated with the Leave to Construct process.

Following Leave to Construct

Following Leave to Construct, a more detailed submission is required. Engineering design changes during the detailed engineering, construction and commissioning stages will be examined to provide the BCER with an on-going view of compliance and visibility to technical changes following Leave to Construct.. Following Leave to Construct, the focus of the 6 month submissions typically shifts to a mode where changes to key Leave to Construct submissions are highlighted and reviewed as required.

Submission Content & Format

Examples of information that could be included in the permit holder's update are:

- a summary of significant design changes made during the previous 6 month period. A significant design change is a change that would require a HAZOP including changes to an engineered solution that causes a material impact on functionality, technical integrity, technical and operational risk;
- a summary of any new or revised risk assessments, including, HAZID, Process Hazard Analysis and Safety Integrity Level Study;
- a current project schedule, focusing on changes to the permit holder's plan;
- a summary of changes to facility layouts or plot plans;
- a summary of any construction variances and non-compliance and how they will be mitigated; and,
- a summary of any planned and completed pre-operational testing (for example: performance test runs, pre-commissioning and commissioning tests) and results.

The summary information detailed above could be included in, or complimented by, a listing of key documents which indicates if a change or new revision has been issued in the previous 6 months.

Following submission of the update the BCER may request additional details, documents, or clarifications as required.

3.6 Modular Units Built Outside of British Columbia

During the application stage, the applicant is required to provide information to the Regulator on any plans to construct modular units outside of British Columbia. Under Section 6 of the Regulation, the Regulator can require third party verification to ensure that any modular unit constructed outside British Columbia is constructed and tested in accordance with the quality assurance program. This third party would provide documentation outlining the results of their verification that the quality assurance program described in the submissions before construction (per Subsection 3 (1) (f) of the LNGFR) was implemented during

construction and testing. Appendix K outlines the expected scope of work for the quality assurance program verification while Section 2.1.3 provides further guidance on the requirement.

If requested by the Regulator, the verification report(s) must be submitted at least 10 days before the module is integrated into the facility. The Regulator recommends that the permit holder submits the verification report(s) as soon as practicable to minimize potential delays. Typically, verification reports are provided shortly after completion.

3.7 Post-Construction Site Restoration

Under Section 7 of the LNGFR, the permit holder must restore the surface of the land disturbed by the construction of the LNG facility. The Regulator recommends that the LNG facility permit application's construction schedule and work plan includes plans for site restoration. Conditions applicable to site restoration may be specified in provincial or federal environmental assessment approvals or the LNG facility permit.

The permit holder must restore land disturbed by the construction of the LNG facility that is not required for the safe and efficient operation of the facility. This includes:

1. Removing all structures installed to facilitate construction; and,
2. Stabilizing, contouring, conditioning or reconstructing the surface of the land.

The Regulator recommends that the permit holder also re-plant appropriate vegetation for visual screening and control of run-off.

Site restoration must occur while the construction of the LNG facility is underway to the extent practicable and as soon as practicable after beginning operations of the LNG facility.

Chapter 4: Operating Requirements

4.1 Commissioning a Facility

Division 1 of Part 4 of the LNGFR requires that the permit holder make a number of submissions to the Regulator in advance of commencing operations of any portion of the LNG facility. The purpose of these submissions is to satisfy the Regulator that the permit holder has the appropriate policies, procedures and pre-operation testing in place to ensure the safe operation of the facility.

These submissions include:

4.1.1 Safety and Loss Management Program

Under Section 8 (1) of the LNGFR, before beginning operation of a LNG facility the permit holder must prepare a Safety and Loss Management Program (SLMP) The SLMP shall comply with the safety Management System described in CSA Z276. The SLMP must include, but is not limited to, the following components:

- an integrity management program for the LNG facility. The integrity management program should provide a systematic approach for assuring facility integrity throughout the entire facility lifecycle including design, construction, operation and maintenance. Refer to the Center for Chemical Process Safety Guidelines for Mechanical Integrity Systems for further guidance. Compliance Assurance Protocol Integrity Management Program for Facilities provides guidance on the expected components of a Facility Integrity Management Program.
- an emergency response plan. Note that LNG facility permit holders must comply with the Emergency Management Regulation. The Regulator's Emergency Management Manual provides further guidance;
- a fugitive emissions management plan. The fugitive emissions management plan should include monitoring programs, operating procedures and performance objectives for controlling fugitive emissions. This can be accomplished through the implementation and maintenance of fugitive emissions leak detection and repair program. At a minimum, the Regulator expects that the Fugitive Emissions Management Plan (FEMP) for LNG facilities can demonstrate an equivalent level of performance with the prescriptive requirements of the current BC methane regulations (refer to BC Drilling and Production Regulation (DPR) sections 41.1, 52.01 to 52.10, and 52.12) which are applicable to gas processing plants, compressor stations, and batteries.
- a management of change program that details the processes and procedures to identify and manage any change that could adversely affect safety, security or environmental protection. Refer to the Center for Chemical Process Safety Guideline for Management of Change for Process Safety for further guidance.

Permit holders should incorporate into the SLMP the Incident Reporting Instructions and Guidelines, identify requirements for reporting incidents to the Regulator and identify how incidents are reported and investigated internally.

When preparing the SLMP, permit holders may consider implementing CSA Z767, Process Safety Management as referenced in CSA Z276.

In accordance with Subsection 8 (3) of the LNGFR the permit holder must submit, as soon as practicable after being prepared, the emergency response plan. The remainder of the SLMP should not be submitted to the Regulator but must be available upon request in accordance with Subsection 8 (2) of the LNGFR.

4.1.2 Pre-operation Testing

Under Section 9 of the LNGFR, the permit holder must complete all inspections and tests reasonably necessary to ensure the LNG facility is safe to operate before any flammable gas, flammable liquids or LNG is introduced and operations begin in that portion of the facility.

Permit holders must:

a) test the components and systems of the facility in accordance with CSA Z276;

b) inspect and test all control and safety devices and systems to ensure that the devices and systems are operating properly;

c) test the LNG containment system integrity;

d) test the fire-water systems; and,

e) conduct any other inspections or tests reasonably necessary to ensure the facility is safe to operate.

Tests should be carried out following appropriate methodology as defined by relevant codes and standards or best practices and verify that systems operate in accordance with their performance specifications.

The Regulator must be notified at least 7 days in advance of any testing referred to in Subsection 9 (1) (b) through (e) of the LNGFR. The Regulator understands that many pre-operational tests will be undertaken and recommends that the construction schedule supplied under Section 5 of the LNGFR be supplemented by an inspection test plan that highlights the testing referred to in Subsection 9 (1) (b) through (e). Notification at this time will allow the Regulator to identify tests that it may wish to attend.

Regular communication between the permit holder and the Regulator will ensure that the timing of the selected tests is well understood as the construction schedule evolves.

Under Section 9 (3) of the LNGFR the permit holder must provide the Regulator with the test results for LNG containment system integrity and fire water systems as soon as practicable after carrying out the tests. In order to satisfy this requirement, the permit holder should submit a report with enough detail to illustrate how the tests have met the requirements of the standards identified in the LNGFR, for the Regulator's review.

Relevant information on other tests should be maintained by the permit holder and be made available to the Regulator on request.

Pneumatic testing

If the owner determines that a hydrostatic leak test is impractical, a pneumatic test or a combined hydrostatic-pneumatic test may be used, provided it fully complies with CSA Z276 and ASME B31.3. Permit holders must have a pneumatic test procedure for each test. For pneumatic tests where the stored energy is less than 1677 kJ, a standardized procedure may be used. For pneumatic tests where the stored energy is equal to or greater than 1677 kJ, an application specific procedure is to be developed and approved by a professional engineer.

Before conducting any application-specific pneumatic testing, a sample document containing the following information should be submitted to BCER for review:

- Rationale & Owner Approval: Justification for conducting the specific pneumatic test and confirmation of the owner's approval.
- Test Design & Procedure: A proposed pressure test design and pneumatic test procedure stamped by a BC Professional Engineer (P.Eng.).
- Overpressure Protection Assurance: A statement from a P.Eng. confirming that a pressure relief valve (PRV) is capable of protecting the system and equipment from overpressure during the pneumatic test.

While pressure test logs and other construction/testing records are not required for submission, the permit holder must retain them for future audits.

4.1.3 Signs

In accordance with Section 10 of the LNGFR the permit holder must display signage at the facility. The purpose of this requirement is to provide basic facility information to the general public and first responders that may be of general interest, or useful in the event of a complaint or emergency. Signs must include the following:

- the name of the LNG permit holder;
- emergency notification information, including a telephone number;
- the legal description of the site;
- if the facility handles flammable gas, a flammable gas symbol from Schedule 3 of the LNGFR;
- if the facility handles gas containing 10 parts per million or greater of hydrogen sulphide, a poisonous gas symbol from Schedule 3 of the LNGFR.

The warning signs described above are included in Schedule 3 of the LNGFR and can be found in Appendix J. A LNG facility permit holder must not post warning symbols where no hazard exists.

4.1.4 Notice of Operation

Under Section 11 of the LNGFR before commissioning and operation of any portion of the LNG facility can begin the permit holder must submit, in writing, to the BCER, notice of their intent to begin commissioning a portion of the LNG facility prior to operations. This letter should be sent via email to Pipelines.Facilities@bc-er.ca. In addition to the written notice, a notice of intent to operate must be submitted via KERMIT. Should multiple notices be anticipated, only the first notice requires submission via KERMIT. The inherent risk of the facility shifts when hydrocarbons are introduced into the facility during commissioning. Before a Leave to Operate can be issued to allow hydrocarbon introduction, the BCER must be satisfied that the permit holder has complied with Section 8 through Section 10 of the LNGFR. To obtain the Leave to operate, the permit holders are encouraged to submit a Leave to operate plan to the BCER to provide a comprehensive outline of the project's plans during commissioning and initial operations.

The notice of the permit holder's intent to begin operations must be submitted at least 14 days before commissioning begins on any portion of the LNG facility and, at a minimum, should include:

- the permit number and any administrative identifier that relates to the facility;
- the lead contact information for the LNG permit holder;
- a description of the portion of the LNG facility being commissioned and/or operated; and,
- the dates that commissioning with hydrocarbons will begin and when facility operations will commence.

Permit holders are encouraged to make submissions related to Sections 8, 9, and 10 of LNGFR (in addition to any applicable permit conditions) as information becomes available, in advance of the 14 day notice period. This will assist the BCER in issuing timely decisions on notices of operation.

On receiving the notice from the permit holder, the BCER may decide to extend or reduce the notice period. This decision would be based on the quality, and content of the permit holder's submission. Should the submission not be to the BCER's satisfaction, the BCER will extend the 14 day period to give the permit holder the opportunity to seek further input from the BCER, and resubmit information as required.

4.1.5 Record Drawings

Under Section 12 of the LNGFR permit holders must submit record drawings to the Regulator. Record drawings (including process flow diagrams, metering schematics and plot diagrams, signed and sealed by a qualified professional) must be submitted:

- 9 months after the permit holder submits its notice of intent to begin operations; or,
- if the Regulator extended the review period for the results of the pre-operational testing, 9 months after the expiry of the review period.

Permit holders should refer to Information Bulletin 2010-14 for information regarding the Regulator's expectations for the submission of record drawings. Permit holders should also review the content of the Quality Management Guidelines provided by Engineers and Geoscientists BC.

Where proprietary or confidential information is contained, drawings should be marked as such and the permit holder should meet with the Regulator to discuss handling of the confidential information.

4.2 Operations Standards

Part 4, Division 2 of the LNGFR outlines the operational standards and practices that permit holders must adhere to in the operation of the facility.

4.2.1 General Requirements

Under Section 13 of the LNGFR, permit holders must operate the facility in accordance with CSA Z276, the permit holder's SLMP submitted under Section 8 and any conditions specified in the LNG facility permit or any conditions specified in an exemption approved under Section 25 of the LNGFR.

4.2.2 Emergency Response

In accordance with Section 14 of the LNGFR the permit holder must respond to all incidents and emergencies in accordance with the facility emergency response plan submitted under Section 8 of the LNGFR and updated as per Section 22 of the LNGFR.

LNG facility permit holders must also comply with the Emergency Management Regulation. The Regulator's Emergency Management Manual provides further guidance regarding emergency response requirements.

4.2.3 Noise and Light Control

Under Section 15 of the LNGFR the permit holder must ensure that construction and normal operations of the LNG facility do not cause excessive noise or emanation of light on human and wildlife receptors. Under

Subsections 4 (1) (c) and (e) of the LNGFR, the effect of noise and light from the LNG facility is to be considered throughout the engineering design.

Noise is both a safety issue for workers on site, and a nuisance issue in the surrounding area. Permit holders should ensure that mitigation measures are built into the design and operating procedures using the Noise Control Best Practices Guideline. In some cases a noise management plan may be used rather than the prescriptive requirement in the guideline. Operations must also adhere to any conditions of the provincial or federal environmental assessment approval and the LNG facility permit.

The following considerations are associated with light emissions:

- light trespass – the light spilling beyond the boundary of the property on which a light is located, sometimes shining through windows and curtains and affecting sleep;
- glare – the uncomfortable brightness of a light source when viewed against a darker background. Glare may affect safety by affecting the vision of people operating motor vehicles or vessels; and,
- sky glow – the pink or orange glow we see for miles around towns and cities caused by a scattering of artificial light by airborne dust and water droplets.

For light control, the Regulator will be looking for information to indicate that the permit holder has done all that is reasonable to minimize light emissions to surrounding areas, without compromising the safety of workers or the facility's safe operation. The permit holder should be managing lighting in both the core of the facility and other areas (such as roadways, docks, etc.). Permit holders should ensure that mitigation measures are built into the design. CIE 150:2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations could be used by permit holders for guidance on meeting the requirement for no excessive emanation of light.

Mitigation measures that might be considered include:

- not using unnecessary lighting;
- avoiding using unnecessarily bright lights;
- use of automated sensors that shut down lighting in areas of no activity where it is safe to do so; and,
- re-angling, shading or screening of lighting.

4.2.4 Measurement

All facilities in British Columbia must be capable of measuring feed streams, marketable product streams and waste streams, reliably and with accuracy. Measurement requirements may include quantity and composition. Under Section 16 of the LNGFR the permit holder must ensure that:

- measurement equipment and associated methodology for the LNG facility is sufficient to determine the actual flow of each feed stream, waste discharge and marketable product stream at the facility; and,
- all meters installed to meet the above requirement are maintained in good operating condition and are safeguarded from weather and interference by unauthorized persons.

Waste stream measurement monitors process streams and supports compliance to conservation of the resource. Feed, product and by-product measurements are required in determining taxes and resource monitoring.

For the purposes of this section, waste refers to production wastes and does not include other site waste streams.

The Measurement Guideline for Upstream Oil and Gas Operations provides guidance that can assist the permit holder with meeting the criteria of this section of the LNGFR, particularly in determining accurate flow and in protection and maintenance of the measuring devices. For reporting and notification purposes, the volume of a substance in "m3" means one cubic metre of the substance measured at 101.325 kPa and 15°C.

Examples of streams that would typically require measurement include:

- facility inlet;
- flared/incinerated material;
- vented material;
- fuel gas used;
- produced LNG and other by-products; and
- liquid waste.

4.2.5 Venting

Venting, Flaring and Relief system design basis is reviewed in the permit application stage of the project, in accordance with Section 2 (f) of the LNGFR. Under Subsection 17 (1) of the LNGFR a permit holder must not vent gas from the LNG facility unless the gas heating value, volume or flow rate is insufficient to support stable combustion and each of the following applies:

- the venting is conducted in a manner that does not constitute a safety hazard;
- the venting does not cause off-site odours;
- the quantity of vented gas is minimized; and,
- the duration of venting is minimized.

The permit holder may use gas containing hydrogen sulphide for pneumatic instrumentation or to provide motive force to pumps if the gas contains no more than 20 parts per million of hydrogen sulphide. Any potential for worker exposure to hydrogen sulphide levels in excess of 10 parts per million is subject to Section 5.48 of the Occupational Health and Safety Regulation.

Best practices, standards and guidelines for flaring and venting are available in the Flaring and Venting Reduction Guideline. Permit holders should consider public and environmental concerns, economic alternatives and health impacts when evaluating the opportunity to eliminate or minimize venting at a facility. Permit holders should place particular emphasis on eliminating or minimizing venting during normal operation, planned shut–downs, maintenance and start-up.

If a permit holder has chosen venting over flaring or conservation they must demonstrate how they have met the requirements under Subsection 17 (1) of the LNGFR.

4.2.6 Flaring and Incinerating Limits

Under Section 18 of the LNGFR the permit holder must minimize the duration of flaring and the quantity of gas that is flared from the LNG facility. Gas cannot be flared from or incinerated by the facility unless flaring is:

- required in an emergency;
- required for maintenance, including commissioning and start-up; or,
- permitted under the LNG facility permit.

The Regulator considers the term flaring to refer to the combustion of gas in a flare stack or an incinerator unless otherwise specified. Continuous activities, such as combustion for a flare pilot light or incinerator, are required to be permitted under the LNG facility permit.

Best practices, standards and guidelines for flaring and venting are available in the Flaring and Venting Reduction Guideline. Permit holders should consider public and environmental concerns, economic alternatives and health impacts when evaluating the opportunity to eliminate or minimize flaring at a facility.

Particular emphasis should be focused on eliminating or minimizing flaring during normal operation, planned shut-downs, maintenance and start-up.

4.2.7 Flaring Notification and Reporting

Under Section 19 of the LNGFR the permit holder must provide 24 hour notice to the Regulator of a planned flaring event if the quantity of gas flared is expected to exceed 10,000m3 (where “m3” means one cubic metre of the substance measured at 101.325 kPa and 15°C). In addition, the permit holder must provide notice to the Regulator within 24 hours if an unplanned event results in flared gas in excess of 10,000m3. Permit holders are recommended to use the Notice of Temporary Flaring/Incinerating for Facilities available on the Regulator’s website.

Continuous activities, such as combustion for flare pilot lights or incinerators are excluded from the notification requirement.

Permit holders must maintain a log of all flaring, including incinerating, that occurs at the LNG facility. The flaring log should track flaring volumes and identify recurring (non-routine) flaring events. Recurring events should be investigated and repaired. The flaring log must be made available to the Regulator upon request.

4.2.8 Notice of Cessation and Resumption of Operations

Section 20 of the LNGFR applies to temporary cessation of operations (for emergency or maintenance purposes) and to long term or permanent cessation of operations.

Permit holders must provide notice to the Regulator of their intent to cease operations of one or more liquefaction trains 60 days before the beginning of the cessation process.

Where an unplanned shutdown occurs, the Regulator must be notified as soon as practicable, which generally means within 24 hours. This reporting is in addition to any other reporting requirements (e.g. Emergency Management BC reporting, spill reporting, WorkSafe BC reporting, etc.).

The Regulator must be notified prior to resuming liquefaction after a shutdown. The intent of this notification is to ensure that any significant changes that occurred during the shutdown are managed appropriately. For example, if during the shutdown, ownership changed and key personnel were replaced, the Regulator would want to ensure that adequate training and procedures were in place in expectation of a safe start-up. In the event of an unplanned cessation of operations of less than 24 hours, it is acceptable to notify the Regulator of resuming liquefaction as soon as practicable.

This section is not intended to address the normal starting and stopping that is part of the initial commissioning of a facility unless an emergency situation arises. This section is also not intended for facilities which are designed to regularly pause and resume liquefaction as part of normal operations.

4.2.9 Site Restoration after Operations Cease

Under Section 21 of the LNGFR the permit holder must complete site restoration on the permitted LNG facility site, whether on private or Crown land, as soon as practicable after the permanent cessation of operations at the facility.

If the site is on private (fee simple) land, provincial Crown land or on provincially administered land the permit holder must comply with Section 19 of the Environmental Protection and Management Regulation. When the site is on federal Crown land or on federally administered land the permit holder will be governed by federal requirements.

Under Section 19 of the Environmental Protection and Management Regulation, site restoration includes:

- de-compacting of soils;
- restoring drainage patterns;
- re-vegetating any exposed soils in a manner that promotes the restoration of the wildlife habitat that existed on the area before the oil and gas activity was begun:
- stabilizing the soil;
- removing any stream crossing structures;
- stabilizing any cut slopes or fill sites; and
- re-contouring bladed areas or excavations in pipeline corridors and seismic lines.

In accordance with Section 21 of the LNGFR the permit holder must remove all facility structures and test for contamination to determine the nature and extent of any contamination around the facility site. Testing should be conducted in accordance with the Contaminated Sites Regulation and should specifically test for soil, sediment and groundwater contamination.

The permit holder must submit the results of testing to the Regulator and prepare an action plan to mitigate any contamination. The Regulator will advise the permit holder in writing if the action plan is acceptable.

Once the action plan is accepted by the Regulator, the permit holder must implement the action plan within the timelines identified, to the satisfaction of the Regulator.

Chapter 5: Additional Considerations

5.1 Implementation of Safety and Loss Management Programs

Under Section 22 of the LNGFR the permit holder must implement a Safety Loss Management Program (SLMP). The Regulator will monitor the permit holder's compliance with this section.

A SLMP is a key element of managing LNG facility safety. The permit holder must review and update its SLMP at least once every 3 years. If no changes are found to be necessary as a result of the review, the programs may be kept unchanged. However, the program must be updated with a new date stamp that will restart the 3 year review period. The review must be documented whether changes are necessary or not. The Regulator recommends that the permit holder resubmit the emergency response plan after the review.

5.2 Records

Under Section 23 of the LNGFR the permit holder must maintain records of any spillage and any damage or malfunction that is likely to cause spillage that could be a risk to public safety or the environment.

All reports and records must be maintained for as long as the facility is functioning and be available to the Regulator upon request. This section does not affect or replace the Regulator's requirements for spill reporting.

5.3 Record Retention

A permit holder must comply with the record retention requirements set out in CSA Z276.

5.4 Exemptions

Section 25 of the LNGFR allows the Regulator to exempt a permit holder from one or more provisions of the regulation in cases where:

- the permit holder proposes approaches that are equivalent or better to what is in the LNGFR; or,
- if compliance with the provision is not reasonably practicable or if it is in the public interest.

Any exemption will require justification and verification and must be approved by the Regulator. It is expected that this power will only be used sparingly and in a justifiable manner.

The exemption request can accompany an application or submission required under the LNGFR, or can be made anytime as long as the request is provided in a manner that will provide the Regulator sufficient time to render a decision. The activity cannot proceed until the permit holder has received a written response from the Regulator.

Any request should include an explanation of why the LNGFR cannot be followed and an alternative approach is warranted. A Regulator official will review this request and, in the event the exemption is granted, the provision in the LNGFR may be replaced with conditions.

Appendix A: Glossary of Terms and Abbreviations

The terms and abbreviations below are for particular words or phrases as used in this manual. Other words in this manual have the meaning given in the Energy Resource Activities Act and the Liquefied Natural Gas Facility Regulation.

"Applicant" is a person or organization that is submitting an application for a LNG facility permit.

"As low as reasonably practicable" or **"ALARP"** is the level of risk that represents the point, objectively assessed, at which the time the difficulty and cost of further reduction measures become grossly disproportionate to the additional risk reduction obtained.

"LNG Facility Construction" begins with the installation of foundations and other civil works and includes scopes integral to the LNG facility including the construction of buildings and structures, assembly and integration of modular units. Construction, as used in this manual, does not include site preparation activities that precede the actual erection of the tanks, vessels, equipment and its associated foundations.

"Commissioning" is a stage following Mechanical Completion, where individual equipment and systems are being put into trial operations. Some commissioning activities, in particular those which require introduction of hydrocarbons into the facility may require a Leave to Operate by the Regulator.

"Detailed Engineering" is the final engineering stages before the plant is built.

"Front End Engineering Design" or **"FEED"** is basic engineering that comes after the conceptual design or feasibility study.

"Hazard Planning Zone" is the geographical area within which persons, property or the environment may be affected by a hazard arising from the LNG facility.

"Leave to Construct" is notification by the Regulator to a permit holder in writing indicating that the permit holder may begin construction of a phase of the overall construction pursuant to the submissions before construction, LNG facility permit, and any other requirements.

"Leave to Operate" is notification by the Regulator to a permit holder in writing indicating that the permit holder may begin commissioning in preparation for operations pursuant to the LNG facility permit and any other requirements.

"Permit Holder" is a person or organization that has received a permit to construct and operate a LNG facility as designated in the LNGFR and is constructing, operating or decommissioning a LNG facility.

"Phase," or **"phase of construction**" is a block or segment of construction activities for which a permit holder can seek approval to construct so that construction can proceed in a sequence that is practical for the permit holder.

"Preliminary information" is pre-FEED information submitted upon making an application for a LNG facility permit that provides sufficient detail for the Regulator to understand what is being proposed. The requirement for "preliminary information" anticipates

that “additional information” will be provided to the Regulator after the permit has been approved and prior to the commencement of construction.

“Qualified Professional” is a person who is licensed or registered as either a professional engineer or a professional geoscientist under the Professional Governance Act.

“Safety critical” refers to systems whose failure could result in loss of life, significant property damage, or damage to the environment.

“Satisfaction of the Regulator” means that the Regulator will evaluate a permit holder’s submission to ensure the submission provides information in sufficient detail and on the correct points, such that the LNGFR requirements are met.

“Siting” refers to both the location of the LNG facility and the layout of all of its equipment.

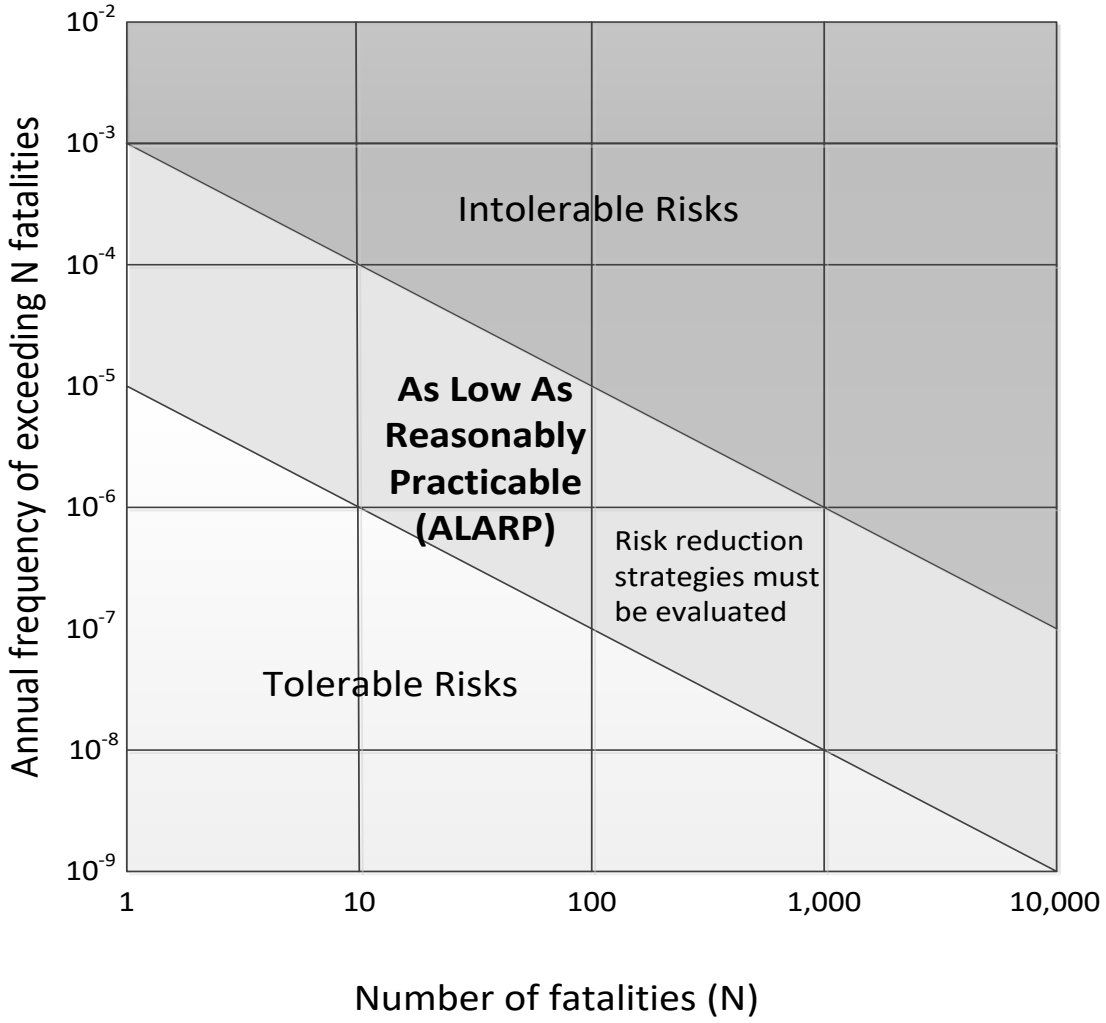
“Validation” is the process of confirming that all of the appropriate standards, practices and procedures are selected and used in design and construction.

“Verification” Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. The term “verified” is used to designate the corresponding status (ISO 9000:2005).

Appendix B: Schedule 2 of the LNGFR

Schedule 2 of the LNGFR is reference by Subsection 4 (4) and provides the risk criteria for the frequency versus number of fatality (FN) curves.

Figure: Fatality Risks Outside a Facility



Appendix C: ALARP Principles

Key premises in the application of the as low as reasonably practicable (ALARP) principle are as follows:

- ALARP argument must consider all relevant risks to safety and the environment;
- a risk must be well understood and assessed in detail before making an ALARP decision;
- regulations, permit conditions, corporate requirements (including risk tolerance criteria), international standards and recommended practices together provide a low level of risk. The ALARP principle is to be applied only after all requirements have been implemented;
- for well understood risks in standard situations, the application of applicable codes and standards together with good practice will normally be sufficient to demonstrate ALARP as it is assumed that an ALARP judgment was made in establishing the good practice. While compliance with regulations and industry standards is a pre-requisite to demonstrate ALARP; compliance alone may be insufficient to manage the risks to ALARP;
- the intention of "grossly disproportionate" is that the sacrifice must significantly outweigh the risk reduction. Parity is not enough to reject a risk reduction measure; also the ratio of sacrifice to risk reduction achieved, "disproportion factor", will be greater when the risk is high and could be lower for lower risk levels. For example, high risks associated with a hazard or hazardous activity typically require more cost and effort to demonstrate ALARP than lower risks. This is also to take into account uncertainties in risk analysis. The more uncertainty about the consequences and/or likelihood, the more conservative must be the assessment of risk or, correspondingly, the higher the burden of proof of gross disproportion.
- ALARP changes over time. Changes in societal values, expectations, technology, codes and standards and cost reductions in risk reduction techniques will mean ALARP continually changes;
- "reverse" ALARP evaluation is not acceptable. For example, that the standard is lowered compared to "good practice" giving a lower cost. Then arguing that it would not be "reasonably practicable" to increase the standard to good practice.
- an ALARP Register must be maintained to track the process and it must be proven and documented clearly when a risk reduction measure is rejected;
- it is important to remember that the operator of the facility is the owner of the ALARP process, its result and the decisions related to whether a reduction measure shall be included or not;
- tolerable risk is not acceptable risk, but instead it is risk that society is willing to live with as to secure certain benefits in the confidence that the risk is one that is worth taking and that the risk is being properly controlled and,
- ALARP does not represent zero risk.

Appendix D: Out of Province Design of LNG Facilities

The Regulator employs a professional reliance model in its regulation of oil and gas activities. All submissions made to the Commission in support of an application or a regulatory requirement that include work relating to the practice of professional engineering or professional geoscience are expected to accord with the Professional Governance Act, [SBC 2018], c. 47 and the Bylaws of Engineers and Geoscientists British Columbia (EGBC). This includes any requirements relating to authentication of documents.

In addition, Section 12 of the LNGFR requires the submission of record drawings signed and sealed by a qualified professional defined as a person who is licensed or registered as either a professional engineer or a professional geoscientist under the BC Professional Governance Act.

Proponents must ensure that a qualified professional takes responsibility for the engineering design of an LNG facility.

Typically, the following would be sufficient:

1. The applicant/permit holder must include the following in either the permit application or submissions before construction:
    a. a strategy that outlines how the qualified professional will confirm that the out of province design will meet the requirements of the LNGFR; and,
    b. a document signed and sealed by the qualified professional that outlines the performance specification/design basis for out of province designs.
2. When construction and testing is completed and upon receipt into British Columbia, confirm, through a signed and sealed report by the qualified professional, that the out of province design meets the requirements of the LNGFR and the LNG facility permit.

The Regulator recommends that the qualified professional reviews all elements of the LNG facility permit and LNGFR with particular focus on the aspects of the out of province design that affect safety, technical and operational integrity, environmental compliance and technical/construction assurance in order to prepare the report confirming that the modules meets the requirements of the LNGFR.

These requirements are consistent with the Engineers and Geoscientist BC Guide to the Standard for the Authentication of Documents.

Appendix E: Project Description Requirements

Under Section 2 (a) of the LNGFR the applicant must provide a detailed project description as part of the application for a LNG facility permit.

The project descriptions should include:

1) the project's name, nature and proposed location;
2) the applicant's name and contact information and the name and contact information of their primary representative;
3) a description of the project's context and objectives;
4) a description of the feed gas source, and connected pipelines (e.g. a simplified gathering schematic);
5) a description of the physical works that are related to the project including their purpose, size and capacity;
    a) pipeline and pipeline interface;
    b) feed gas flow rate and composition, including maximum H_2S content;
    c) acid gas removal process;
    d) dehydration, fractionation and liquefaction process;
    e) liquefaction train capacity;
    f) LNG storage type and size;
    g) LNG loading facilities and approaches (e.g. marine loading, rail loading, truck loading, mobile container loading)
    h) berths and associated marine facilities;
    i) anticipated loading rates;
    j) Hazardous material storage type and size, including refrigerant;
    k) expansion plans; and,
    l) site selection considerations.

Appendix F: Terms of Reference for Quantitative Risk Assessment

The LNGFR allows applicants and permit holders to use either a risk-based approach or a prescriptive approach for designing and siting a LNG facility. CSA Z276 Clause 14.3 provides requirements for the conduct of a Quantitative Risk Assessment (QRA).

QRA Throughout the Engineering Design Lifecycle

QRA can be used as a tool to support decision making, assess risks and risk reduction options, and allow for the demonstration of ALARP.

The main objectives of QRA are to:

- determine risk to the public, and workers from major hazards;
- identify main risk contributors;
- assist in decision making and comparison of design options;
- define incident scenarios (for use as the design basis for emergency systems, or for emergency planning);
- assist in the identification and assessment of potential risk reduction measures;
- assist in establishing incident related design loads, where required;
- assist in the demonstration and achievement of risk reduction to ALARP;
- assist in demonstrating appropriate risk reduction against company, provincial and federal legislation, standards and guidance.

In early pre-FEED, a QRA model can be developed to evaluate risks to the public. This model should be refined during subsequent stages and ultimately provide input to a living risk monitoring tool, for example, using bow-tie for the operating facility.

The preliminary QRA model, developed during pre-FEED and submitted during the permit application, is intended to assist with siting and is focused on risks to the public. The primary purpose of this study is to assist with option selection so that the resulting design's risks are ALARP, and do not fall in the intolerable risk range identified in the LNGFR and CSA Z276. The results of the preliminary QRA should be expressed as Location Specific Individual Risk (LSIR).

The next stage of risk model refinement is the coarse QRA, developed during the FEED stage and submitted before construction. The coarse QRA should be used to develop the layout and workforce levels and distribution to minimize risk of the facility to workers and the public. The resulting risk data will be used to demonstrate that the facility design's risks are ALARP and do not fall in the intolerable risk range identified in the LNGFR and CSA Z276. For risks to the public the results of the coarse QRA should be expressed as LSIR and as frequency versus number of fatality (FN) curves. For risks to workers the results of the course QRA should be expressed as Total Individual Risk Per Annum (IRPA).

During the detailed engineering design stage, the model is further refined to a detailed QRA. This detailed QRA should be submitted to the Regulator during a regular update meeting prior to Leave to Operate. This study will use the design issued for construction as input data and will demonstrate ALARP and confirm that the facility's safety risk is not intolerable. This QRA

model should also be used as the initial risk model for the safety case and can subsequently be used to evaluate the risks through the life of the facility.

Preliminary QRA Requirements

The permit application must demonstrate that the applicant has carried out sufficient due diligence to indicate the contemplated LNG facility will comply with the design and siting requirements of the LNGFR.

It is recognized that at the early development stage of a project (prior to and up to pre-FEED) the information necessary for comprehensive studies may not be available. Notwithstanding these limitations, it is the applicants responsibility to ensure any QRA work undertaken during the project development and execution phases will culminate in the LNG facility complying with the design and siting requirements of the standard and LNGFR, as applicable.

In the case of multiple adjoining developments, where residual risk outside the property boundary exists, the risk-based approach should be considered to ensure that any credible concurrent events (e.g. loss of power) are evaluated.

Risk Criteria

The permit holder shall use the risk criteria in the LNGFR and in Clauses 14.3.4.3-14.3.4.5 of CSA Z276.

Criteria for Tolerability of Individual Risk

The criteria for individual risk contours as measured in fatalities are defined in CSA Z276 as follows:

Total LSIR for Public

Intolerable risks: ≥ 10-4 per annum (pa)

Tolerable risks if ALARP between: 10-4pa > IR > 10-6pa

Broadly acceptable risks ≤ 10-6pa

Total IRPA for Workers

Intolerable risks: ≥ 10-3 per annum (pa)

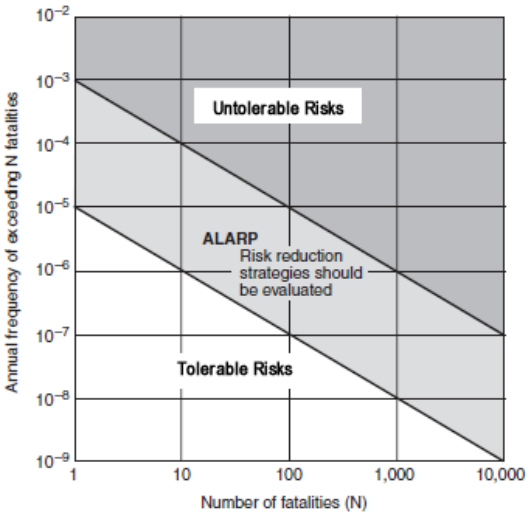
Tolerable risks if ALARP between: 10-3pa > IR > 10-6pa

Broadly acceptable risks ≤ 10-6pa

Criteria for Tolerability of Societal Risks Outside the LNG Facility

The tolerability of societal (fatalities) risks outside the LNG plant is defined by Schedule 2 of the LNGFR (see Appendix B) and is shown in Figure 1.

Figure 1: Acceptability Regions of Societal Risks – Outside the Plant (CSA Z276-18)



Execution of QRA

Scope

The scope of the QRA will cover the plant facilities within its battery limits including the water lease. For equipment installed within the water lease, the plant battery limit is at the outboard flange of the loading and/or unloading arms. Where the feed gas pipeline has a marine approach to the LNG plant, risks inside the water lease will be considered.

Internal initiating events will be considered. As failure frequencies are not available for most external events (e.g. seismic events, dropped anchor on pipe in a marine environment, risk from airplanes), it is expected that external events will be considered in the engineering design for the LNG facility and will be evaluated outside of the QRA using another risk assessment tool.

The QRA will cover both the initial development stage and any future expansion of the facilities, if applicable. The impact of simultaneous operation and expansion will be considered.

QRA Input Data and Modeling

Input data selection for the QRA study should be sourced from independent industry databases and the data set should align with the chosen rule set, assumptions, methodology and defined criteria for tolerability.

QRA Report

The QRA terms of reference established by the applicant/permit holder will include the following.

- introduction;
- objective;
- scope including philosophical approach – analytical or reference liquefaction train;
- methodology (failure case definition, frequency analysis, consequence analysis, risk summation);

- data used for the study (weather categories, wind direction, atmospheric parameters, ignition sources, congestion volumes, vulnerability/impact criteria for fire and explosion, risk criteria, failure case definition, component failure frequencies, dispersion modeling);
- ignition and explosion probabilities (Immediate ignition, delayed ignition);
- sensitivity analysis;
- deliverables (details of model development, cases evaluated, design case results with/without future expansion and sensitivity analysis, potential consequences, and if required, recommended mitigating measures);
- list of assumptions; and,
- references.

Supporting Information

The following supporting information may be required.

- deliverables specified in the terms of reference of QRA;
- all data used in the study including any component failure frequency data correlation;
- available relevant project documents mutually agreed between the Regulator and applicant/permit holder including modularization study;
- main findings and risk drivers;
- demonstration of the evaluation of overpressure scenarios, flash fires, jet fires, pool fires, vapour cloud explosion overpressure and toxic vapour clouds for all potential sources within the scope of the QRA;
- LSIR risk contours for total risk to human life*;
- LSIR contours for flash fire risk, fire radiation risk, explosion overpressure risk and toxic gas risk, as applicable*; and,
- when sufficient project data becomes available, the societal risk FN curve.

(*) The contours will be overlaid on a clear local area map showing the applicant/permit holder's onshore and water lease battery limits.

Appendix G: Seismic, Geotechnical and Tsunami Site Studies

Section 2 (i) of the LNGFR requires that applicants provide the Regulator with the results of hazard identification studies, including studies of both process hazards and natural hazards as part of the LNG Facility Permit Application. Generally, the Regulator would expect the studies conform to the following guidance.

Seismic Study

The seismic study should identify the qualifications of the principal investigator (PI). The PI should be a qualified professional (experienced in the area of seismology, geophysics or closely related field), an expert in conducting investigations in the topic area and be acceptable to the Regulator.

The seismic study should:

1. Reference the applicable National Building Code of Canada seismic hazard calculator used to determine spectra, given the latitude and longitude of the site. This calculation should be the starting point for a pre-FEED seismic assessment. The site-classification for the facility should be established, and the spectra modified per the coefficients provided in the National Building Code of Canada, Section 4.1.8.4.
2. Include available geotechnical data for the site, or the estimate of the site class (A-F) utilized to determine the spectral amplification factors. Estimates of the soil properties to -30m below the mudline should be obtained and used for this assessment.
3. Establish two levels of earthquake ground motion. The return period for the Safe Shutdown Earthquake should be justified (CSA Z276 provides a return period of 2475 years for field-erected tanks; and the return period for other areas of the facility are based on a risk assessment).
4. Address fault rupture hazard at the site.
5. Include a final summary report with an estimate of soil classification and spectra.

All reports, documentation and drawings should be signed by the PI.

Geotechnical Study

The geotechnical study should identify the qualifications of the principal investigator (PI). The PI should be a qualified professional (geotechnical, civil or related), an expert in conducting investigations in the topic area and be acceptable to the Regulator.

The geotechnical study should:

1. Include available geotechnical data for the site or adjacent facilities.

2. Provide a review of available technical reports and papers identifying potential geotechnical issues including static settlement, slope stability, liquefaction potential and potential for degradation of soils under design earthquakes, seismically induced settlement, and lateral spreading under seismic loading.
3. Recommend appropriate foundation types for the proposed structures.
4. Include necessary documents and drawings to support conclusions and recommendations.
5. Include a final summary report with an estimate of liquefaction potential and any other soil information that will be relied upon for FEED analysis or design.

All reports, documentation and drawings should be signed by the PI.

Tsunami Study (if applicable)

For coastal or floating LNG facilities, the applicant should complete a study outlining the tsunami potential. The tsunami study should identify the qualifications of the principal investigator (PI). The PI should be a qualified professional, an expert in conducting investigations in the topic area and be acceptable to the Regulator.

The tsunami study should:

1. Reference CSA Z276 or another suitable code for the selection of the tsunami return period and performance standard.
2. Explain how the structures and components will address the demands from a performance level tsunami load.
3. Identify how the tsunami potential zones have been incorporated into the pre-FEED evaluation and how existing research about the tsunami threat have been included in the assessment (refer also to the Natural Resources Canada tsunami website).
4. Reference and provide a summary of available literature covering historical and potential tsunami sources and local impacts in the area. The lack of any available literature or historical evidence of local submarine landslides or landslide tsunamis may not be an indicator of the future likelihood of occurrence.
5. Investigate tsunami catalogs as a primary source, resulting from either distant or local earthquakes. For known faults, without any historical record of tsunamigenic ruptures, information about these faults may be used to estimate a future tsunami hazard.
6. Examine local topography and offshore bathymetry for evidence and future potential of subaerial and submarine landslides and be used with any available literature on landslide tsunamis. In the event there is a credible source, a numerical simulation of the resulting tsunami wave and current should be developed. For landslide generated tsunamis, it may not possible to estimate return periods with accuracy, and a pragmatic approach based on empirical results published for similar or nearby coastal regimes in British Columbia and southeast Alaska, may be adopted to identify the most credible scenario or range of scenarios as the basis of evaluating facility performance. The performance standard for this event should be equivalent to the one identified above.
7. Develop the potential tsunamigenic rupture wave height at source, numerically simulate the resulting tsunami wave at the facility location, estimate run-up height and expected maximum current for the event return period identified above.
8. The possibility of simultaneous occurrence of tsunami waves to other events impacting water levels should be considered such as tides, storm surge, seiches, sea level rise and major El Niño events. Consideration should be given to the likelihood that the tsunami event may occur over one or more tide cycles.
9. Include a final summary report with maps, historical information, references, and estimates of run-up and maximum current velocities.

All reports, documentation and drawings should be signed by the PI.

Appendix H: Floating LNG Facilities

Additional or special considerations related to floating LNG facilities are described below. Since floating LNG facilities fall outside the scope of CSA Z276, an applicant/permit holder must undertake a QRA study to demonstrate acceptable risk performance of the overall floating LNG installation. Please note, that further information on additional considerations relating to floating LNG facilities is available from some classification societies.

The Regulator may require permit holders to maintain marine vessel classification by a suitable classification society when permitting floating LNG facilities and storage arrangements.

Congestion and Layout Challenges

The limited plot plan or footprint of a floating LNG facility can lead to denser packing of equipment, congestion, and layout challenges for the entire topsides. Factors of particular focus include:

- arrangement allowing natural ventilation;
- the configuration and density of equipment;
- adequate separation between hazardous processes and between these and designated safe areas;
- layout configuration including possible barriers, in such a manner as to avoid explosion overpressures and event escalation (e.g. locations where refrigerant hydrocarbons such as propane are employed); and,
- process control, event detection and fire protection (passive and active) appropriate to the topsides process hazards and configuration.

Storage and Containment Tanks

Floating LNG systems can take several forms ranging from barges supporting small scale LNG production systems through converted carriers for captive storage (e.g. alongside a small scale production barge that may be floating or grounded) to large scale fully integrated floating LNG production and storage facilities. Under Section 4 (2) (c) of the LNGFR, the safety of the storage of LNG facility must meet or exceed the level of protection from failure that is provided by CSA Z276.

The storage and containment tanks for floating LNG facilities include the following:

- Moss (or spherical IMO type B) tanks. These tanks are spherical, self-supporting storage systems. All piping into the tank comes in via the top;
- Membrane containment tanks. These tanks are integral to the hull construction and provide primary and secondary containment barriers while the double hull feature of LNG carriers and likely, floating LNG units, also afford protection from collision and other lateral impacts. The tanks operate at atmospheric pressure are protected by multiple overhead barriers including the floating LNG deck system. Nonetheless an important related aspect of design will be the protection of the tanks from dropped objects and explosion overpressure;
- Prismatic containment tanks. These tanks also provide a degree of secondary containment afforded by the insulation construction and inner hull and operate at atmospheric pressure. Tank protection may be addressed in a similar vein to membrane tanks; and,
- Type C (or IMO Type C) tanks. These tanks are usually deployed in small scale production applications with limited storage requirements. They are distinct from either membrane or prismatic tanks in that they are entirely separate from the hull system, consisting of cylindrical or “bi-lobe” vessels usually horizontally orientated. LNG is

maintained in liquid form partly through insulation in the form of a PU-foam system, or for smaller tanks vacuum jackets and pressurization. Type C tanks might typically operate at around 4 to 5 bar. The QRA should review requirements for secondary containment with this type of storage.

In some installations, there may be a requirement to store liquefied petroleum gas for export, use as refrigerant or both. The above containment systems could be considered for liquefied petroleum gas storage.

Escape, Evacuation and Rescue

The inherent configuration of a floating system requires special consideration for escape (directly to shore and water), evacuation and rescue. For further information regarding special considerations, refer to the applicable class societies.

Hull and Deck Systems

Loading and motion induced effects include:

- Transfer of static loads from the topsides facilities into the hull system.
- Interaction of motion induced loads between the hull and the topsides, for example, the piping systems. These may also include fatigue type loads and loads induced during transportation from the construction yard to final location.

Consideration will be given to protecting the deck and hull structure from cryogenic spills that could lead to steel embrittlement.

The inspection and integrity of the hull should be considered in the design to ensure that the maintenance and inspection requirements are not onerous during the operation of the facility (e.g. regular dry docking).

Facilities

Facilities may be considered on floating LNG systems. The location, occupancy level, and design of any occupied unit must be taken fully into account in the QRA study and in the design of escape, evacuation and rescue provisions.

Mooring Systems

These may take several forms, all of which will be subject to review, and may include:

- Permanent mooring to an at-shore marine structure.
- Spread moored (in a fixed orientation) by anchor lines and fixed anchors.
- Turret moored utilizing either an internal or external turret system and anchor lines that permit the facility to weathervane.
- Tower moored – a fixed tower to which the facility is moored at the bow, permitting the facility to weathervane.

An applicant may be required to submit a mooring analysis which estimates the expected mooring and breasting loads and LNG carrier motions due to environmental conditions, and passing ships where applicable, at the berth.

A mooring analysis shall be carried out for representative design LNG carriers under the normal operating and extreme operating conditions to develop the design criteria for the structural design.

Mooring analyses shall consider the following conditions as a minimum. Depending on site specific conditions, additional analyses might be required:

a) two current directions (maximum ebb and flood);
b) two tide levels (mean higher high water and mean lower low water);
c) two loading conditions (ballast draft and fully-laden conditions);

d) minimum of eight wind directions (45° increments) and more if needed to allow for wind directionality at the location;
e) waves and seiche (representative heights, periods, and directions, when applicable);
f) passing ships (if applicable); and
g) tsunamis (if applicable).

For further guidance refer CSA EXP276.2:19.

Differential Movement in Relation to Land Based Services

Each of the mooring systems above will require particular solutions for receiving gas on-board the facility. At-shore permanently moored facilities will likely receive gas from an onshore pipeline. This may be delivered across a marine structure, as well as other services such as power, water and possibly process fluids. There may be significant differential movements between the marine structures and the facility, for example large vertical excursions from tidal cycles. Design of delivery systems is a special consideration.

LNG and Other Liquids Offloading

LNG transfer to a carrier from floating LNG facilities will differ from land based facilities, unless the facility is grounded. Although relative movement from tidal cycles will be eliminated, other more complex relative motions between the floating LNG facility and carrier will have to be taken into account in devising the LNG transfer/offloading system. In addition, the mooring system maintaining the carrier in position alongside (or even at the stern) of the floating LNG facility will require special consideration.

Converted LNG Carriers

Carriers and/or any other vessels nominated for conversion were not originally designed to accommodate the various duties and special considerations of a floating LNG facility. Hence, in addition to the requirements described in this appendix particular areas of focus include:

- service life extension requirements, also considering the new/different duties (also see the Hull and Deck Systems section above);
- modifications to existing hull structural systems e.g. to support topsides loads; and,
- impact of new additions and modifications on existing structures and systems.

Appendix I: Schedule 1 of the LNGFR

Schedule 1 of the LNGFR is reference by Subsection 4 (3) and provides the allowable thermal radiation flux for flares and ignited vent stacks.

Allowable Thermal Radiation Flux (Excluding Solar Radiation) Inside Facility Boundaries

Column 1	**Column 2**	
Targets Inside Boundary	**Maximum Thermal Radiation Flux (kW/m²)**	
	Normal Flow Rate[1]	**Accidental Flow Rate[2]**
Peak within sterile area	5	9
Outer edges of restricted area	N/A	5
Roads and open areas	3	5
Tanks, other than LNG storage tanks, and process equipment	1.5	5
Control rooms, maintenance workshops, laboratories, warehouses and other occupied structures within the LNG facility	1.5	5
Administrative buildings	1.5	5
[1] normal flow rate results from all operating modes within the LNG facility design intent [2] accidental flow rate is the highest flow rate that results from an uncontrolled or unplanned event and is the sum of combined flow rates from all possible uncontrolled or unplanned scenarios that may occur simultaneously		

Allowable Thermal Radiation Flux (Excluding Solar Radiation) Outside Facility Boundaries

Column 1	Column 2	
Targets Outside Boundary	**Maximum Thermal Radiation Flux (kW/m^2)**	
	Normal Flow Rate[1]	**Accidental Flow Rate[2]**
Remote area	3	5
Critical area [3]	1.5	1.5
Other areas	1.5	3

[1] normal flow rate results from all operating modes within the LNG facility design intent

[2] accidental flow rate is the highest flow rate that results from an uncontrolled or unplanned event and is the sum of combined flow rates from all possible uncontrolled or unplanned scenarios that may occur simultaneously.

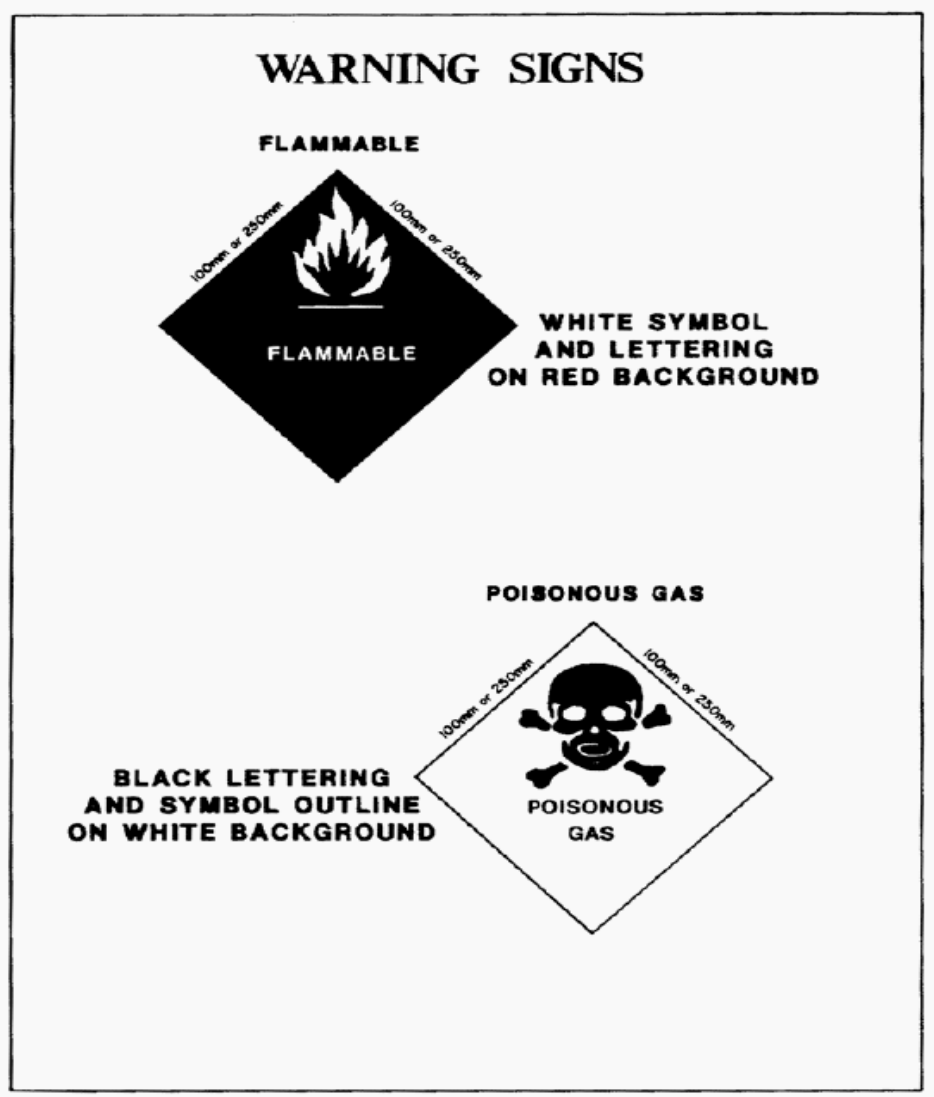
[3] an area

(a) that is thermally unshielded and where service personnel, who do not wear protective clothing, may be required to be present at all times, or
(b) that is difficult or dangerous to evacuate at short notice.

Appendix J: Schedule 3 of the LNGFR

Schedule 3 of the LNGFR is reference by Section 10 and provides warning signs to be used in LNG facility signage.

Figure: Signs



Appendix K: Third Party Verification of Modules

Section 6 of the LNGFR provides the Regulator with the ability to require verification of any modular units built outside of British Columbia by a third party acceptable to the Regulator. The purpose of the verification is to demonstrate that the module's components have been constructed and tested in accordance with the design and quality assurance program through an audit or review process. Note that Subsection 3 (1) (f) of the LNGFR requires a validation of the quality assurance program to be submitted to the Regulator before construction.

The Regulator is more likely to require third party oversight of modules constructed outside British Columbia for systems whose failure could result in loss of life, significant property damage, or damage to the environment; for customized modules; or when the manufacturer has not demonstrated a history of expertise in the industry. Since the Regulator can inspect any equipment or module associated with energy resource activities after it arrives in British Columbia, the permit holder may decide to reduce the project execution risk by providing the Regulator with third party verification of modules that are of critical importance to the permit holder. Depending on the project scope, the permit holder should consider regular submission of third party verification reports to demonstrate progressive compliance.

As this third party is working on the Regulator's behalf, the Regulator will consider the following when determining if a third party is acceptable:

- competence of the proposed third party;
- conflicts of interest that could affect the independence of its assessment;
- reporting and communication strategy to ensure transparency between the Regulator and the third party; and
- compliance verification plan scope.

Typically, the third party would confirm:

- Equipment layout and spacing requirements are as per design;
- Inspection records show that appropriate materials were used and the practices and procedures outlined in the quality assurance program submitted under Subsection 3 (1) (f) of the LNGFR were followed to meet the design specifications, focusing on safety critical systems;
- Construction of module is consistent with design deliverables submitted to the Regulator and any documented changes via MOC process;
- The construction and testing of safety critical elements and equipment identified in the project's safety studies (e.g. HAZID, PHA, safety integrity level study, etc.) ;
- Construction process includes appropriate control of all design deviations, changes and non-conformances;
- Gas-fired appliances and equipment under BCER jurisdiction (e.g. gas fired engines, gas fired incinerators) are installed correctly and certified or verified by a qualified organization using suitable methods ;
- Any out of province, pre-operation testing referred to in the LNGFR ss. 9 (1) is completed in accordance with the design standard used; and,
- Depending on measurement requirements for plant balance and regulatory reporting, confirm meter calibrations, configurations, gas analysis, orifice plates, production tank level transmitters.

Any module that is constructed/assembled outside of British Columbia may also have components and design considerations that are within the jurisdiction of another authority (e.g. Technical Safety BC, Transport Canada). The Regulator encourages permit holders to co-ordinate the scope of verification activities by third parties to include all requirements from authorities having jurisdiction in addition to any requirements from the permit holder. For example, items under Technical Safety BC's jurisdiction includes:

- Individual pressure vessels (including material specifications and supply; and manufacturing processes);
- Boilers and boiler systems;
- Electrical installations and grounding;
- Elevating devices and passenger conveyors; and,
- Passenger ropeways.

Appendix L: AMS Guidance

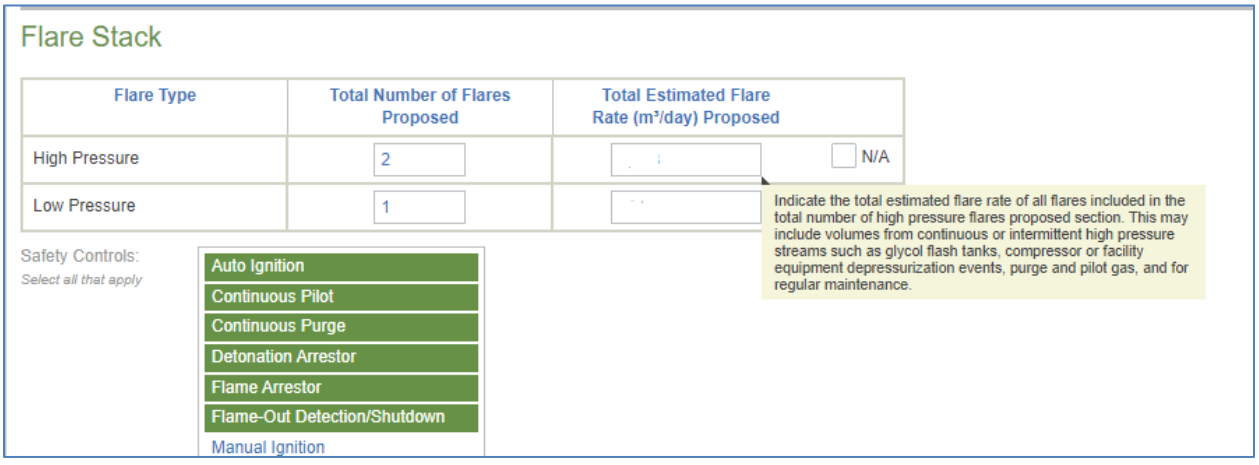
The Application Management System is an online portal that applicants use to submit oil and gas and associated activity applications. Users may prepare multiple applications at the same time by selecting one or all of the activities of the oil and gas project. Multi-activity applications provide a complete picture of the project and the Regulator encourages applicants to consider applying for all activities at the same time. More information on how to use the system can be found in the AMS user manual.

Completing the Facility Information in Application Management System

The Facility Tab is made up of three components: the Facility Overview Tab captures the general information of the activity, Facility Details Tab captures technical details of the activity and Land Details Tab captures information related to the land area specific to the activity.

This Appendix contains guidance for completing the data fields within the Facility Details Tab. Note, the guidance is general in nature, different approaches may be required depending on the parameters of a particular application.

- The Regulator's information systems will assign a Facility Identification Number (FACID) to the facility once a new facility application is created in the AMS system. The FACIDs are used to track facilities and associated operational submissions in the Regulator's KERMIT information system.
- Applicants must apply for a specific type of facility. The appropriate facility type must be selected in the facility details component of the Facility Tab in the Application Management System. For a LNG facility, facility type should be "LNG Facility".
- Facility names are generated by, and populated into AMS automatically when spatial data is uploaded. Facility names are based on information gathered at the application stage.
- Facility details fields are designed for all the facilities regulated by the BCER. Applicants should follow hover –over guidance in the AMS application when completing the information in the Facility Details Tab. These hints are available for most fields in the Facility Details Tab. An example is shown below.



- Refer to the example below when completing the feed, product, and waste streams details in the LNG facility applications. For reporting and notification purposes, the volume of a substance in “m3” means one cubic meter of the substance measured at 101.325 kPa and 15°C.