

Woodfibre LNG Limited Response to SIGTTO LNG Ports and Risk Reduction Options

Introduction: The following is in response to the Environmental Assessment Office request for the Society of International Gas Tanker and Terminal Operators (SIGTTO), “LNG Ports - Risk Reduction Options,” as outlined in its “Site Selection and Design for LNG Ports and Jetties,” Information Paper No.14, June 2004, and Woodfibre LNG Limited’s response to those risk reduction options as they pertain to the Woodfibre LNG Project.

SIGTTO is an international non-profit organization dedicated to protecting and promoting the safe and reliable operation of gas tankers and terminals within a sound environment. The Society has consultative status at the International Maritime Organization (IMO), and represents more than 200 companies that operate more than 95% of the world’s LNG tankers and terminals, and more than 50% of the world’s LPG tankers and terminals. Woodfibre LNG Limited is an Associate Member of SIGTTO (June 2015), and is committed to becoming a full member of SIGTTO once the Woodfibre LNG project is operational (as is required by SIGTTO).

The information cited below has been discussed in many meetings with Transport Canada, Pacific Pilotage Authority and the BC Coast Pilots, and forms part of the Transport Canada Technical Review Process of Marine Terminal Systems and Transshipment Sites (TERMPOL) studies that Woodfibre LNG Limited will submit to the TERMPOL Review Committee. Woodfibre LNG Limited is committed to implementing the recommendations of the TERMPOL review.

SIGTTO: LNG Ports and Risk Reduction Options	Woodfibre LNG Limited Response
1.0 The Port	
1.1 Port Analysis	
<p>Speed restrictions for LNG Carriers should be appropriate to limit grounding and collision damage.</p>	<p>Subject to the recommendations of the TERMPOL Review Committee, LNG carriers transiting Howe Sound to the Woodfibre LNG terminal will travel between 8 to 10 knots, will have two BC Coast Pilots on board and will be escorted by at least three tugboats, at least one of which will be tethered to the carrier. This tugboat arrangement also serves as an emergency provision to address contingencies that may require the carrier to stop or engage in manoeuvres on very short notice. This tugboat arrangement enables the LNG carrier to proceed at minimum speeds and be stopped or manoeuvred at any time. Minimum manoeuvring speed for an LNG carrier varies between 3 to 5 knots.</p>

1.2 Approach Channels & Turning Basins	
<ul style="list-style-type: none"> a. Navigable depths (for most LNG carriers) should generally not be less than 13 meters below the level of chart datum. b. Under-keel clearances should be established in accordance with the sea- bed quality. c. Channel width should be about five times the beam of the ship (approximately 250 meters). d. Turning areas should have a minimum diameter of two to three times the ship's length (approximately 600 to 900 meters). e. Short approach channels are preferable to long inshore routes which carry more numerous hazards. f. Traffic separation schemes should be established in approach routes covering many miles. g. Anchorage should be established at the port entrance and inshore, for the safe segregation of LNG carriers and to provide lay-by facilities in case, at the last moment, the berth proves unavailable. 	<ul style="list-style-type: none"> a. The minimum depth of Howe Sound is 60 metres. b. Howe Sound has adequate vessel under-keel clearance. c. The narrowest portion of the shipping channel in Howe Sound is 1,440 metres wide. d. The turning area in the foreshore of the Woodfibre LNG project site is approximately 5,200 metres. e. Howe Sound is generally a mile (1.6 km), or more wide with few outlying navigational hazards (source: BC Coast Pilots). It extends from Passage Island at the tip of the Strait of Georgia, approximately 42 km north to its head at the mouth of the Squamish River. f. Subject to the recommendations of Transport Canada's TERMPOL Review Committee, Woodfibre LNG will deploy at least three tugboats, at least one of which will be tethered, to provide a <i>dynamic safety awareness zone</i> for recreational and pleasure craft around the LNG carrier during its transit within Howe Sound. This <i>dynamic safety awareness zone</i> would extend up to 50 m on either side of the vessel and would move with the LNG carrier. This tugboat arrangement also serves as an emergency provision to address contingencies that may require the carrier to stop or engage in manoeuvres on very short notice. This tug arrangement enables the LNG carrier to proceed at minimum speeds and be stopped or manoeuvred at any time. Minimum manoeuvring speed for an LNG carrier varies between 3 to 5 knots. g. Woodfibre LNG Limited has committed to not anchoring in Howe Sound. Rather, as there will be three to four carriers per month, or approximately one every 10 days (and not at the same time), BC Coast Pilots, who board foreign vessels near Victoria, BC, will advise the captain of the LNG carrier on whether conditions are appropriate to make that transit into Howe Sound to the Woodfibre LNG terminal. Under the Pilotage Act, international vessel of 350 gross tonnes (gt) or larger travelling in Canadian waters are legally obliged to use the services of a Canadian marine pilot. It is expected that two BC Coast Pilots will board from Victoria, BC and remain on board as the vessel transits through Howe Sound to the Project site.

1.3 Navigational Aids	
<ul style="list-style-type: none"> a. Buoys to mark the width of navigable channels should be placed at suitable intervals. b. Leading marks of lit beacons, to mark channel centrelines and to facilitate rounding channel bends, should be appropriately placed. c. Electronic navigational aids, to support navigation under adverse weather conditions, are needed in most ports. d. Lit navigational aids should be provided to allow ship movements at night. 	<p>a-d. The Canadian Coast guard publishes annual information in Notices to marines, which provides an up-to-date list of lights, buoys, and fog signals along the Pacific coast (CCG 2014d). Based on this list, key navigational aids relevant to the Project have been identified in Table 7.3-04 in Woodfibre LNG Limited’s Environmental Assessment Certificate (EAC) Application. However, Woodfibre LNG Limited will install aids and navigational lights based on recommendations following the <i>Navigation Protection Act</i> permitting process.</p>
1.4 Port Services	
<ul style="list-style-type: none"> a. Tugs should be made available and three to four are normally required giving 140 tonnes total bollard pull. (Tugs may be required to meet LNG carriers farther offshore). b. Mooring services are often required and these services should normally provide a minimum of two boats, each having at least 400 horsepower. c. Escort services comprising fast patrol craft, to clear approach channels, turning areas, jettys, etc. should be provided in busy port areas. d. Fire fighting services comprising specially equipped craft, or, one or more suitably equipped tugs should be provided. 	<ul style="list-style-type: none"> a. Subject to the recommendations of Transport Canada’s TERMPOL Review Committee, Woodfibre LNG will deploy at least three tugboats, at least one of which will be tethered, to provide a <i>dynamic safety awareness zone</i> for recreational and pleasure craft around the LNG carrier during its transit within Howe Sound. This <i>dynamic safety awareness zone</i> would extend up to 50 m on either side of the vessel and would move with the LNG carrier. This tugboat arrangement also serves as an emergency provision to address contingencies that may require the carrier to stop or engage in manoeuvres on very short notice. This tug arrangement enables the LNG carrier to proceed at minimum speeds and be stopped or manoeuvred at any time. b. Tugboat operations will be provided under contract including mooring services. c. Howe Sound is not considered a busy port area by BC Coast Pilots or BC Chamber of Shipping and the Woodfibre LNG Project will increase large vessel traffic movement by less than 1% in Howe Sound. d. Woodfibre LNG will have a tugboat equipped with firefighting capabilities at the Woodfibre site as well as additional docking space for vessels associated with the project.

1.5 Port Procedures	
<ul style="list-style-type: none"> a. Traffic control or VTS systems should be strictly enforced to ensure safe harbour manoeuvring between pilot boarding area and jetty. b. Speed limits should be introduced in appropriate parts of the port approach, not only for the LNG carrier but also for other ships. c. Pilotage services should be required to provide pilots of high quality and experience. Pilot boarding areas should be at a suitable distance offshore. d. Ship movements by nearby ships, when the LNG carrier is pumping cargo, should be disallowed. e. Pilots and tugs should be immediately available in case the LNG carrier has to leave the jetty in an emergency. 	<ul style="list-style-type: none"> a. The Canadian Coast Guard (CCG) is mandated by the Canada Shipping Act and provides marine programs and services such as search and rescue, boating safety, environmental response, ice-breaking services, marine navigation services, marine communications and traffic services (MCTS), and navigatable waters protection. The CCG's MCTS branch in Vancouver, BC is responsible for all waters located within Howe Sound, including the Project area. The MCTS and the Regional Marine Information Centre (also in Vancouver) provide marine safety and communications co-ordination to all marine vessels, including: weather conditions and safety information; vessel traffic services (VTS); waterway management; sail plan services; marine safety and navigation information; and, notices to shipping. b. Subject to the recommendations of Transport Canada's TERMPOL Review Committee, Woodfibre LNG will deploy at least three tugboats, at least one of which will be tethered, to provide a <i>dynamic safety awareness zone</i> for recreational and pleasure craft around the LNG carrier during its transit within Howe Sound. This <i>dynamic safety awareness zone</i> would extend up to 50 m on either side of the vessel and would move with the LNG carrier. This tugboat arrangement also serves as an emergency provision to address contingencies that may require the carrier to stop or engage in manoeuvres on very short notice. This tug arrangement enables the LNG carrier to proceed at minimum speeds and be stopped or manoeuvred at any time. Minimum manoeuvring speed for an LNG carrier varies between 3 to 5 knots. c. Under the Pilotage Act, international vessel of 350 gross tonnes (gt) or larger travelling in Canadian waters are legally obliged to use the services of a Canadian marine pilot. It is expected that two BC Coast Pilots will board from Victoria, BC and remain on board as the vessel transits through Howe Sound to the Project site. d. The upland portion of the Project area will be fenced, and a control zone extending between 450 metres and 550 metres from the shoreline will be established around the marine portion of the Project area (EAC Application, Marine Transport, 7.3-38 and 7.3-41). e. It is anticipated that it will take 24 hours for an LNG carrier to be loaded with LNG at the Woodfibre site. A tugboat equipped with firefighting capabilities will be moored at site.

1.6 Port Operating Limits	
<ul style="list-style-type: none"> a. Environmental limits for wind, waves, and visibility should be set for ship manoeuvres and these should ensure adequate safe margins are available under all operating conditions. b. Weather limits for port closure should be established. 	<ul style="list-style-type: none"> a. Woodfibre LNG Limited will ensure that any transits in poor weather will be at the approval of BC Coast Pilots. Limits on weather and conditions, including wind speeds, waves, and traffic and (b) port closure will be placed following studies conducted as part of TERMPOL and through consultation with Pacific Pilotage Authority.
1.7 Weather Warnings	
<ul style="list-style-type: none"> a. Forecasting for long range purposes should be provided to give warning of severe storms, such as typhoons and cyclones. b. Forecasting for short range purposes, such as those required for local storms and squalls, should be made available. 	<p>a-b. The Canadian Coast Guard (CCG) is mandated by the Canada Shipping Act and provides marine programs and services such as search and rescue, boating safety, environmental response, ice-breaking services, marine navigation services, marine communications and traffic services (MCTS), and navigable waters protection (CCG 2014a). The CCG's MCTS branch located in Vancouver, BC is responsible for all waters located within Howe Sound, including the Project area. The MCTS and the Regional Marine Information Centre (also in Vancouver) provide marine safety and communications co-ordination to all marine vessels, including (CCG 2014b): weather conditions and safety information; vessel traffic services (VTS); waterway management; sail plan services; marine safety and navigation information; and, notices to shipping.</p>
2. Jetty	
2.1 Jetty Location	
<ul style="list-style-type: none"> a. Jetty location should be remote from populated areas and should be well removed from other marine traffic and any other port activity which may cause a hazard. b. The maximum credible spill and its estimated gas cloud range should be carefully established for the jetty area. c. River bends and narrow channels should not be considered as appropriate positions for LNG carrier jetties. d. Breakwaters should be constructed for jetty areas exposed to sea action, such as excessive waves and currents. e. Restrictions, such as low bridges, should not feature in the jetty approach. f. Ignition sources should be excluded within a predetermined radius from the jetty manifold. 	<ul style="list-style-type: none"> a. The Woodfibre LNG terminal will be located at the former site of the Woodfibre pulp mill, about seven kilometres southwest of downtown Squamish. Woodfibre LNG's project includes three to four LNG carriers visiting the terminal per month, and would result in a less than 1% increase in large vessel movement in Howe Sound. b. Maximum credible spill and its estimated gas cloud range have been established as part of the quantitative risk assessment. Once the Woodfibre LNG facility becomes operational, LNG will be transferred to LNG carriers via loading arms on the Floating Storage and Offloading (FSO) unit. A potential full loading arm rupture during offloading operations and release of LNG to Howe Sound could result in a subsequent pool or flash fire, provided the LNG vapour is within the flammable range and an ignition source is present. This would represent the credible worst-case scenario with potential affects to public safety.

	<p>Results from the Preliminary QRA show that the effects of this scenario have the potential to extend approximately 410m past the Project boundary. If a member of the public was present within this potential zone during this particular event the risk would be a fatality; however, the probability of this event occurring is one in every 1.75 million years. Given the low likelihood of the scenario and the Project site being located more than 5km from any residential development, public risk associated with a loading arm failure is considered to be very low.</p> <ul style="list-style-type: none"> c. The Woodfibre LNG project is not located on a river bend or narrow channel. Howe Sound’s channel width is more than five times the beam of the ship or approximately 250 metres. The narrowest section of the shipping route is in Montagu Channel between Anvil Island and Brunswick Point. It exceeds 1,600 metres, and is approximately 29 times the beam width of the LNG carriers anticipated for this project. Turning area of the Woodfibre LNG Project is more than a minimum diameter of two to three times the ships length or approximately 600 to 900 meters. The turning area in the foreshore of the Woodfibre LNG project site is approximately 5,200 metres. d. There are currently no plans for a breakwater. e. There are no low bridges in the jetty approach. f. The project site is being designed to separate ignition sources from the jetty manifold.
<p>2.2 Jetty Layout</p> <ul style="list-style-type: none"> a. Mooring dolphin spacing – between the outermost dolphins – should not be less than the ships length (approximately 290 meters). b. Mooring dolphins should be situated about 50 meters inshore from the berthing face. c. Mooring points should be suitably positioned, and have suitable strength, for the environmental conditions. d. Quick release hooks should be provided at all mooring points. e. Breasting dolphin spacing should be designed to ensure that the parallel body of the ship is properly supported. f. Fendering for the dolphins, and for the berth face, should be suitably standard. 	<ul style="list-style-type: none"> a. While LNG vessels calling at the Woodfibre LNG Terminal would berth alongside the floating storage and offloading (FSO) unit and would not require traditional mooring dolphins as with other land-based facilities, b. the configuration of the mooring hooks on the FSO would be sited to ensure the lines are longer than the LNG carrier. c. Mooring points will be available on the FSO to accommodate a variety of LNG carriers. d. Each mooring point will be provided with quick release hooks.

	<ul style="list-style-type: none"> e. The parallel body of the FSO will be the berthing face for the LNG carrier and thereby ensure the parallel body of the vessel is properly supported. f. As the FSO is an offshore facility, it will not utilize mooring dolphins as with other shore-based terminals; however, fendering of a suitable standard will be employed for the FSO berthing face.
2.3 Jetty Equipment	
<ul style="list-style-type: none"> a. Pipelines and pumps etc. should be designed to provide a rapid port turn-round. b. Emergency Release Systems at the hard arms should be fitted in accordance with industry specifications. The ERS should be suited to both ship and shore by interlinking and a PERC should be fitted to each hard arm for emergency stoppage and quick release purposes. c. Emergency shut-down valves should be fitted to both ship and shore pipelines and should form part of the ERS system. d. Powered emergency release couplings (PERCs) with flanking quick-acting valves should be fitted to the hard arm as part of the ERS system. e. Plugs both on ship and shore to carry all ESD and communication signals should be standardized. f. Surge pressure control should be provided in LNG pipelines. g. Communications equipment (telephone, hotline and radios) should be provide for ship to shore use. h. Load monitors, to show the mooring force in each mooring line, should be fitted with quick-release hooks. i. Gangways should be provided to give safe emergency access to or from the ship. 	<ul style="list-style-type: none"> a. Woodfibre LNG Limited will employ suitable pipelines and pumps to ensure a rapid port turn-round. b. Emergency release systems will be utilized at the hard arms and fitted with industry specifications with the provision of a ship/FSO interlink and the fitting of a PERC to each hard arm for emergency stoppage and quick release purposes. c. Emergency shutdown valves will be fitted to both the ship and shore pipelines and form part of the ERS system. d. Powered emergency release couplings (PERCs) with flanking quick-acting valves will be fitted to the hard arm as part of the ERS system. e. Standardized plugs will be provided to LNG carriers for ESD and communication signals. f. Surge pressure control will be provided in the LNG pipelines. As there is such a short distance between the FSO and the LNG carriers, Woodfibre LNG does not anticipate any surge effects to occur in the pipelines. g. Communication equipment such as radio telephones will be provided for ship to shore use. h. Load cells with quick release hooks will be fitted at each mooring point to provide indication of mooring force in each mooring line. i. Gangways will be provided on the offshore side to provide safe emergency access to and from the LNG carrier.

2.4 Basic Firefighting Equipment	
<ul style="list-style-type: none"> a. Water curtain pumps and pipelines should be provided. b. Fixed Dry Powder systems should be provided. c. Gas detection monitors should be fitted at strategic locations. g. Fireproof material should be used for the construction of hard arms (no aluminium). 	<ul style="list-style-type: none"> a. Woodfibre LNG will provide water curtain pumps and pipelines and (b) fixed dry powder systems on deck, (c) gas detection monitors at strategic places, and (g) ensure that fireproof material with no aluminium is utilized in the construction of the hard arms on board the FSO.
2.5 Jetty Procedures	
<ul style="list-style-type: none"> a. On-shore jetty safety zones should be effectively policed while the ship is alongside thus providing control over visitors and vehicles. b. Offshore safety zones should be effectively policed by a guard boat to limit the approach of small craft. c. Passing ships, close to the jetty, should have their speed controlled by the harbour VTS. d. Communications procedures should be well established and tested. e. Contingency plans should be available in written form. f. Operating procedures should be available in written form. g. A Port Information/Regulation booklet should be provided for passing operational advice to the ship. 	<ul style="list-style-type: none"> a. The upland portion of the Project area will be fenced, and a on-shore jetty safety zone policed. b. Unlike shore-based facilities, access to and from the LNG will only be through boats on the offshore side with an effective Safety/Control zone policed to limit the approach of small craft. c. The location of the Woodfibre LNG terminal is distant from passing vessels and all vessels including small craft will be monitored at the central control station. d. Communications plans will be established and tested. Communication equipment such as radio telephones will be provided for ship to shore use. e. Contingency plans and (f) operating procedures will be prepared by Woodfibre LNG for safety at the terminal and (g) a port information/regulation booklet will be provided to offer operational advice to attending LNG carriers.