

# THE REQUIREMENTS FOR SAFE TRAFFIC AND MANOEUVRING IN APPROACHES TO THE PORT OF ŚWINOUJŚCIE AND THE OUTER PORT OF ŚWINOUJŚCIE WITH PARTICULAR EMPHASIS ON LNG VESSELS

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## Abstract

*This paper presents an overview of the most important requirements and recommendations of international organizations for the area of LNG terminal under construction in Świnoujście. These recommendations should be considered when planning safe traffic and manoeuvring of ships in port approaches to the Port of Świnoujście and to the Outer Port of Świnoujście. The approach area to the new terminal is located on shallow waters. Up to the present moment the fairway, anchorages and seamarks have been used by vessels of smaller size. After the construction of the new port with an LNG terminal it will handle the greatest LNG carriers. To ensure their safe entrance to the port, the fairway should be prepared with sufficient width and depth, with navigational aids. It is also necessary to prepare appropriate emergency anchorages and places where the vessels can return in case further voyage is dangerous. Additionally LNG cargo is very dangerous, because of this there is a compulsory to introduce of the highest safety standards, both in the design of the approach area and the application procedures for ships traffic. In particular, fairways and port canals, Under Keel Allowance, air draft, turning basin, vessel traffic services (VTS), traffic separation schemes (TSS), moving safety zone, and required speed limit are presented in the paper.*

**Keywords:** LNG, LNG terminal, approach tray, fairway, port canal, air draft, VTS, Vessel Traffic System

## 1. Introduction

When designing the approach to the newly built LNG terminal it should be taken into consideration that ships with a very dangerous cargo will navigate in this area. Safety traffic and maneuvering rules for vessels should be arranged so as to ensure maximum safety of the vessel and in practice reduce the risk of an accident or the occurrence of emergency situation to a minimum. Global standards for LNG transport have been developed by SIGTTO (Society of International Gas Tanker and Terminal Operators) one of the leading organizations that work out recommendations for the construction of new LNG terminals and areas on their approach. Proper preparation of approach areas for traffic of LNG vessels is very important when the area is restricted (shallow waters, shoals, high ships traffic, etc.). The roadstead of the port of Świnoujście is characterized by low depth. Therefore, it is essential to prepare the fairway, port channels and turning basin properly. To ensure safe traffic management it is necessary to implement an efficient traffic control system, the design of the traffic separation scheme and moving safety zone for LNG vessels.

## 2. Fairways and port canals

According to SIGTTO fairways leading to LNG port should have the cross-sectional depth and width of at least 5 beams of the largest LNG vessel to use this fairway. According to the Critical Parameters for LNG Marine Terminal Site Selection – OTC 19658 the width for fairways leading to the port should be between 6 and 8 beams of an LNG vessel. The proposed fairway width depends on the manoeuvring characteristics of vessels calling at the port of Świnoujście, taking

into account the worst permissible operating conditions together with appropriate value of the ship's speed necessary to maintain the ship's stability, the vessel and the required turning circle on curved track sections at the point of changing the angle of course over ground. It is necessary to check if the fairway is long and wide enough and provides sufficient depth for navigation. In order to do this, the following should be considered:

- speed of the vessel which depends on the increase in draft due to reduced density of water,
- squatting dependent on speed of the vessel, the depth of water, and the profile of the track/canal,
- decrease in under keel clearance due to rolling and pitching,
- the interaction between the sea bottom and the bottom of the vessel, as a consequence of the ship's trim,
- effect of crosswind on the ship,
- effect of the cross current on ship in the fairway,
- effect of wave on a ship,
- accessibility of methods for determining the navigational position,
- the nature of the seabed,
- the ratio of water depth to the draft of the vessel,
- the type of cargo.

The fairway between the seaward end and the LNG terminal should be clearly marked by seamarks. In particular, the ends of the fairway should be clearly marked. Where it is difficult to determine the seaward end of the fairway, an IALA safe water buoy equipped with racon and AIS as the approach (fairway) buoy should be placed. Seamarks can be fixed - beacons (especially in places which experience strong currents) or floating – buoys of appropriate size, shape and colour, etc. The marks should be clearly marked and distinguished - different characteristics of light (if vessels are to use this channel after dark).

Leading marks (with light for navigating at night or during restricted visibility) are very useful for determining safe passage lines (mostly along the center line) on the fairway, especially where strong currents or dense traffic may temporarily lead to changes in the position the floating seamarks (buoys). Seamarks fixed to the ground (beacons) are more reliable than buoys – floating marks which are anchored. The usefulness of leading marks depends on the distance between the front and rear beacon and the distance of the observer to the first mark. Leading marks are particularly useful in long approach channels to terminal and especially at sailing along rivers. Passage of a vessel along the desired route may then be monitored continuously from one leading marks to the next one. At the same time the maximum available width of navigable water in the fairway may be marked with buoys or beacons.

When designing the final version of the approach channel, it is important to keep ample space for the vessel for reducing her speed while maintaining a steady course during the approach at the same time. The final approach should be possible without going to the berthing place directly however, while maintaining sufficient speed of advance. The approach and entrance channel to the LNG berth should be as straight as possible with a minimum number of bends and without the need for a significant alternation in ship's course.

The limits of the fairway should be clearly marked with seamarks. Leading lights should indicate the axis leading the vessel safely to a sheltered port basin.

There are two main types of fairways leading to the port:

- outer fairway – in the open sea,
- inner fairway – inland waterway, sheltered areas (inside ports and harbours on rivers).

The outer fairway – open sea / sea area unprotected from the wind and waves. Recommended minimum Under Keel Clearance (UKC) is not less than 20% of the draft of the vessel. This clearance is to be increased, if necessary, taking into account the actual sea state. Nominal width of the outer channel/fairway for a manoeuvring LNG carrier is 6–8 beams of the ship.

The inner fairway – inland waters sheltered (e.g. in a port or on a river). Recommended minimum Under Keel Clearance (UKC) is not less than 10% of the draft of the vessel (for the ship

turning at the turning basin this value should be increased). Nominal width of the inner track/fairway used for a manoeuvring LNG carrier is 5-6 beams of the ship.

It may be required to increase the width of the channel if strong cross-wind, wave and cross-current are experienced. Vessels of restricted size and draft will be allowed to enter the fairway if it was impossible to widen or dredge the fairway.

### **3. Under Keel Allowance**

The required by PIANC value of Under Keel Allowance (UKA) depending on the type of bottom should take into account local conditions. The recommended initial value of UKA is equal to 10–20% of the draft of the vessel (for the conditions without waves). Ships in waters with higher waves require higher values of UKA than ships navigating on calm waters.

### **4. Air draft**

The maximum height of the ship from the waterline – air draft for most of the existing LNG carriers usually is 40-49 m but may be increased. This should be taken into account when considering the construction of bridges in the vicinity of the approach channel for LNG carrier. It is recommended that on the route of an LNG carrier there are not any constructions under which she would have to go.

### **5. Turning basin**

Turning basin should have a minimum diameter twice as long as the length of the largest ship planned to turn in area where the current activity is minimal. Where turning basins are situated in sea area with a strong current, the diameter shall be increased by the expected drift of the ship. Turning basin for LNG vessels – for turning before berthing or unberthing, should be of a size corresponding to the possibilities of manoeuvring the vessel in the worst hydro-meteorological conditions for mooring operations with the tug assistance. Milder hydro-meteorological conditions allow its smaller size. The stronger the predicted winds and currents, the greater the size of the turning basin should be. Shallow port basin will make the ship manoeuvring more difficult during its rotation. If, as a result of working tugboats' propellers, bottom sediments get into the ship's engine cooling system, they can clog the engine of the LNG carrier. The turning basin should also be considered as an emergency anchorage, for example when approaching tanker crashes or makes a wrong manoeuvre that interferes with safe approach to the quayside. Otherwise, if necessary, when a ship has to leave the berth suddenly it can be anchored in the turning basin to wait for the necessary assistance to continue with its voyage in the fairway or channel. Turning basin should be clearly marked with buoys or beacons so as the pilots and tugs can easily establish the dimensions of the basin and its limits.

The main determinant of setting parameters for approach channels for LNG vessels is to eliminate the possibility of strong hitting of the hull against the bottom or side bank of the basin and thus preventing its puncture. For this purpose, it is also necessary to remove above water rocks and other obstacles littering the bottom of the fairway.

### **6. Vessel traffic services (VTS)**

Port for an LNG vessel must have an effective system of VTS monitoring the approach area and controlling all ships traffic coming to the area used by LNG carriers. This service monitors and manages the ships traffic in port, at its approach and waterways and provides passing ships with navigation information and assistance by radio (VHF). The AIS is also an aid to monitoring vessel traffic by providing the necessary data about ships and their movement parameters.

The information provided by VTS in congested port waters and fairways, in high density unpredictable traffic is especially important for the safety of gas carries which must totally eliminate the risk of collision.

## **7. Traffic Separation Schemes (TSS)**

A properly designed Traffic Separation Scheme – TSS creating ordered traffic flow of vessels effectively regulates the movement in the port and in the approach channels. Properly established TSS greatly reduces the risk of seriously damaging ship-ship interactions in the sea area and will help to keep them within safe navigable waters. The usefulness and effectiveness of the TSSR is particularly valuable in the elimination of the interaction of ships moving in the same fairway but opposite courses “bow to bow”, which often takes place in confined waters or waters with heavy traffic. VTS in connection with TSS is particularly useful to control the traffic passing near the LNG carrier. VTS operators can communicate with the gas carriers and other ships in the vicinity if they expect the development of a dangerous situation, e.g. a vessel in breach of COLREG regulations is detected and when the vessel does not comply with the rules of VTS/TSS. To ensure the safety of the gas carrier and safety in the port area, other traffic in the fairway is suspended during passage of a gas carrier to or from the port and the assistance of patrol vessel is provided.

## **8. Moving Safety Zone**

Common practice is to establish a Moving Safety Zone-MSZ around passing gas carrier where other vessels must not enter. As a result a gas carrier should not meet in the Moving Safety Zone any other ships that would create a risk of collision and puncturing its hull. Dimensions and shape of the Moving Safety Zone should be determined according to the conditions of a given port.

In a port with a narrow fairway other vessels are prohibited to move on the lane in the opposite direction when a gas carrier is passing. In cases of extremely long stretches of fairways/approach channels, the ship traffic coming from the opposite direction may be exceptionally allowed but must be directed to the anchorage when they meet a gas carrier on the fairway and wait until the gas carrier safely passes. In such cases the passing LNG carrier has the right of way.

The Moving Safety Zone of a gas carrier must be determined depending on the distance needed by the LNG carrier to stop safely. Vessels following the gas carrier astern should also keep clear for a similar distance allowing the gas carrier reducing her speed and manoeuvring without problems. Generally, as a rule, gas carrier in the channel or fairway cannot be overtaken, irrespective of the width of the channel or fairway.

It is advisable to assign a patrol boat to escort a passing gas carrier. The escort may be a small unit some distance ahead of the gas carrier patrolling the area of the fairway and keeping other vessels clear of the gas carrier. The escort may also be a tug which will help to maintain the Moving Safety Zone coming between a gas carrier and ship coming. In some ports it is preferred that the assisting tug is powerful enough to assist the gas carrier to change its course in emergency or, if it is necessary. Tug does not have to be an “escort tug” able to assist the gas carrier at full passage speed but it should have the ability to change the trajectory of gas carrier when it moves at low speeds. Due to the need to intervene, escorting-patrol boat cannot be part of the tow.

## **9. Required Speed Limit**

Speed limit should be established in areas of port approaches where risk of collision or grounding exists or there is need for traffic regulation ensuring the priority for passage of a vessel carrying dangerous goods. These restrictions should be related not only to gas carriers but also to other vessels in the waters. The speed limit may result from the requirements of both the local regulations and the recommendation received from the VTS operators.

## **10. Conclusions**

LNG is one of the most hazardous cargoes carried by sea. Compliance with standards developed for the safety of ships carrying this cargo should provide virtually trouble-free navigation in areas

of approaches to the terminals. This has been evidenced by past practice (so far these vessels have not been involved in any serious accident). High safety standards should be provided in this area already at the stage of designing port and port approach infrastructure. A very important element is to follow SIGTTO requirements and recommendations but local factors should also be taken into account. Providing adequately prepared approach areas enables the efficient use of safety procedures (introduced by the administration responsible for this area) and vessels manoeuvring. Ships with dangerous goods are obliged to carry out a risk analysis for the passage of the vessel on the selected routes. If the approach channels, fairways, anchorages, turning basins, port channels and procedures meet the safety standards for the size of the vessel carrying dangerous goods then the decision, on the basis of the analysis, which allows the vessel to enter, is positive.

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