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The operational states of LNG tankers – the expectations and hazards

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ABSTRACT

The article shows the operational states of merchant vessels. Characteristic states of ships used for the transport of liquefied natural gas (LNG) has been specified with the hazards which may occur during the transport of LNG by sea. In the next part of article identified the operational states of LNG tankers taking voyage on the South part of the Baltic Sea, with area of LNG terminal in Swinoujście. It was shown the current legislation for LNG tankers.

Keywords: LNG tankers, LNG terminal in Świnoujście, transport of LNG

1. INTRODUCTION

Globalization of the economy, the impact on the enhancement of natural gas transport by sea. A particular dynamic has been observed over several recent years. Increase the cargo in international exchange, resulted in an increase in capacity.

The increase in the size of the new tankers, not accompanied by an increase in installed capacity in their energy systems. The systematic evaporation cargo forced relatively need for rapid transport to the port of destination of the cargo. Therefore, modern tankers' maritime voyages are laden with speed 19,5 – 20,5 knots, which requires adequate power size of the main engine system. Development of LNG tankers propulsion systems associated with the use of natural gas vaporization, formed to apply:

- engine steam turbine powered by dual fuel boilers with mechanical transmission (called DFMS),
- the drive with dual fuel piston internal combustion engine with electric transmission (called DFDE),
- direct engine with two-stroke engines, piston internal combustion engine with the installation of condensing again BOG, which played almost exclusively on the ships of the type Q-flex and Q-max (called DRL).

This development is a consequence of the effort to obtain, as the largest energy system efficiency of a tanker during the execution of the transport task. The LNG tanker is different from all other merchant ships and performs its tasks in two basic operational states: with full tanks in cargo during a voyage to the port of destination, with nearly empty tanks and ballast during the return journey. As merchant ships, during the journey, on tankers, there are basic operational states. Each of these tankers, depending on the propulsion system, will have their own, individual, specific to its type, the operational states.

2. OPERATIONAL STATES OF MERCHANT VESSELS

The main task of the merchant ships are transport cargo from the port of loading to the port of destination. In the course of carriage of cargo, the ship is in a few basic operating states:

- loading operations,
- sea voyage with a cargo,
- unloading operations and
- sea voyage without cargo (in ballast).

Each of these states is distinguished by its different safety requirements, and the crew tasks, for example, during loading operations:

- to ensure the proper conduct of loading (compatible with stowage plan),
- operation and management of pumping ballast water,
- management of the condition of the cargo in the holds,
- securing cargo,
- carry out the draft survey to verify the amount of loaded cargo,
- ensuring the functional ship handling equipment,
- to ensure required energy streams,
- management and control of auxiliary equipment.

Execution of individual tasks is to ensure the proper conduct of the operations of loading, which affects the time at a port. Operational reasons, owner's management and freight needs, layover the vessel in the port should be as short as possible. On the length of stay at a port also affect weather conditions. The onset of adverse weather conditions (rain, snow, wind, low temperature, etc.) ship loading may be interrupted, due to the negative impact on the quality and safety of the crew, the ship and the cargo. One of the more sensitive loads to changes in weather conditions, is bulk cargo, for example. ore, fertilizers, grain.

After loading and the formal requirements, the vessel may begin the voyage, which is planned and accepted by the master of the vessel. For a valid cargo corresponds to the captain and crew of the vessel, ensuring the safety of the cargo, the ship and crew through the use of technical and manoeuvring properties of the vessel and the area's characteristic (ship traffic, the available depth), taking into account the existing legislation and the actual weather conditions.

Approach the vessel to the quay is prefaced by manoeuvring approaching to the port, usually assisted by tugs and the presence of a pilot on the bridge of the ship. Unloading ship, begins after the safe arrival of the vessel to the quay, under the management of the crew. This is to ensure the qualitative and quantitative requirements, contained in the contract of carriage of the cargo. At the same time with the unloading, ballasting operations are carried out of the tanks, the ship have to meet basic stability requirements.

When the unloading is finished, the ship departs from a port and take next voyage by sea, except that no load, and only under the ballast. During the voyage, the ship is exposed to similar risks, during carriage of cargo. Due to the greater free board of the ship, it is exposed to the increased influence of atmospheric conditions, in particular the action of the wind.

Each of the operational states of the ship, carries other risks. The common feature of these states is the safety of the crew, the ship and cargo in operational and legal terms.

3. LNG TANKERS – CHARACTERISTIC OPERATIONAL STATES

Liquefied natural gas is a dangerous good. For this reason, the LNG transport by sea must meet specific safety conditions. These criteria apply to construction the hull of the LNG tankers, LNG loading equipment, tanks and installations.

Depending on the installed type of propulsion system (engine with condensation gas, which currently are provided to handle LNG terminal in Świnoujście), may experience the following states:

- loading of liquefied natural gas with the use of terminal's pumps,
- sea voyage with the liquid cargo,
- discharging with retargeting gas cargo on a ship,
- unloading without retargeting gas cargo on a vessel.

Each of the above operational states is characterized by a variable at the time of the load energy system by individual receivers of energy located on the vessel.

In the case of discharging with retargeting gas cargo on a ship, in tanks remains about 800 – 1000 m³ of LNG. It is used mainly for cooling installations and tanks before of the entrance to the port. To reach the port of refrigerated (cool condition), it allows to save time at a port. The time needed for cooling tanks and installations for Q-flex type of LNG tanker is approximately 11 hours.

4. REQUIREMENTS FOR LNG TANKERS

LNG terminal in Świnoujście was the objective of diversification of LNG supply to Poland. The location of the port of Świnoujście in the southern part of the Baltic Sea, which

enables to use LNG terminal as a refuelling station for ships equipped with dual-fuel engine rooms.

Entrance of LNG tanker requires:

- to have authorization, which permissions to enter and the operation of the ship on the area of port of Świnoujście,
- environmental requirements,
- comply with the requirements of the area.

The Baltic Sea area is located in the SECA, which in the near future may also be covered by the zone of NECA, which imposes emission limits on sulfur oxides (SOx), and in the near future, nitrogen oxides (NOx). Requirements in the relationship of the hull geometry-seaway are shown in Table 1.

Table 1. Limitations of the basic parameters of the ships could berth in LNG terminal in Świnoujście.

Maximum length over all	315,16 m
Maximum breadth	50 m
Maximum draft in fresh water	12,5 m
Capacity of tanks	50000 – 217000 m ³

Adopted guidelines for the main dimensions of vessels, may not be met provided a positive transition authorization procedure, which applies to all gas tankers wishing to enter the LNG terminal. The procedure was established as a set of design requirements, safety and risk management across the ship and its owner or operator. LNG tanker must comply with the requirements arising from the provisions of the Polish and international standards SIGTTO and OCIMF.

Authorization procedure is divided into five stages, and is shown in Figure 1. In the first place, followed by the exchange of information between the terminal and the ship owner or operator of the ship. During this stage, the applying for authorization, is obliged to submit a copy of the following documents:

- schemes of general construction of th ship,
- certificates and load values leads for tugs,
- the OCIMF Vessel Particulars Questionnaire,
- report OCIMF TMSA,
- report OCIMF SIRE,
- the certificate Condition Assessment Programme (for gas tankers older than 20 years),
- study of mooring OPTIMOOR,
- gas Form "C" ,
- loading pumps performance Curves together with the maximum discharging increment,
- scaling of cargo tanks,

- certificate of CTMS and its calibration,
- Survey Class Status Report,
- Certificate of entry to P&I,
- emergency procedures and safety procedures,
- a copy of the full documentation from the last classification audit, vetting and control of the PSC.

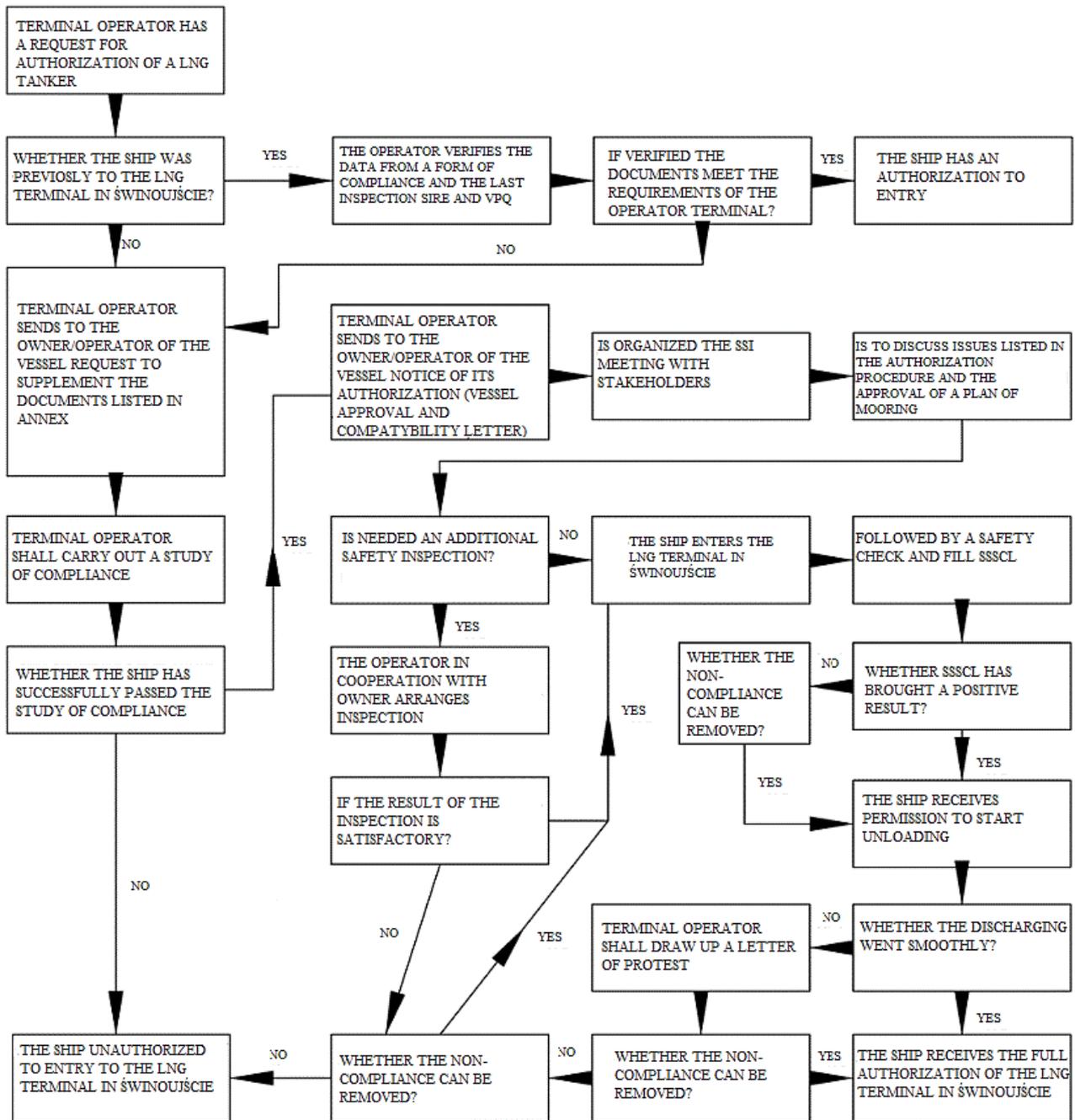


Figure 1. The authorization procedure scheme of LNG terminal in Świnoujście.

The next step is to perform a study of compliance, which is carried out the verification of compliance with the technical requirements of ship and terminal along with operating procedures and safety. This step may end up taking the following decisions:

- to grant authorization for a ship,
- the possibility of granting authorization provided to remove inconsistencies,
- the lack of authorization for a ship.

In the event of non-compliance, authorization may be granted after they are removed. This requires that, at the request of the terminal operator, the organisation of a meeting, the purpose of the joint verification of the requirements by the terminal and communication systems and the safety of the vessel, the applicant for authorization. The participants of this meeting must be:

- a representative of the company,
- a representative of the user terminal,
- a representative of the freight forwarder,
- a representative of the Port Captain and pilot station and
- operator representative terminal.

Terminal operator has the right to order vetting ship passing verification procedure, which depends on the result of the authorisation process. Inspection of the ship is the next stage of the procedure of authorization of the vessel in order to verify the safety of cargo operations at the terminal.

The result of the above described steps of the procedure, authorization depends on whether the ship can be allowed to the discharging test, the purpose of the final verification of the compatibility of the LNG tanker to the terminal. On the basis of the test, is one of the following decisions:

- do not grant the authorization,
- the authorization granted subject to future test and verification within three years,
- to grant full authorization for a period of three years.

Table 2. List of vessels authorized by PLNG.

LNG tanker's name	IMO Number	Operator (Owner)
Al Nuaman	9431135	Shell Trading and Shipping Company
Al Khattiya	9431111	Shell Trading and Shipping Company
Arctic Princess	9271248	Hoegh LNG Fleet Management
Al Khuwair	9360908	Teekay Shipping Glasgow
Al Gattara	9337705	OSG Shipmanagement UK
Umm Al Amad	9360829	K Line LNG Shipping
Al Huwaila	9360879	Teekay Shipping Glasgow
Al Gharrafa	9337717	OSG Shipmanagement UK

Currently, eight LNG tankers have granted full authorization. Seven of them are Q-flex, while one is LNG tanker a different type. Summary of gas tankers, which had been granted authorization can be found in Table 2.

Thanks to obtain authorization for the next LNG tankers, supplies of gas are possible to LNG terminal in Świnoujście. The first delivery of LNG in 2017 took place on January 21. To Polish terminal entered vessel Al Huwaila, presented in Figure 2.



Figure 2. LNG tanker, Q-flex type, Al Huwaila.

5. CONCLUSIONS

Increase in the use of maritime transport for the carriage of goods, enforces design and build vessels with greater parameters. Economic considerations, in addition, contribute to the use of the engine rooms about getting greater efficiency and reliability. Legal requirements, in particular concerning the protection of the environment – the formation of zones with emission limits of chemical compounds into the atmosphere (sulphur and nitrogen oxides), force the install dual-fuel propulsions, which in the process of combustion use LNG. In the operation of merchant ships, because of their high specialisation, there are characteristic of the operational states. This also applies to LNG tankers carrying liquefied natural gas. Due to safety requirements, within the LNG terminal procedures, which must be met by LNG tankers. An example of such a procedure is provided for vessel authorization to handle LNG terminal in Świnoujście. Despite the relatively short operation of the terminal and the procedure for authorization, the right of entry has eight ships, including seven Q-flex. In this way, terminal, can take next supply of LNG, to pursue its regasification and distribution.

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