The 13th Annual General Assembly of the IAMU

Expanding Frontiers -
Challenges and Opportunities in Maritime Education and Training

The Role of the Baltic Sea Region and Poland as a New part of the European LNG Market

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Abstract: The paper presents the actual situation of the import of LNG to the Baltic Region and contains the latest information about the new building of an LNG Terminal in Poland. The construction of the external port in Swinoujscie along with the terminal for LNG unloading constitutes one of the largest investments carried out in the post-war history of Poland. The fundamental objective of the investment is diversification of gas suppliers to Poland. The external port will be located within an area of approximately 130ha and the terminal surface will be approximately 48 ha. The external port will be able to receive 300-meter long ships with 100 000 DWT and draughts of 13.5 m. The LNG terminal will be capable of handling gas tankers with 200 000 m^3 and the capacity of the terminal will amount to 2.5 b m^3 of gas per year. The first ship will call at the Świnoujście LNG terminal in 2014. The paper addresses competition from pipelines, characteristics of the first LNG vessel build in a Polish shipyard in 2009, whether the shale gas revolution will reach Poland and plans and projects for building new LNG terminals and LNG bunkering stations. Also addressed is the EU strategy for the Baltic Sea Region, formal risk assessment for LNG carriers in the Baltic Sea Area, challenges for Maritime Education and Training concerning LNG investments in Baltic Regions and the role of Gdynia Maritime University in preparing reliable and competent personnel for transporting and transferring systems.
Keywords: LNG transportation, LNG Terminal, Shall gas, CNG

1. Introduction

Natural gas is expected to be the world's fastest growing energy source in the coming years. In a liquid state, LNG is not explosive, not corrosive and not toxic. Possible spillage does not cost any ecological problems as the liquid will boil to gas.

Poland, as with other countries within the Russia area of natural gas distribution, is trying to diversify their sources and increase the security of supply. New pipelines have been built in Europe which only increase the dependency on the supply from Russia[1]. The decision to build or plan receiving terminals in Poland, Lithuania, Latvia and other countries is a method of diversification of sources of supply LNG. Another option is exploration for our own shale gas.

2. Worldwide LNG Maritime Transport.

The main factors which determine development of world LNG trade and maritime transport are:

1. Sources located large distances from consumers (importers).
2. In many places pipelines are impossible to build (distances, earthquake etc.).
3. Systematic development of technical methods of transporting, storage and discharging.
4. Growing tendencies to eliminate non ecological sources of energy and change for LNG sector.
5. Increasing quantity of import countries.
6. Resignation of nuclear energy, especially after damage to a Japanese nuclear power station.

Dynamical development of LNG transport by specialized carriers has been observed from the beginning of the 21st century. Poland is one of the European countries that is desperately trying to change traditional methods of producing energy (90% based on coal) to more ecological methods such as nuclear or LNG sectors. Additionally, the most important matter is the necessary diversification of LNG exporters due to complicated dependence on the Russian strategy of political and economical addiction.

According to realistic prognoses, in the whole world there are approximately 187.5 billion m^3 of natural gas; enough for supplying in full energy for a minimum of 70 years. Actually production is around 3 billion m^3 of gas per year and this figure is systematically increasing[4]. The biggest consumers of natural gas are the USA, Japan and Western Europe (in Europe the biggest importers are UK and Spain). The structure of world importers and exporters is shown in Figure 1.

Importer	MMtpa
Japan	70.6
S Korea	34.1
Spain	20.5
UK	14.2
Taiwan	11.6
France	10.5
China	9.5
India	9.3
US	8.5
Italy	6.7
Turkey	5.9
Belgium	4.5
Mexico	4.4
Chile	2.3
Portugal	2.2
Kuwait	2.1
Brazil	2.0
Canada	1.5
Argentina	1.3
Greece	0.9
Dominican Rep.	0.6
Puerto Rico	0.6
UAE	0.1

Exporter	MMtpa
Qatar	57.5
Indonesia	23.6
Malaysia	23.1
Australia	19.1
Nigeria	18.1
Trinidad	15.2
Algeria	14.3
Russia	10.6
Oman	8.7
Egypt	7.1
Brunei	6.7
UAE	5.8
Yemen	4.3
Equatorial Guinea	4.1
Norway	3.5
Peru	1.3
US	0.6
Libya	0.2

Figure 1. Structure of import and export of LNG [6].

Analysis of the above world list of exporters and importers shows that the biggest exporters of LNG are Qatar (57.5 billion m^3), Indonesia (23.6 billion m^3) and Malaysia (23.1 billion m^3). In 2010 Qatar had a threefold increase in its profit from LNG export.

In 2005 and 2006 Maritime transport of LNG increased 8% and 12%. In 2008 Guinea Equatorial, Norway and Russia (Sakhalin) became important new exporters . In 2009 the big LNG Terminal at Canaport LNG in Canada was built. China (terminal in Guandong Dapeng) and, from 2014, Poland (Terminal Swinoujscie) were added to the group of importers. Singapore, Jamaica, New Zealand and Germany[3] expressed great interest to import LNG in the last year.

3. Maritime transportation of LNG in the Baltic Sea region.

Routing for LNG on the Baltic Sea in past years for the transport of natural gas was only by pipelines, but there is actually a great concept for 9 Baltic countries to establish a system of safety routes for the transportation of LNG through their vision of building LNG terminals in Baltic countries.

Actually, on the Baltic Sea, there exist IMO regulations concerning vessel traffic (IMO, 01-07-2006) which include separation zones and routes north of the Danish island of Bornholm and north of the German island of Rugia and near coastal routes of German waters(Fig.2).

Drafts of LNG tankers is the limiting factor for transportation on the Baltic, where the maximum draft is 15m. There is a plan in many of the Baltic countries to build import LNG Terminals and a few bunker stations. This gives a chance of approaching a wide energy market, strategic for energy independence, and is a tool to guarantee non-dependence on one source of supply. Figure 2 shows the proposed locations of LNG terminals and bunker stations in the Baltic.

Lithuania plans to open (in 2014) a new import terminal for LNG in Klajpeda for 2-3 billion m3 of gas per year. Latvia has a plan to build an LNG terminal (for 2 billion m3 a year) in the port of Riga. Estonia plans to build an LNG terminal in Palenski for 2 billion m3 a year.

In Sweden the plans for building import LNG terminals were stopped last year (Oxelosund). In May 2011 an LNG terminal was opened in Nynashamn where LNG from Norway was delivered. According to the last Swedish declaration, additional small LNG Termimals in Gothenburg and Gavie will be only bunker stations.

Finland declared (in 2011) a big interest in building an LNG Terminal in Turku but it is only a conception plan for now.

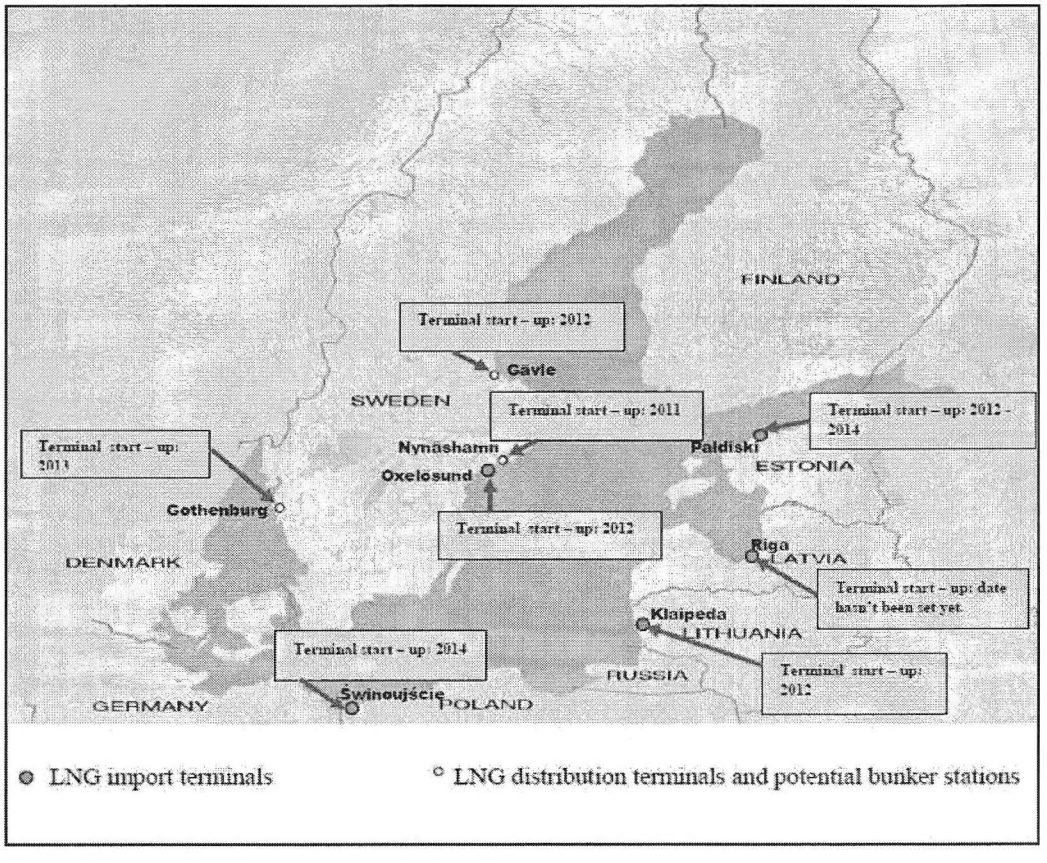


Figure 2 Proposed LNG importing terminals on Baltic Sea [8] .

4. Project for an LNG Terminal in Swinoujscie (Poland).

The most advanced plan for building an LNG terminal is in Poland. On January 3, 2006, the Government of Poland decided to build their own Polish LNG Terminal due to growing dependence from one importer (Russia) and possible pressure or economical extortion of Russia (as happened on the Ukraine and Belarus boundary). The total cost of building a terminal located in the western part of Poland is from 350 to 600 million Euro. Initial production in 2014 will be 2.5 – 3 billion m^3 of gas and in 2015; 5 – 5.75 billion m^3 [7]. This LNG Terminal is not enough to be fully independent in the energy safety sector. There are plans to establish a national fleet of LNG vessels with a maximum and optimal vessel size of 130 000m^3.

To defend sources of imported gas, a fleet should contain:

A. Delivery from North Sea – 1 vessel 130 000 m^3 and 1 vessel 75 000m^3 or 3 vessels 75 000m3 each.
B. Import from Algeria: 3 vessels 130 000 m3 each
C. Persian Gulf source: 6 vessels 130 000m3 each.

Polish shipyards have great experience in building LPG carriers up to 50 000 DWT. The first LNG vessel named "Coral Methane" with a capacity of 7500m3 and approximately 6000 DWT was launched on May 7, 2008 (the vessel was build for a Dutch owner for trading in North European waters).

On January 17, 2007 Poland and Algeria, to minimize energy and exploration, signed an agreement for delivery of LNG to Poland.

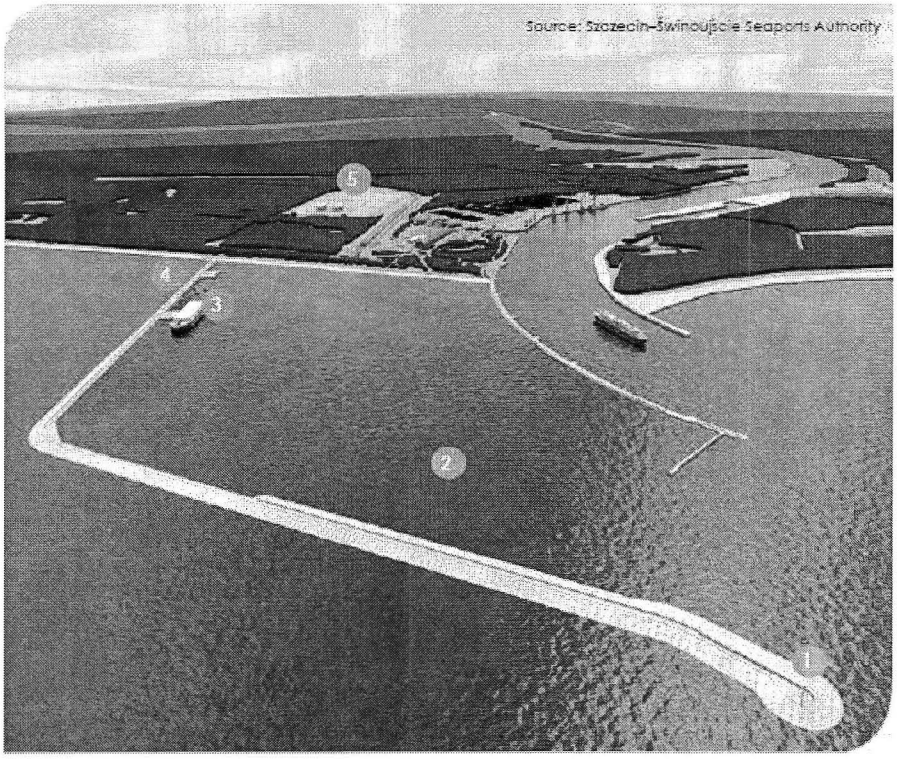
On April 17, 2007 a new company, Polskie LNG, was established for building and preparing for cargo operations for importing LNG into the port of Swinoujscie.

In 2009 a contract with Qatar Gas for delivering LNG to Polish Terminals from 2014 till 2034 was signed.

According to planned construction, there will be 2 gas tankers of 160 000 m3 each. The final productivity of the LNG Terminal provides the chance to receive close to 50% of actual Polish gas consumption. An international Consortium of the Canadian company Suanprogetti Canada Inc., Saipem SA (France), Saipem (Italy), Techint Compagnia Technica Internazionale SA (Italy) and 2 Polish companies PBG SA and PBG Export Ltd. set June 30, 2014 as the date of opening for theSwinoujscie LNG Terminal.

An underwater pipeline connecting Russia and Germany's "North Stream" which was concluded in 2011/2012 creates some problems for the Polish plan and the limiting draft of up to 13.5 meters for vessels approaching the new terminal (Fig.3).

Optimism for the new project of delivering LNG vessels gave stimulation to prepare a new project to build one more LNG terminal in the eastern part of Poland in Gdansk Bay.



Model of LNG Regasification Terminal in Świnoujście

1. Breakwater
2. External Port
3. LNG Unloading Berth
4. Pipe rack for process lines
5. LNG Terminal

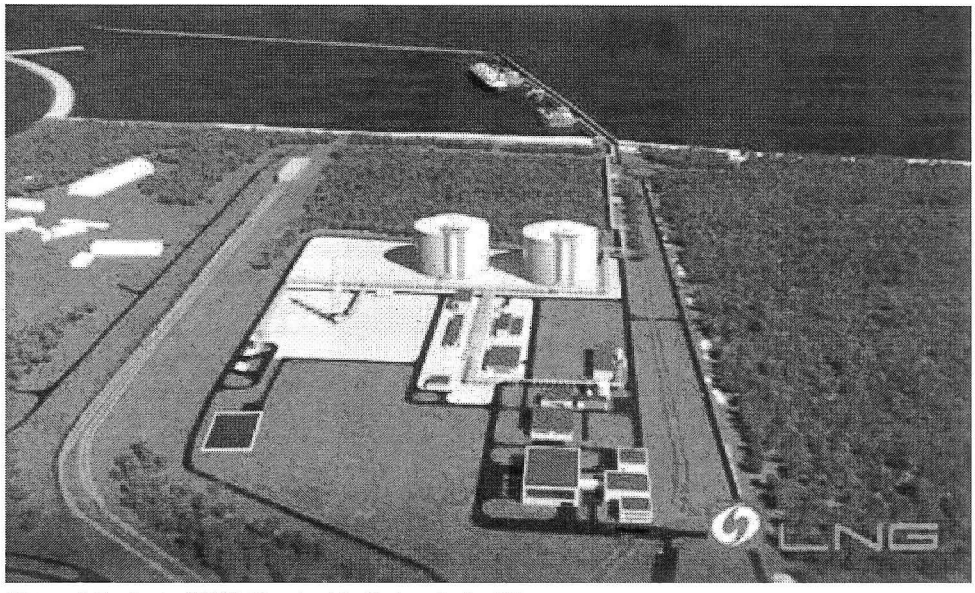


Figure 3 Project of LNG Terminal in Swinoujscie [7].

5. The shale gas revolution in Europe.

The shale gas revolution that has transformed the natural gas market in North America has yet to have an impact in Europe. The US Energy Information Administration in a recent report (April 2011) identified that the potential of shale gas technically recoverable resources in Europe are over 600 trillion ft^3, some four times more than the proven reserves of conventional natural gas (Fig.4).

Europe's Technically Recoverable Shale Gas Resources	
Country	**Resources in trillion ft^3**
Poland	187
France	180
Norway	83
Ukraine	42
Sweden	41
Denmark	23
UK	20
Romania, Bulgaria, Hungary	19
Holland	17
Turkey	15
Germany	8
Lithuania	4
Total	**639**

Figure 4 Europe's Technically Recoverable Shale Gas Resources

The growth in the role played by LNG In meeting Europe's natural gas demand is expected to continue but there will be competition from buyers elsewhere in the world for the available supplies (Fig.9).

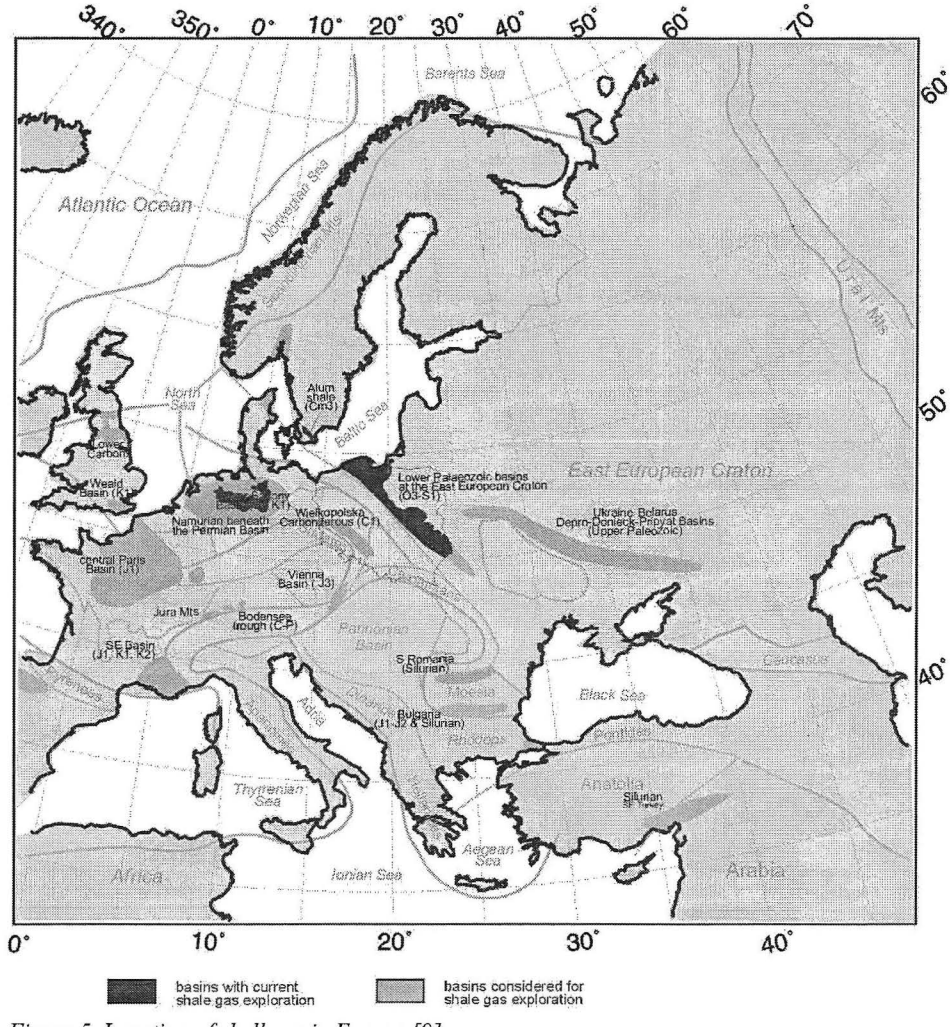


Figure 5. Location of shell gas in Europe [9].

6. First LNG carrier build in Polish Shipyard.

The April 2009 delivery of the 7,500m3 *Coral Methane* to Anthony Veder by the Polish Remontowa yard in Gdansk marks a new departure in the history of LNG ship construction. The ship is the first multipurpose gas carrier built to transport LNG, LPG and liquefied ethylene gas (LEG)

Coral Methane

Shipbuilder	Remontowa, Gdansk
Shipowner	Anthony Veder
Flag	Dutch
Year built	2009
Containment system	IMO Type C tanks
Class	BV
Intended sphere of operations	Regional distribution
Length	117.8m
Breadth moulded	18.6m
Draught, design	6.3m
Deadweight	6,150 tonnes (butane cargo)
Cargo capacity, 100%	7,500m3
Propulsion system type	Dual fuel
Propulsion power output (kW)	5,000
Service speed	14.0 knots
Main engines (four)	Rolls-Royce
Cargo system design	TGE Marine Engineering
Cargo pumps	Hamworthy Svanehoj
Inert gas generator	PSA system
Propellers	Azipull thrusters
Bow thruster	Rolls-Royce

Maritime transport of CNG seems to be an alternative solution for transport liquefied gas on short distances (up to 2000 km) and delivering smaller portions of cargo [2,5].

The maritime CNG system of transportation is sometimes called the "floating pipeline". New CNG vessels are able to carry liquefied natural gas in special tanks under a pressure of 8-10 Mpa and with a temperature mostly at -60°C.

7. Challenges for maritime education in Poland.

Deep analysis of the existing situation and the prognosis for coming years (time horizon 2014 and 2020) stimulated immediate action in establishing a program (accepted by industry) of a well organized system of education and training for cadets and officers for the LNG fleet.

In the common opinion of members of the Faculty of Navigation of GMU, the 54 hour IMO Model Course 1.06 is only a minimal standard for familiarization with LNG vessels, cargo and operations typical for that sector.

This training program for LNG junior officers has two parts:

1. Education during academic period of studies
   - Track A – LNG education during the whole academic period of studies (191 hours)
   - Track B – LNG education during the 2nd part of the period of studies (191 hours)
2. Special modules for officers Track D (139 hours).

Undergraduate studies
Faculty of Navigation

	Semesters I + II	Semesters III + IV	Semesters V + VI	9 months from June till March	Semester VII	Graduation
Track C				Non liquid cargo vessel practice		
Track B		SM 1,2,3		LNG LPG/Tankers practice	SM 4	
Track A	SM 1	SM 2	SM 3		SM4	

Module 1 – LNG elementary knowledge
Module 2 – LNG ship operation
Module 3 – LNG Safety course
Module 4 – Senior cadets

Post graduate studies
M. Sc.
Faculty of Navigations
2 semesters

Offshore Operations from 2010	Ship Management from 2012	Ship Surveyor from 2013	LNG Operations from 2012

Master of Science project

Track D (experienced tankerman officers) should pass 139 hours special formed LNG course (3 weeks)which replace and modify IMO model course 1.06 (54 hours).

8. Conclusions.

New regulations concerning environmental protection and control of the emissions of NOx, SOx and vessel dust (3 kinds of air pollution) caused perhaps the most realistic solution: NEW FUEL – LNG. Different simulations of the cost of building new vessels with dual fuel supply engines in parallel with the equipping of existing vessels with machinery increasing the emission of pollutants are reasons to establish a system of LNG bunkering stations on the Baltic Sea.

The crucial interest for Poland are:

- economical independence,
- diversification of suppliers (exporters) of LNG,
- exploration of rich natural sources of shale gas located in Poland
- reach a level of 40% of national consumption of LNG delivered by LNG Carriers.
- Plans to start to build a second LNG import terminal in Gdansk (2016-2018).

The Faculty of Navigation in cooperation with the Engineering Department will initiate, in Oct 2012, a new system of specialization for a group of 20-25 students educated and trained specially for LNG vessels.

Experience in building modern LNG vessels in Remontowa Shipyard in Gdansk gives the chance to establish a specialized Polish LNG shipping company which will be operating 35000 – 70000 m³ capacity LNG Carriers.

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