Nordic Yards and innovative solutions for (LNG) in Arctic regions

MarTech – LNG
09.01. – 10.01.2014 Technologiezentrum Warnemünde
Contents

1. Nordic Yards with the ship yards in Wismar and Warnemünde
2. POLAR
3. Technology platform POLAR
4. Key points - POLAR
5. The role of Nordic Yards in POLAR
   a) Development of icebreaking ship structures
   b) Development of a LNG-Tank A concept for Arctic LNG-Ships
   c) Use of the Nordic Yards own LNG tank type A tanks system as Fuel tank
   d) The Nordic Yards POLAR-Mock-Up-Program
Nordic Yards overview
Company structure

» **Owner:** Nordic Yards is a privately owned group of companies

» **Start-up:** Mid 2009: Take over of the yards in Wismar and Rostock-Warnemünde (Asset Deal)
Nordic Yards overview
Facilities | Warnemünde

- **Shipyard area:** 850,000 sqm, 85,000 sqm roof-covered
- **Dry dock:**
  - length 320 m x width 54 m x height 80 m
- **Crane capacity:** 600 t
- **Hook height:** 77 m

- Special dry dock assembly procedures for large-scale offshore projects
- extensive areas for transport, temporary storage and final assembly
- very high colouring and conservation capacities
- high steel throughput (up to 55,000 t per year)
Nordic Yards overview
Warnemünde | Production workflow
Nordic Yards overview
Wismar | Production workflow
Company profile
Maritime expertise since 1946

1946:
Foundation of the yards in Wismar & Warnemünde

1951
1957
1964 - 1972
1978 - 1982
1986 - 1989
1995
2000
2001
2009: Nordic Yards

Wismar:
Combined container passenger ship PCV 400

Warnemünde:
First ship constructed of steel

Warnemünde:
First ocean-going ship delivered

Wismar:
Reefer and transport ships – Type: Kristall
Insulation method is the cutting-edge technology at the time

Wismar:
Rail freight ferries type EGF
Very short turnaround time

Warnemünde:
Semi-submersible, self-positioning drilling platform CS 30 “Stena Don”

Wismar:
Seagoing passenger ships – Ivan Franco-Series
At the time the largest of its type delivered by a German shipyard

Wismar/Warnemünde:
CV 5500
Largest container ship built at the yards
Global offshore market leader in the HVDC converter platform segment

Ferry champion: supplier of the world's largest RoPax ferries

First-class construction facilities: the most modern roofed dry dock facilities in Europe

Top Employer: one of the largest employers in the Baltic region

Deliveries and orders in the past four years:
Nordic business units 2013
Nordic Arctic Projects

B047 | Nordic AC-IB 1400 | Ice-breaking container ship

B048 | Nordic SDIB | Icebreaker

B073 | Nordic ALNGC 175 | LNG-Carrier
Polar

Production-Operation-Living-Arctic-Region

Polar – Modular construction system

» Systems development
» Interface development
» System integration

13 alliance partner
Key points

Technology platform

Modular system for transportation, storage and processing of gas under extreme environmental conditions

System technology

<table>
<thead>
<tr>
<th>Special ships and offshore structures</th>
<th>Topside Equipment</th>
<th>Tank periphery</th>
<th>Living quarters and Service Module</th>
</tr>
</thead>
</table>

Production

- LNG - Carrier
- FPSO / FSO
- Offshore- Conveyor systems
Key points - POLAR?

**IMG GmbH**

» System Engineering for welding equipment
   » Laser-hybrid welding equipment
   » Automatic welding equipment for arctic ship structures

» System engineering for transportation of heavy load blocks / units inside and outside of arctic region
Key points - POLAR?

Developing of a concept for an Arctic LNG-Tanker designed for the Yamal project

⇒ Nordic Yards design

Developing of solutions for Nordic Yards for "LNG as Fuel" with its own LNG tank system and solutions for double-walled pipelines
The role of Nordic Yards in POLAR

- Nordic Yards was team leader in the joint project 2;
- has worked in the development of ship structures for use in the Arctic;
- has its own LNG tank system developed for LNG as fuel;
- a main point for Nordic Yards was to find future solutions for the theme winterization for Arctic ships;
- Improved knowledge on the subject of LNG as Fuel.
Development of ship structures to break ice under Arctic conditions up to 2m → particular in the forebody and afterbody

- Hull design with ice strengthening in bow and stern area.
- In the stem bar area is a full cross-section of each frame arranged.
- Ice intermediate frame placed on each half frame.
- Longitudinal stringers are placed at a distance of 1.20m in addition.
- Local stiffening on the shell ➔ eventual ice blast.
- Above the frame floor web frames used on every 2nd frame. The shell itself is reinforced with longitudinal frames.

Closely frame spacing with high and compact frames.
Development of LNG-Tank A concept to use under Arctic conditions

<table>
<thead>
<tr>
<th>Location</th>
<th>Normal and equivalent stress [N/mm²]</th>
<th>Shear stress [N/mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>238</td>
<td>127</td>
</tr>
<tr>
<td>MIG weld</td>
<td>131</td>
<td>70</td>
</tr>
</tbody>
</table>

**ULS acceptance criteria**

- VON MISES equivalent stresses, double hull
- VON MISES equivalent stresses, internal structure, stress range 131 N/mm²

Tank supports designed by Nordic Yards

Support Boundary Conditions and Loads

Certificate n° DT4/1/03265
Rev. 0 – 14th December 2011

**Basic Concept Approval Certificate**
(Approval in Principle)

At the request of:

NORDIC YARDS

BUREAU VERITAS, acting within the scope of the general conditions of the Marine Division 

Prismatic, Self supported LNG containment system
ALUMINIUM DOUBLE BARRIER TANK (ADBT)
for LNG storage and marine transportation

(for liquified gases cargo tanks as defined in BV Rules, Part D, chapter 9 and in the IMO IGC Code).
Development of LNG-Fuel tank system type A based on the ADBT-System ➔ Focus was on the development of the double wall tank dome according to the type A tank system.

The design was tested in a mock-up program.
Fabrication of LNG ADBT-System / Assembly of LNG-Tank system

Double wall profiles are connected by Friction Stir Welding

Tank fabrication and ship construction can be realized independently.
Development of special winterization design for equipment on deck on Arctic ships.

**Input**

- **Anti-icing**
  - valve DN200
  - winterization with heating, insulation and presenning

- **De-icing**
  - two different systems
  - de-icing system by R&M versus de-icing with mallet

**Output**

- **Anti-icing**
  - knowledge about the function of the valve and winterization at -50°C.

- **De-icing**
  - knowledge of the de-icing system by R&M and visual inspection of the winterization measure after mallet test
High point last year was the mock-up program ➔ the verification of all (so far) obtained theoretical results.

Three large main points
Components

Fuel Dome (Unit 1)  Expansion Loop (Unit 2)  Double Wall Pipe (Unit 3)
Unit 1

- tank dome of an atmospheric pressure LNG-tank (300m³-400m³)
- scale 1:1 (tank dome and pipe system)
- dimensions of mockup:
  - height: 2m / width: 1.7m / length: 3.5m
  - pipe diameter: DN25 & DN80
- all components of unit 1 are made of aluminium
- installation of all system-relevant piping within mockup
- tank dome has a double barrier
Unit 1

Input
Design space-saving close to reality regulations and rules into account
Welding create different WPS the need to develop test procedures

Output
Design compare theoretical investigations with simulation results
Welding qualification of personnel experience with alternative test procedure like helium leak test
Unit 1 and 3 cryogenic tests

data test track
» temperatures down to -190°C
» blower 2.2kW
» 11,000l nitrogen
» dimensions:
  length:15m / pipe diameter: DN80 / DN125
Unit 1 and 3 cryogenic tests

» nitrogen flow in selected pipes
» cool down: 35h
» 40 measuring points for temperature
e.g.: inside and outside pipe/ inside and outside tank dome/ on connection-box

» nitrogen flow in inner pipe
» vacuum in the barrier
» cool down: 1h
» holding time: 1h
» 40 measuring points for temperature
e.g.: inside and outside innerpipe/ on the bulkhead/ on the double barrier
Thank you for your attention!