Experience of LNG Shipping in the Arctic

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March 5th, 2020 / 15th Arctic Passion Seminar
Today’s Agenda

1. MOL Fleet
2. Yamal LNG Project
3. Arc7 Ice Breaking LNG Carriers
4. Ice Trial of Arc7 LNGC “Vladimir Rusanov”
5. Experience of LNGC Operation in the Arctic
1. MOL Fleet
1. MOL Fleet

Total Fleet of World Major Shipping Company * as of March 2019

- MOL
  - 839 vessels
  - 63 million DWT

MOL is one of the world biggest Shipping Company operating around 840 vessels in total.
1. MOL Fleet

LNG Carrier Fleet of Major LNG Carrier Operator

MOL has operated LNG carriers since 1983 and kept our position of the world biggest LNGC operator.
2. Yamal LNG Project
2. Yamal LNG Project

**WINTER** (mid Nov〜June)
- ARC7 LNGCs shuttle to Europe
- Less Ice-classed LNGCs to Asia
  - Distance: 13,700 miles
  - One voyage: 40 days @14 knots

**SUMMER** (July〜mid Nov)
- ARC7 LNGCs to Asia via NSR transit.
  (Northern Sea Route)
- Less Ice-classed LNGCs to Asia
  - Distance: 4,900 miles
  - One voyage: 20 days @10 knots

Northern Sea Route

Western Route

YAMAL LNG Terminal

European Port

CO2 Emission

abt. 30% reduction

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2. Yamal LNG Project

**LNG Plant Information**

<table>
<thead>
<tr>
<th>Location</th>
<th>Yamal Peninsula (Russia)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Share Holder</strong></td>
<td>NOVATEC(Russia) 50.1%</td>
</tr>
<tr>
<td></td>
<td>CNPC(China) 20%</td>
</tr>
<tr>
<td></td>
<td>TOTAL(France) 20%</td>
</tr>
<tr>
<td></td>
<td>SilkRoad Fund(China) 9.9%</td>
</tr>
<tr>
<td><strong>Production Capacity</strong></td>
<td>16.5 million tons / year</td>
</tr>
<tr>
<td></td>
<td>(5.5 mtons/year x 3 train)</td>
</tr>
<tr>
<td><strong>Plant Start</strong></td>
<td>Train 1 in 2017</td>
</tr>
<tr>
<td></td>
<td>Train 2 in 2018</td>
</tr>
<tr>
<td></td>
<td>Train 3 in 2018</td>
</tr>
</tbody>
</table>

**LNG Transportation**

by ARC7 Class Ice-breaking LNGC

<table>
<thead>
<tr>
<th>Fleet</th>
<th>15 vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>L 299m x B 50m x D 26.5m</td>
</tr>
<tr>
<td><strong>Owner</strong></td>
<td>TEEKAY x 6 vessels</td>
</tr>
<tr>
<td></td>
<td>DYNAGAS x 5 vessels</td>
</tr>
<tr>
<td><strong>MOL x 3 vessels</strong></td>
<td>SOVCOMFLOT x 1 vessel</td>
</tr>
</tbody>
</table>

Arc7 Ice Breaking LNGCs “Vladimir Rusanov”
3. Arc7 Ice Breaking LNG Carriers
3. Arc7 Ice Breaking LNG Carriers

Outline Specification

<table>
<thead>
<tr>
<th>Builder</th>
<th>DSME (Korea)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2016 ~ 2019</td>
</tr>
<tr>
<td>Classification</td>
<td>Class BV &amp; RMRS</td>
</tr>
<tr>
<td>Ship Dimension</td>
<td>Loa 299m x B 50m x D 26.5m</td>
</tr>
</tbody>
</table>
4. Ice Trial of Arc7 LNGC “Vladimir Rusanov”
4. Ice Trial of Arc7 LNGC “Vladimir Rusanov”

Ice Trial Period & Location

- **Trial Period**: 24th February to 11th March, 2018 (16 days)
- **Trial Area**: Kara Sea in Russia
4. Ice Trial of Arc7 LNGC “Vladimir Rusanov”

Movie

https://www.youtube.com/watch?v=mrAfC15QV60
5. Experience of LNGC Operation in the Arctic
### 5. Experience of LNGC Operation in the Arctic

#### MOL- Arc7 Ice Breaking LNG Carrier Fleet

<table>
<thead>
<tr>
<th>Name</th>
<th>Delivery Date</th>
<th>Operation Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLADIMIR RUSANOV</td>
<td>March 2018</td>
<td>2 years</td>
</tr>
<tr>
<td>VLADIMIR VIZE</td>
<td>September 2018</td>
<td>1.5 years</td>
</tr>
<tr>
<td>NIKOLAY URVANTSEV</td>
<td>July 2019</td>
<td>0.6 years</td>
</tr>
</tbody>
</table>
5. Experience of LNGC Operation in the Arctic

Total Number of Voyage (3 vessels)

<table>
<thead>
<tr>
<th>Voyage Route</th>
<th>Total Voyage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sabetta(Yamal) ↔ European Port</td>
<td>27</td>
</tr>
<tr>
<td>2. Sabetta(Yamal) ↔ East Asian Port (China)</td>
<td>7</td>
</tr>
<tr>
<td>3. Sabetta(Yamal) ↔ STS @Norway(*)</td>
<td>25</td>
</tr>
</tbody>
</table>

(*) Ship to Ship Cargo Transfer from Arc7 LNGC to conventional LNGC.
5. Experience of LNGC Operation in the Arctic

First East-bound Transit of NSR by “Vladimir Rusanov” in June 2018

Total 19 days voyage from Sabetta to Far East via NSR
( ⇔ abt 35 days by Suez Chanel Route)

6/25 Depart from Sabetta
7/5 Passing through Bering Strait 11 days in NSR, Ave Speed 10knot
7/17 Arrive at Unloading Port in China 8 days (except for time adjustment)
5. Experience of LNGC Operation in the Arctic

First East-bound Transit of NSR by “Vladimir Rusanov” in June 2018

① Kara Sea
- Open sea or light ice
- Basically using ahead mode but use astern mode twice when vessel stacked in a ridge ice.

② Laptev Sea
- Open sea or light ice
- Ahead mode operation
- Vessel chose south route considering ice radar and satellite photo.

③ East Siberian Sea
- Heavy ice (max. 2m)
- Vessel stacked on the heavy ice twice and use astern mode.
5. Experience of LNGC Operation in the Arctic

West-bound Transit of NSR by “Vladimir Vize” in Nov. 2019

8.5 days in NSR, Ave Speed 11.5 knot

11/16 Passing through Bering Strait
11/24 Arrive at Sabetta

- 80% Sea Ice Concentration from East Siberian Sea to Kara Sea. Ice thickness seems to be around 0.3~0.8 m.
- Only ahead mode operation.

Infrared Camera on Bridge Wing
5. Experience of LNGC Operation in the Arctic

West-bound Transit of NSR by “Vladimir Vize” in Nov. 2019

Vladimir Vize Ship's Operation Data in NSR (Chukuchi Sea Nov16- Kara Sea Nov24)

- **Operation Speed**: 11~12 knot
- **Azipod Load**: 30~60 %
- **Azipod Torque**: below 60%
- **(Ref: Ice Thickness**: 0.3~0.8m)
5. Experience of LNGC Operation in the Arctic

First Ship-to-Ship Transfer Operation at Norway in Nov. 2018

- "Vladimir Rusanov" experienced first STS transfer operation of Yamal Arc7 LNGC in Honningsvag, Norway.
- More than 120 times STS operation in Norway were carried in total by Yamal fleets. (total 15 vessels)
Summary
Summary

- MOL has been operating Arc7 Ice-Breaking LNG Carriers in the arctic since 2018.
- Two years experience makes crews get familiar with vessel operation in ice water which contribute to a safe voyage in the arctic.
- MOL contributed to growing in diversity of LNG trade in the arctic by east-bound transit of NSR to far east and Ship-to Ship transfer operation.
- MOL continues to work assiduously to ensure stable LNG transportation as well as for other energy resources and product transportation through the NSR, where demand is expected to grow in the future.
Thank you for your kind attention!!