

LNG transportation from the Arctic Ocean ~Yamal LNG Project~



June 2018

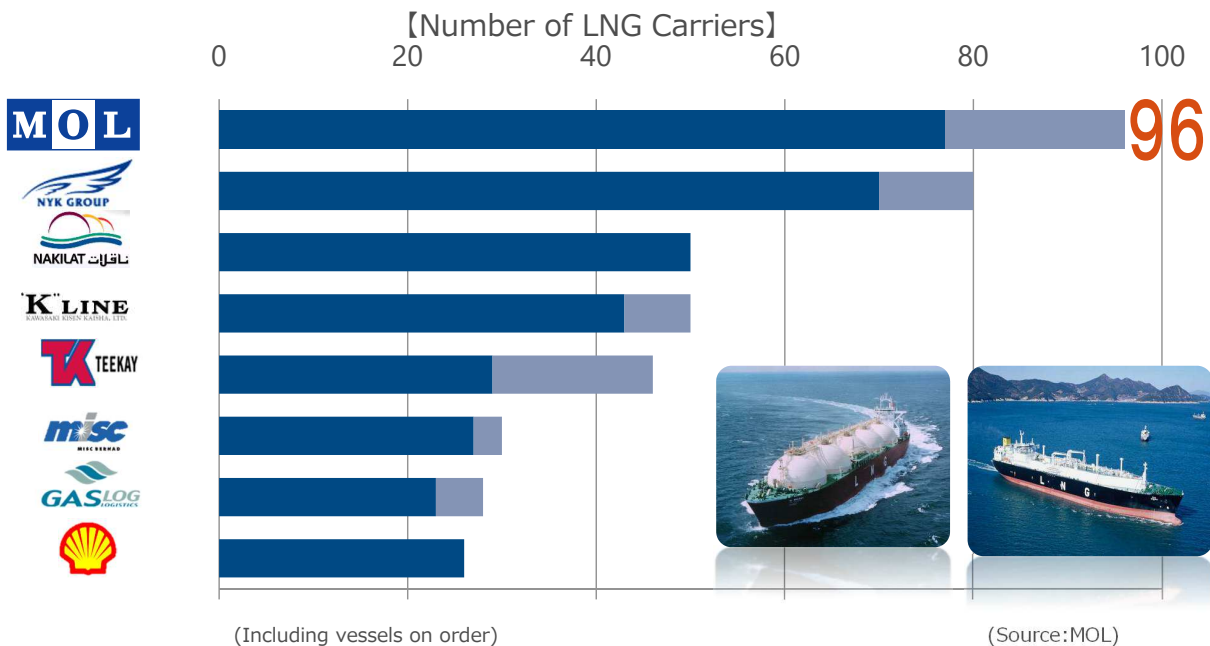
Yoshikazu Kawagoe

Senior Managing Executive Officer

Mitsui O.S.K. Lines

MOL's Market Position in LNG Shipping

MOL has the largest fleet of LNG Carriers in the world.



MOL's Market Position in LNG Shipping



Challenging for Technical High Level Project
 ⇒ Participation in **“YAMAL LNG Project”**



Project Outline



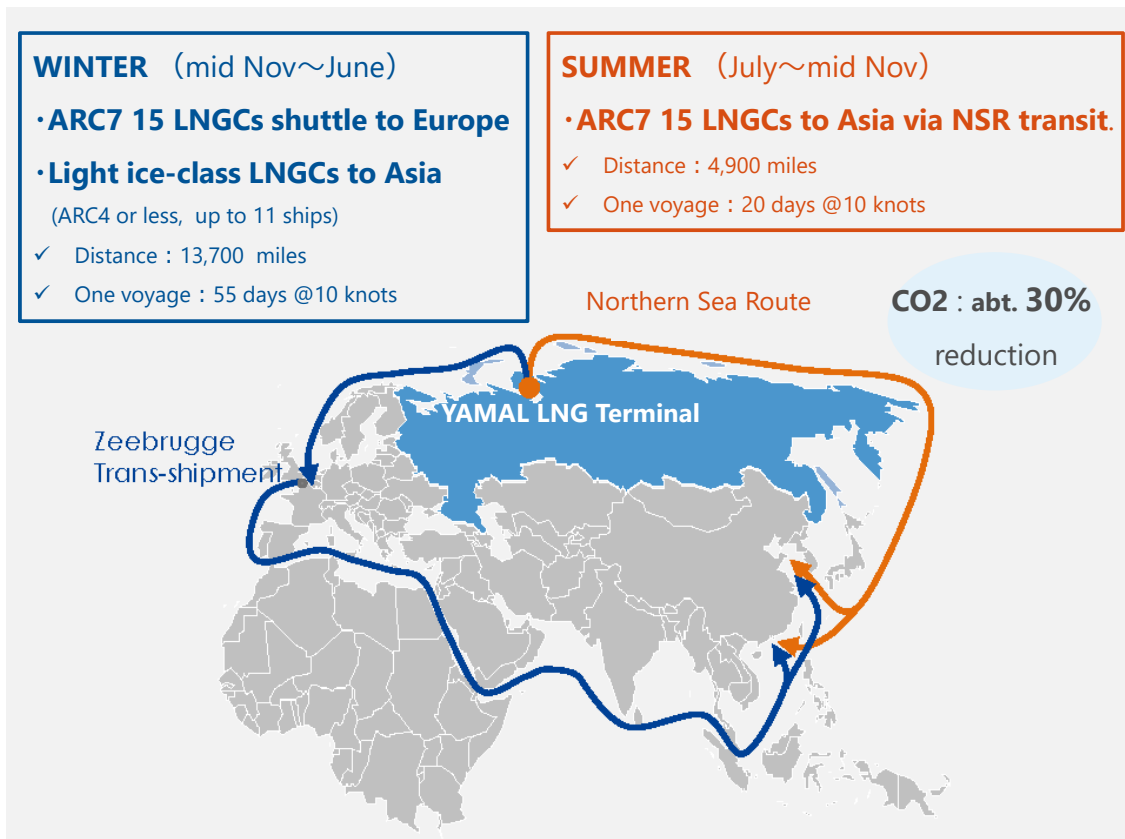
YAMAL LNG Project	
Share Holder	NOVATEC 50.1% CNPC 20% TOTAL 20% SILKROAD FUND 9.9%
LNG Production	16.5million tons / year (5.5 million tons / year x 3 Train)
Production Start	Train 1 in 2017 Train 2 in 2018 Train 3 in 2019

LNGC Fleet Plan

	Ship Owner Ship's Name	Shipbuilding Completion
1	Sovcomflot	2016, November
2	Dynagas/CLNG/Sinotrans	2017, July
3	Dynagas/CLNG/Sinotrans	2017, September
4	Teekay/CLNG	2017, October
5	MOL/China Cosco Shipping Vladimir Rusanov	2017, December
6	Teekay/CLNG	2018, July
7	MOL/China Cosco Shipping	2018, September
8	Dynagas/CLNG/Sinotrans	2018, October
9	Dynagas/CLNG/Sinotrans	2018, November
10	Dynagas/CLNG/Sinotrans	2018, December
11	Dynagas/CLNG/Sinotrans	2019, April
12	Teekay/CLNG	2019, July
13	MOL/China Cosco Shipping	2019, September
14	Teekay/CLNG	2019, October
15	Teekay/CLNG	2019, November



LNG Transportation Plan



Benefit of Arctic Sea Route

<Benefit>

- Short-cut transit route from Europe to Asia
 - Energy Saving
 - Multiple option of transit routes
- Access to potential energy resource in Arctic ocean
 - Arctic water accounts:
 - 17% of discovered natural gas in the world
 - 30% of undiscovered natural gas in the world



<Outstanding>

- Ice navigation Crew training
- Crew health: Polar night/Polar day
- Infrastructures: SAR station(Search & Rescue), Repair dockyard, Airport
- Limited telecommunication environment
(large capacity communication service is not available)
- Custom clearance in Russia
- Bathymetry data (insufficient navigation chart)
- Ice map provider - Weather forecasting system



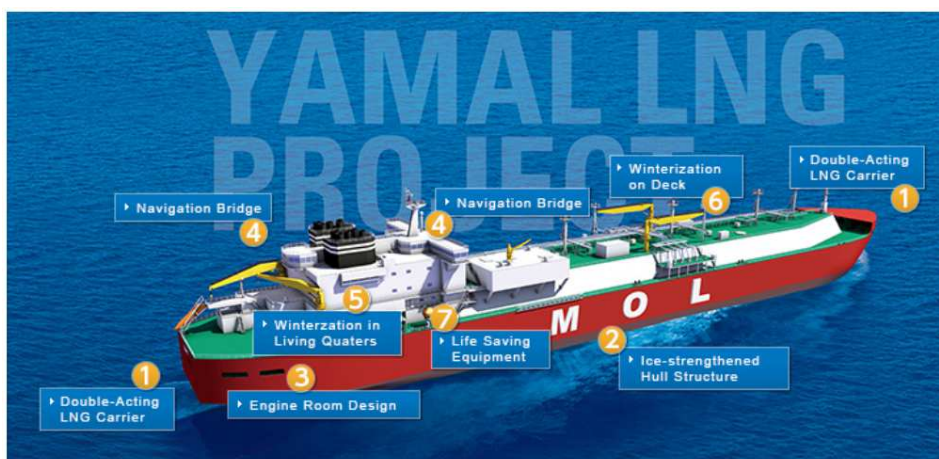
YAMAL ARC7 LNGCs - Vessel Specification

ARC7 LNGC (15 vessels) Principal Particulars	
Builder & Delivery year	DSME in Korea, Delivery Year: 2016:(1), 2017:(4), 2018:(5), 2019:(5)
Ship Owners	Sovcomflot (1), Teekay (6), Dynagas (5), MOL (3)
Classification Society	Class BV & RMRS
Ship Dimension	Loa 299m x B 50m x D 26.5m x Ice draft 12.0 m
Cargo Tank	GTT No96 Membrane, 172,600 m ³ (100% filled)
Propulsion	AZIPOD 3 units (DFDE Generator 6 sets)
Ice Class	RMRS ARC-7 (1st year ice, 210cm thick), Winterization -52 deg.C.



YAMAL ARC7 LNGCs - Vessel Specification

1, Double Acting LNG Carrier	Ship Speed (Ahead 2kts/Astern 5 kts) at 1 st year 150cm Level Ice
2, Ice Strengthened Hull Structure	25% increased hull steel, up to 70mm thick, Low temp steel, Ice coating
3, Engine Room design	Complete double hull, Two engine rooms (center bulkhead), Ice Sea chest
4, Navigation Bridge	Dual bridge stations , Totally enclosed, Polar design Nav./Radio equipment
5, Winterization in Living Quarters	Triple source heating system, Sauna/Hot water swimming pool
6, Winterization on Deck	Semi enclosed mooring space, Electric driven, Heat tracing, De-icing
7, Life Saving Equipment	Polar design LSA, Survival kits



Features of YAMAL Arc7 LNGC

Double Acting Operation



Propulsion Performance

	Ahead	Astern
Open Sea	19.5knot	-
Level Ice 1.5m	2knot	5knot

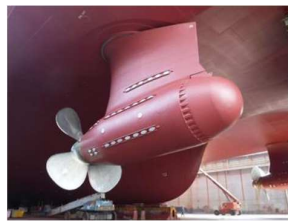
Ice Knife

Bow is reinforced by casting construction.



3 POD Propulsion system

enable double acting operation easily.



Dual Bridge Station



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H2424 Vladimir Rusanov Ice Trial



Ice Trial

Triarl Period Feb.22-Mar.15, 2018

Test Area Kara Sea

Purpose

- ① Ice Performance Capability (Speed/Turning)
 - ② Operation of Azipod & Main Generator
 - ③ Operation under Low Temp. Environment
- + α : Familiarization for Ice Navigation (Crew)



H2424 Vladimir Rusanov Ice Trial

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Thank you for your attention