

26th World Gas Conference

1 – 5 June 2015 – Paris, France



TS PGCD.1 Remote LNG

The Arctic Ice-Breaking LNG Carrier for Yamal LNG

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The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

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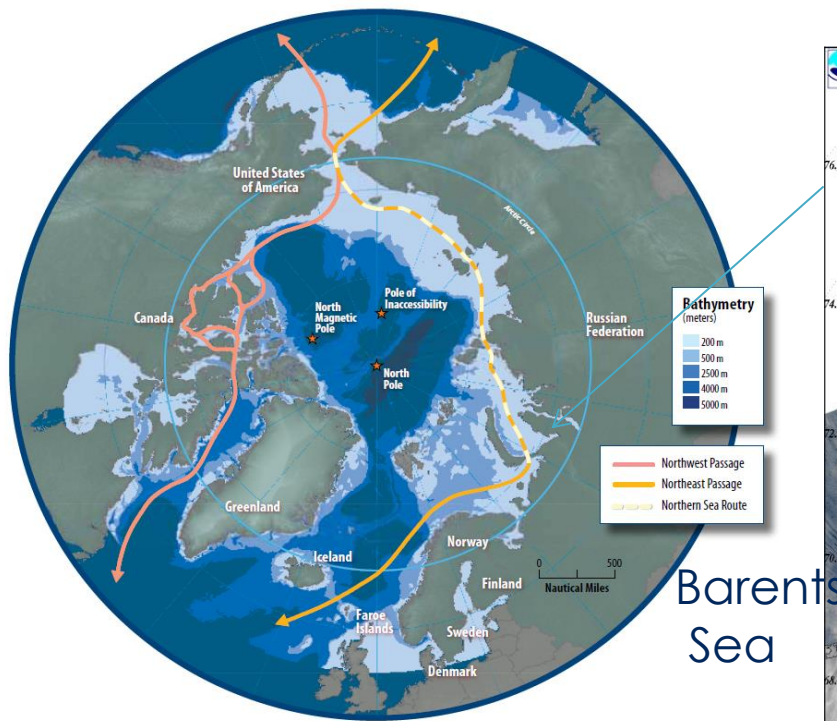
Aims

Methods

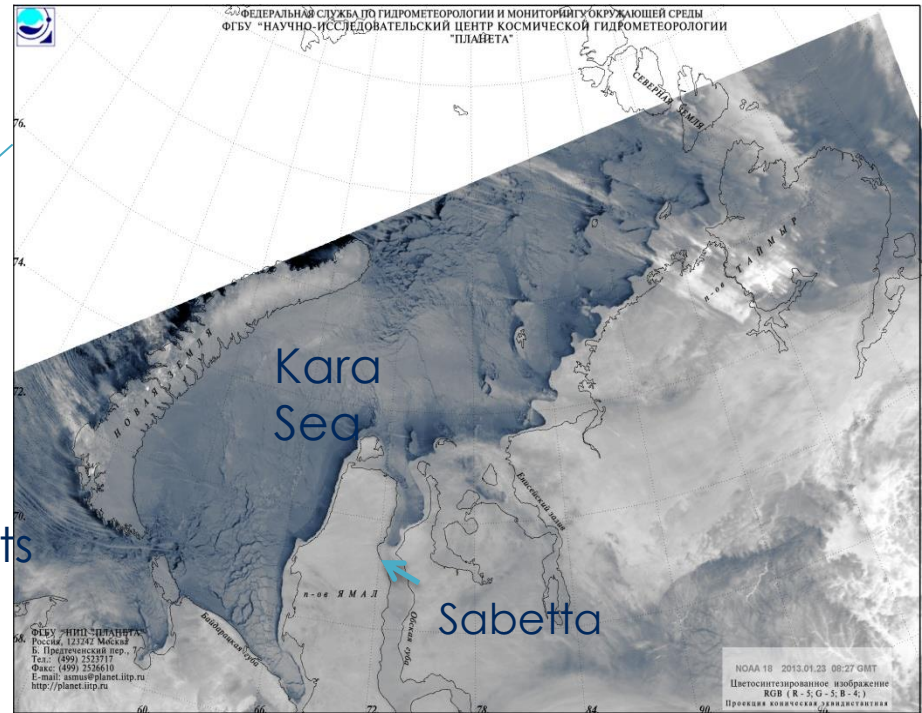
Results

Summary & Conclusions

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



Map 2.1 The Arctic marine area. Source: AMSA



The Northern Sea Route

The Yamal Peninsula

The background

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



Total of Transit Voyages in 2010-2013

	2010	2011	2012	2013
Total Volume of Transit Cargo, t	111 000	820 789	1 261 545	1 355 897
Total Number of Transit Voyages	4 (2 of them in ballast)	34 (10 of them in ballast)	46 (13 of them in ballast)	71 (22 of them in ballast)

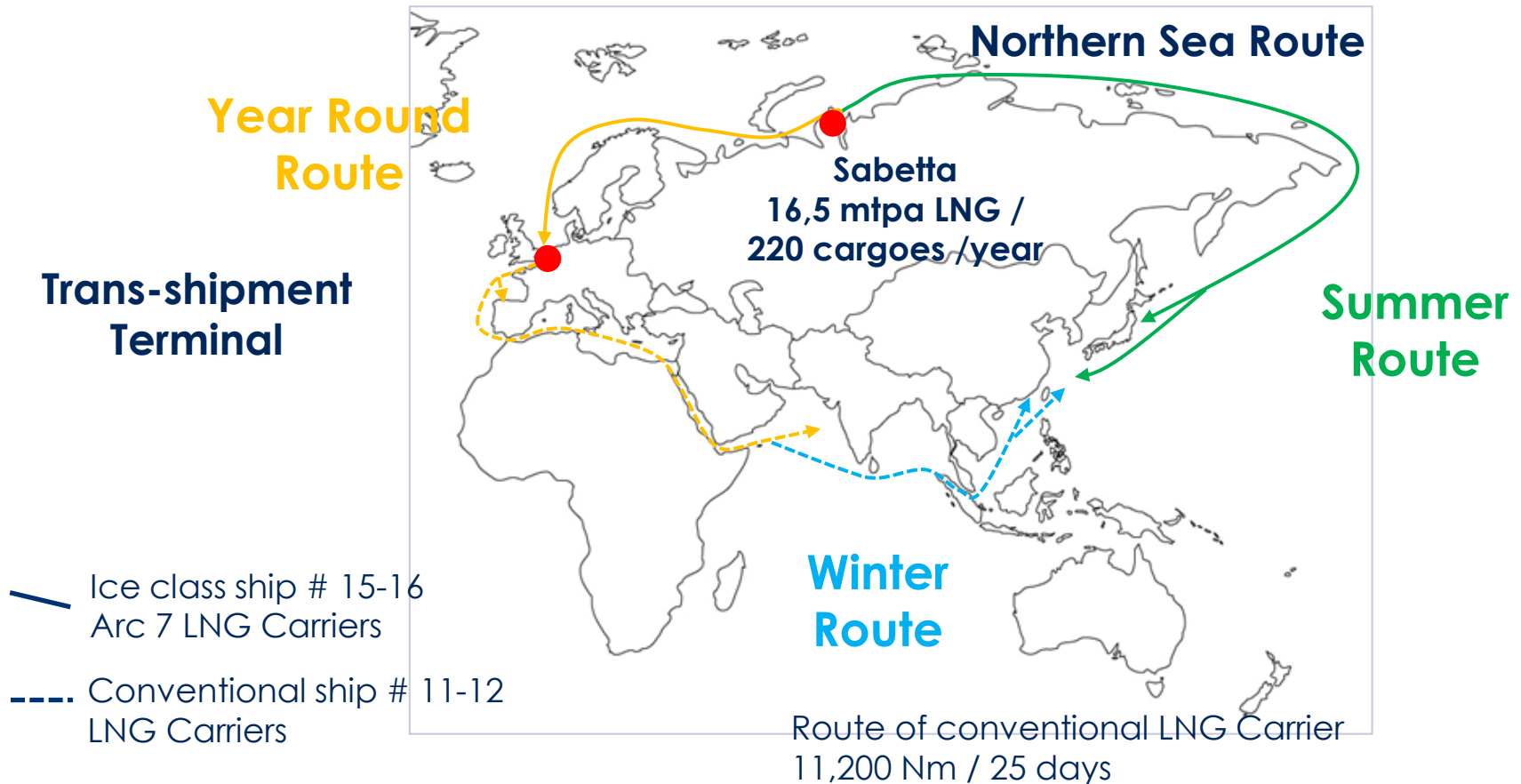


Question : To be or not to be independent from Ice-Breakers ?

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

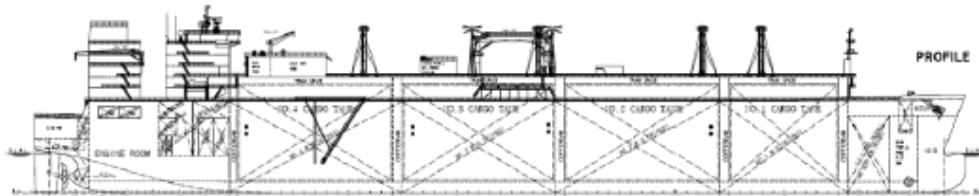
Westbound : annual ice
Average ice extension : 830
Nmiles / 2,900 Nm – 7/9 days

Eastbound : pluri-annual ice
Average ice extension 2,100
Nm / 4,900 Nm – 14/16 days



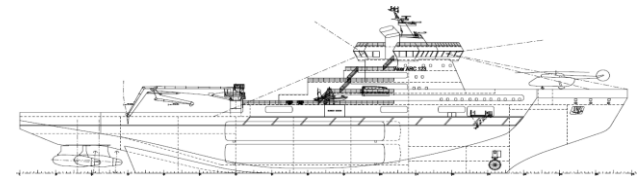
The Shipping scheme of the Project

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



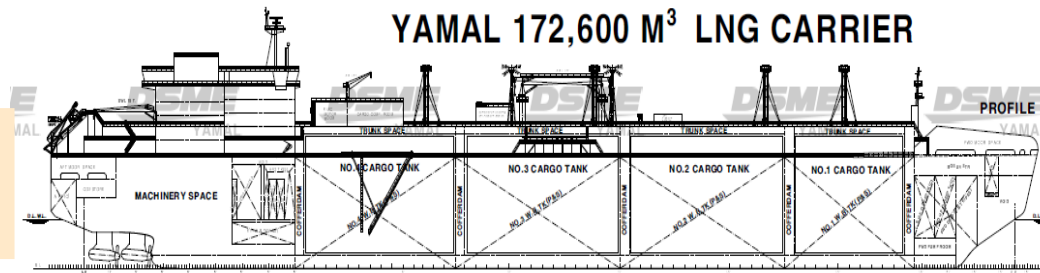
a Conventional LNG Carrier

+



an Ice-breaker

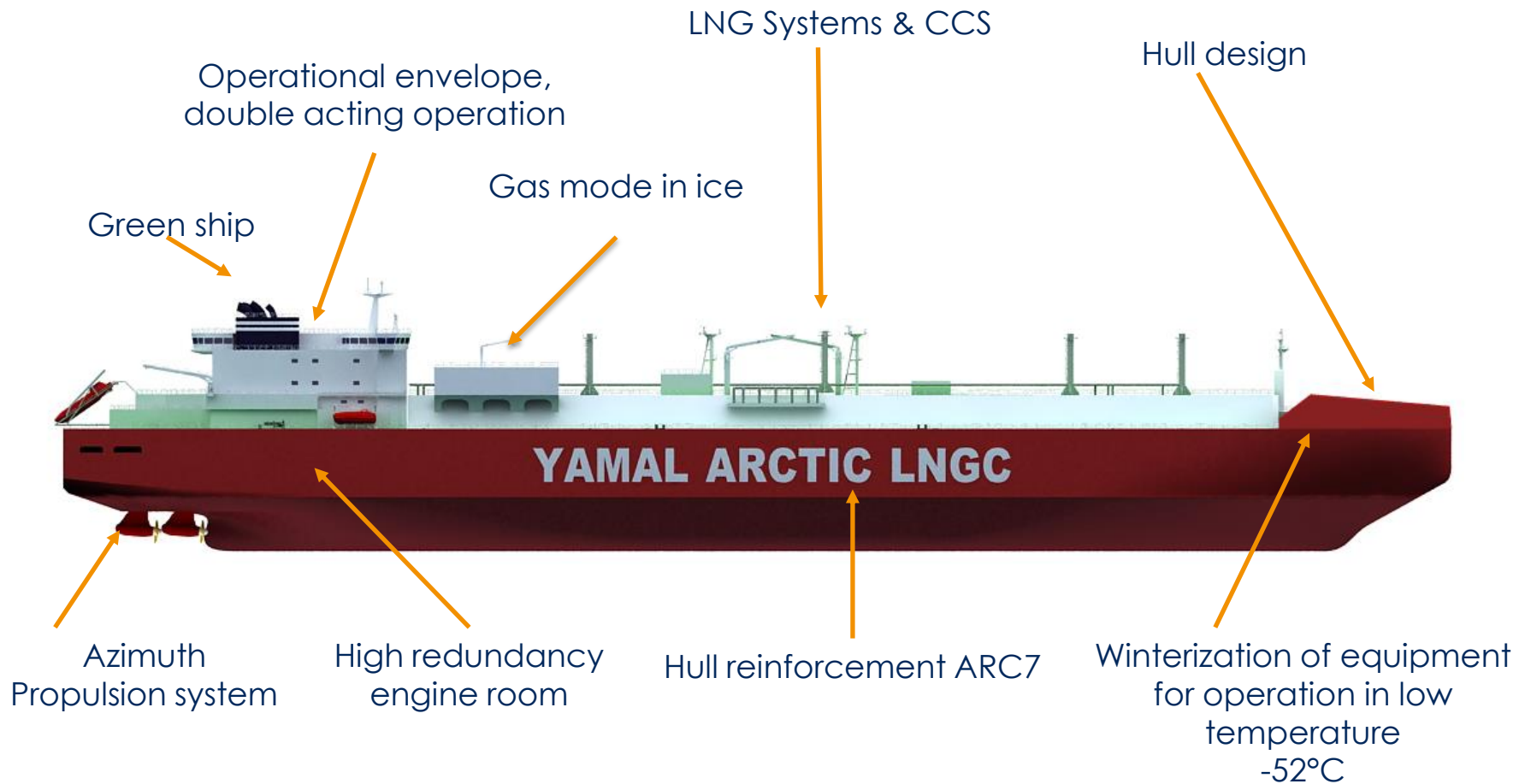
No : It's an High Ice-Class Double-Acting LNG Carrier



Astern first in hard ice condition

Ahead first in open water and light ice condition

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



Main Particulars : LOA : 300 m / B : 50 m / Draft : 12 m
172,600 m³ Cargo Capacity / BOR : 0.13%/vol/day / 45 MW propulsion power

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

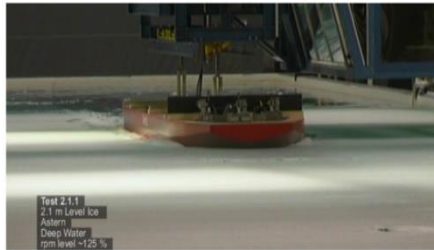
COMPUTER DESIGN AND MODEL TESTS FOR OPTIMIZING HULL AND PROPULSION



Several Propulsion Concepts



Several Bow Concepts



Several Testing Facilities



Several Test Programs



The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

2. For ships with category of ice strengthening Arc4 – Arc9 during the period of navigation from July to November

3. For ships with category of ice strengthening Arc4 – Arc9 during the period of navigation from January to June and in December

Category of ice strengthening of ship	Mode of ice navigation	Kara Sea		Laptev Sea		East-Siberian Sea		Chukchee Sea
		south-western part	north-eastern part	western part	eastern part	south-western part	north-eastern part	
		HML	HML	HML	HML	HML	HML	
Arc4	Ind	- + +	- + +	- - +	- - +	- - +	- - +	- + +
	IA	+ + +	+ + +	- + +	- + +	- + +	- + +	- + +
Arc5	Ind	+ + +	+ + +	- + +	- + +	- + +	- + +	- + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc6	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc7	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc8	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc9	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +

Category of ice strengthening of ship	Mode of ice navigation	Kara Sea		Laptev Sea		East-Siberian Sea		Chukchee Sea
		south-western part	north-eastern part	western part	eastern part	south-western part	north-eastern part	
		HML	HML	HML	HML	HML	HML	
Arc4	Ind	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- - +	- - +	- - +	- - +	- - +	- - +	- - +
Arc5	Ind	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- - +	- - +	- - +	- - +	- - +	- - +	- - +
Arc6	Ind	- - +	- - +	- - +	- - +	- - +	- - +	- - +
	IA	- - +	- - +	- - +	- - +	- - +	- - +	- - +
Arc7	Ind	+ + +	- + +	- - +	- - +	- - +	- - +	- + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc8	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Arc9	Ind	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
	IA	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +

Arc7 vessels can operate year-round independently from IA (Ice-breaker Assistance) in South Western part of Kara Sea

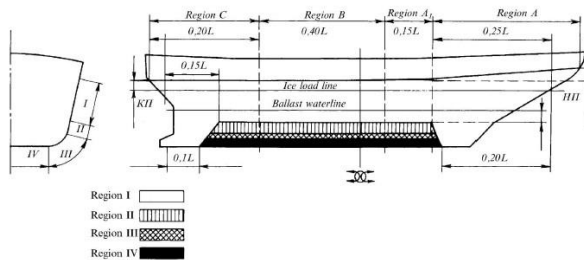
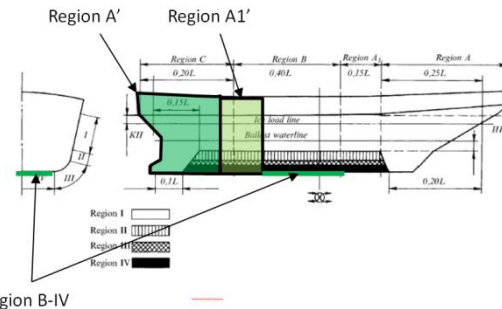
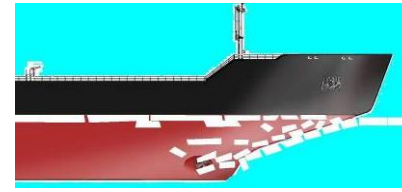


Fig. 3.10.1.3.3
Regions of ice strengthening of icebreakers



Ice Class Notation and Hull reinforcement

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

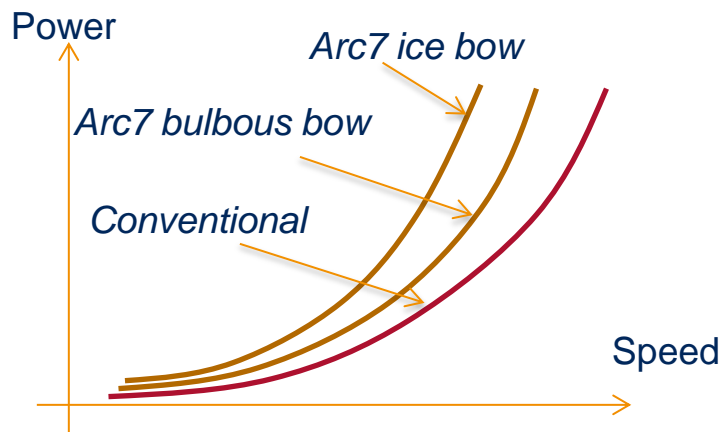


Currently NSR Administration and RMRS rules do not allow bulbous bow for vessels with Ice Class above Arc 4 along the NSR

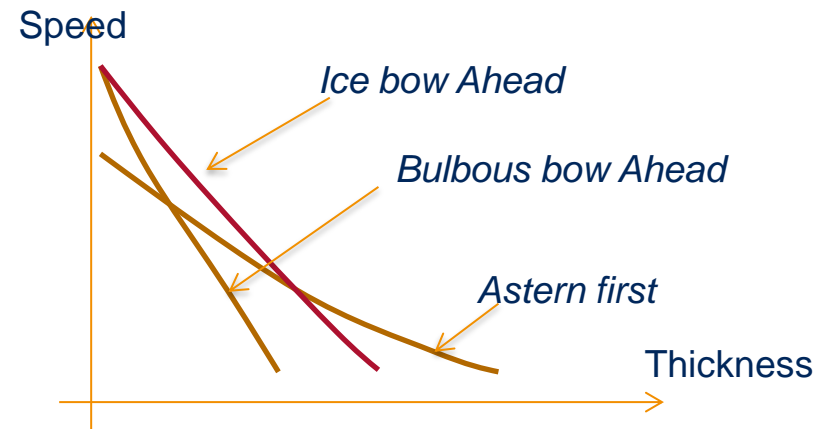
For safety aspects and efficiency, a moderate ice bow has been chosen for this Double-Acting or Push-Pull vessel

Bow options and ship's performances

Open water



Ice

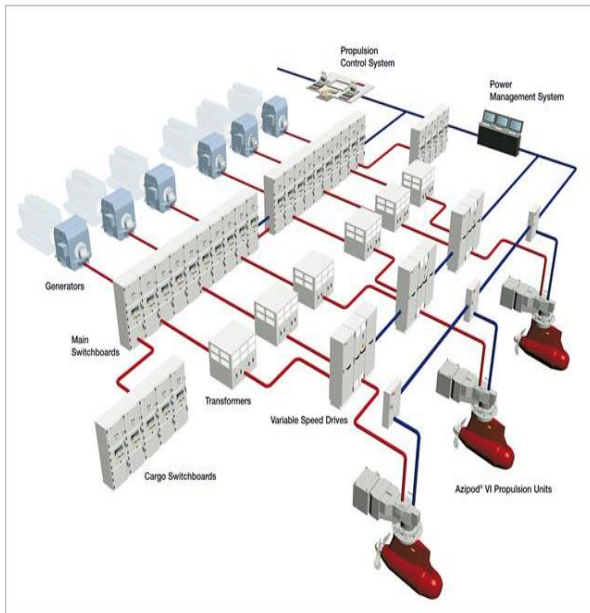


The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



- * The development of a more powerful azimuthal thruster is required for the project (Arc7 15 MW compared to existing Arc7 13 MW) with overtorque of 180% for ice navigation
- * The development of a load bank for coping with gas mode operations in ice (Tri-fuel Diesel Electric propulsion)

An innovative propulsion system for a LNG carrier



**Factory Acceptance Tests of
First Arc7 – 15 MW - Azipod (Dec. 2014)**

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



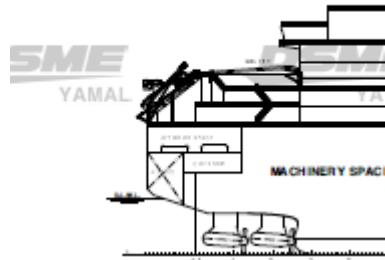
- The basic concept of the hull was generic , capable to incorporate all types of Cargo Containment System (MOSS, SPB Membrane)
- The final choice was made after a thorough assessment of all the technical aspects (impacts of fatigue, vibrations , ice loads , ice collision and requirement for bilge keel)

Applied CCS : Membrane GTT NO96 GW (Glass Wool) from GazTransport & Technigaz

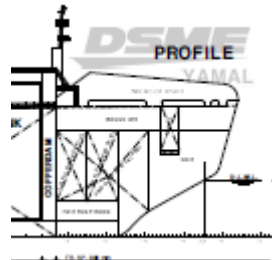
- Dual Classification of Bureau Veritas & Russian Maritime Register (RMRS)

The Cargo Containment System

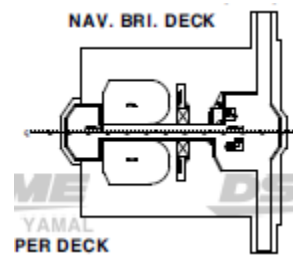
The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



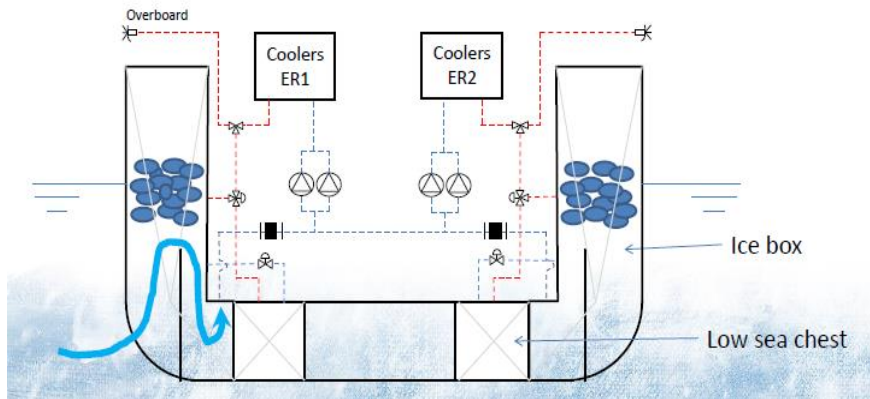
Sheltered Mooring decks



Winterized bridges (Aft & Fwd)



For harsh environment and low temperatures of -52°C



Ice boxes and Ballast tanks heating



Winterization of the Ship

The Arctic Ice-Breaking LNG Carrier for YAMAL LNG



Vessel #1 is under construction at Shipyard (South Korea)

- **Keel laying** : 23d March 2015
- **Sea Trials** : January 2016
- **Gas Trials** : February 2016
- **Ice Trials** : May 2016 in Kara Sea



The Arctic Ice-Breaking LNG Carrier for YAMAL LNG

The ship will be the first ice-breaking LNG Carrier , designed to be independent from Ice Breakers assistance , to achieve a safe, sustainable, reliable, and cost effective maritime transportation along the Northern Sea Route



Bear in mind the invitation date for the Ice trials in Kara Sea : May 2016 as you are invited ...