



Aker Arctic

# “Norilskiy Nickel” a Breakthrough in Cost Efficient Arctic Transports

*March 15, 2007,*

*Anatoly Gorshkovskij & Göran Wilkman,*

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## Basis of the Project

**Based on the Memorandum of understanding signed in December 2002 the target has been to create an efficient and economic cargo vessel for OAO GMK Norilskiy Nickel for the next 20 years to export high-valued metallurgical products from the port of Dudinka to Central Europe on a regular year round basis within the following, given technical requirements:**

# Basis of the Project

- Arctic deadweight 14.500 t at 9.0 m draft
- Concept: DAS, ice performance in level ice 1,2 metres
- Class: RMRS LU 7, with additional strengthening at aft shoulders,
- one compartment damage stability, tank top strengthened for
- even loading 13 t/sq.m. and grab handling
- Flag: Malta or Cyprus
- Propulsion: 9 MW Azipod, KMY to negotiate with RMRS
- Cargo holds adapted for container handling, to exceed 700 TEU
- Crew: 22 in single cabins plus 6 pax cabins, joint mess
- International sanitary standards
- Mechanical pontoon hatch covers for the tween deck, main
- deck covers hydraulically operated
- First two vessels to be fitted with two electrohydraulic
- cranes of 40 tons on port side
- Outside temperatures: -50C, +25C
- Inerta bottom painting
- Plugs for 20 reefer containers
- Dangerous cargo “MOPOG” rules, hold No 1

## Basis of the Project

The new ships are intended to replace the current MSCO-owned ageing "Norilsk" class vessels, built by Aker Yards in 1982 to 1987

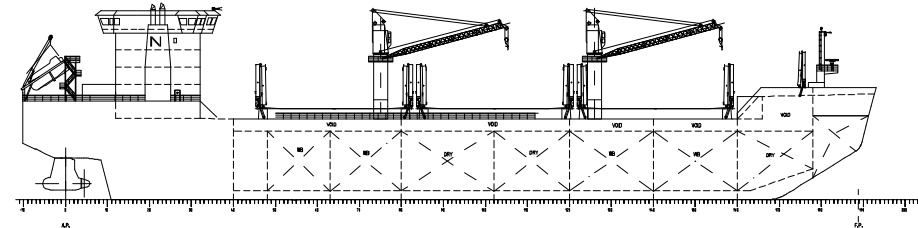


# Ship Type Comparison

## DEVELOPMENT of the concept

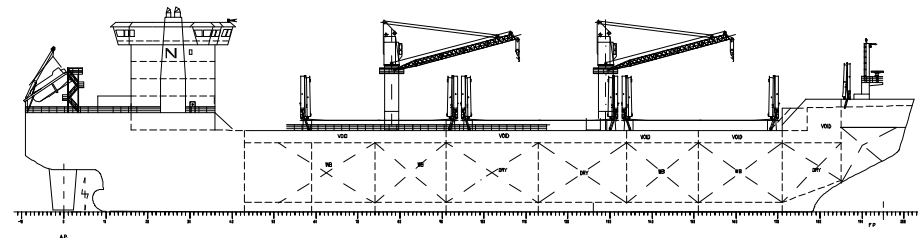
- Two basic ship types have

Loa:	162.5	M
B:	23.1	M
Shaft power:	9.4	MW
Economy power (15 knots):	7.7	MW
Loading time, one way:	72	HOURS
Discharge time, one way:	36	HOURS
Cost (in the study):	60	MEUR



- Double-acting LU-7 ice class vessel with 9.4 MW electrical podded propulsion**

Loa:	167.5	M
B:	23.1	M
Shaft power:	13.0	MW
Economy power (15 knots):	8.0	MW
Loading time, one way:	72	HOURS
Discharge time, one way:	36	HOURS
Cost (in the study):	55	MEUR



- Conventional LU-7 ice class vessel with 13.0 MW direct mechanical propulsion**

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## Double Acting Ships at Successful Work

- The first double-acting cargo ship (DAS) were introduced in 2002
- The 106 000 tdw M/T "Tempera" and "Mastera" have verified their superior ice performance in the difficult ice conditions in shuttle service to Primorsk
- With the 16 MW pod drive they were able to achieve a speed of 6 knots in 70 cm thick ice and break independently through 13 meter deep ridges
- The vessel did not require any icebreaker assistance during the whole winter and in fact acted as icebreakers themselves to other merchant ships





# Simulation Model

§ Using a simulation model developed by MARC the typical ship roundtrip of

- 300 NM River Yenisei
- 500 NM Kara Sea
- 500 NM Pechora Sea
- 1 600 NM Murmansk – Rotterdam (open sea)
- 5 800 NM Total roundtrip

was analysed for each month and required icebreaker assistance were compared

§ The model uses environmental data and ice information collected from various expeditions and full scale measurements



## Ice Conditions at Simulated Areas



**Pechora Sea**



**Kara Sea Ridges**



**Frozen Channel in River Yenisey**

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### Simulation Results

§ For a typical "normal" average winter the following results were achieved:

		<b>Conv.</b>	<b>DAS</b>
Number of roundtrips per year		12.5	12.5
Power required	MWh	61 200	49 900
Assistance needed per year	days	63 *	43 **
Fuel consumption per year	tons	11 000	8 900
Fuel cost	M USD	1.76	1.44

\* Assistance is assumed when speed drops below 4 knots

\*\* Assistance is assumed when speed drops below 5 knots

A convoy speed of 8 knots for DAS vessel and 7 knots for conventional is assumed when assisted

§ As the number of icebreakers in service on the NSR will dramatically drop after 2010, the waiting times will get longer and the ability for more independent operation for the DAS vessel will have strategic importance

### Result

- § A modern multipurpose double-acting Arctic cargo vessel of 14 500 tdw which offers:
- Cargo spaces based on unitised cargo, giving potential for improving the whole Norilskiy Nickel logistic chain to fit with efficient handling systems and global material handling standards
  - Seaworthy bow design for the rough North-Atlantic sea area, however, without compromising ice performance
  - Ice performance allowing for more independent ice operation and less dependence on icebreakers assistance (less waiting times), which may turn to be important in the future
  - A solution that represents fuel efficiency both in open water and ice navigation
  - Good maneuverability (less tug boats)
  - Potential for improvement (e.g. bulbous bow) as per preliminary discussions with the regulatory bodies

# DEVELOPMENT of the concept

## Main Dimensions

LENGTH over all	M	162.50
LENGTH bpp	M	151.10
BREADTH mld	M	23.10
DRAUGHT dwl (ice)	M	9.00
DRAUGHT summer	M	abt. 10
HEIGHT bhd deck	M	14.20
GT		abt. 15 700

CLASSIFICATION

RMRS, LU7

COUNTRY OF REGISTRY

Malta, Cyprus ?

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# DEVELOPMENT of the concept

## Capacities

DEADWEIGHT/ICE WL	T	14 500
DEADWEIGHT/SUMMER WL	T	17 800
CONTAINERS IN HOLDS	PCS	400
CONTAINERS ON DECK	PCS	252
TOTAL CONTAINER CAPACITY	PCS	652
HFO	M3	1 800
FW	M3	250
CREW CABINS	PCS	22
PASSENGER CABINS	PCS	6

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# DEVELOPMENT of the concept

## Machinery

### MACHINERY

ME TYPE		2xMAN 14V32/40
ME TOTAL POWER	kW	13 440
PROPULSION POWER (AZIPOD)	kW	9 400
HARBOUR DIESEL	kW	1 080
PROPELLERS	PCS x type	1 x FP
PROPELLER DIAMETER	M	5.6
SERVICE SPEED	knots	15.0
TRIAL SPEED	knots	16.3

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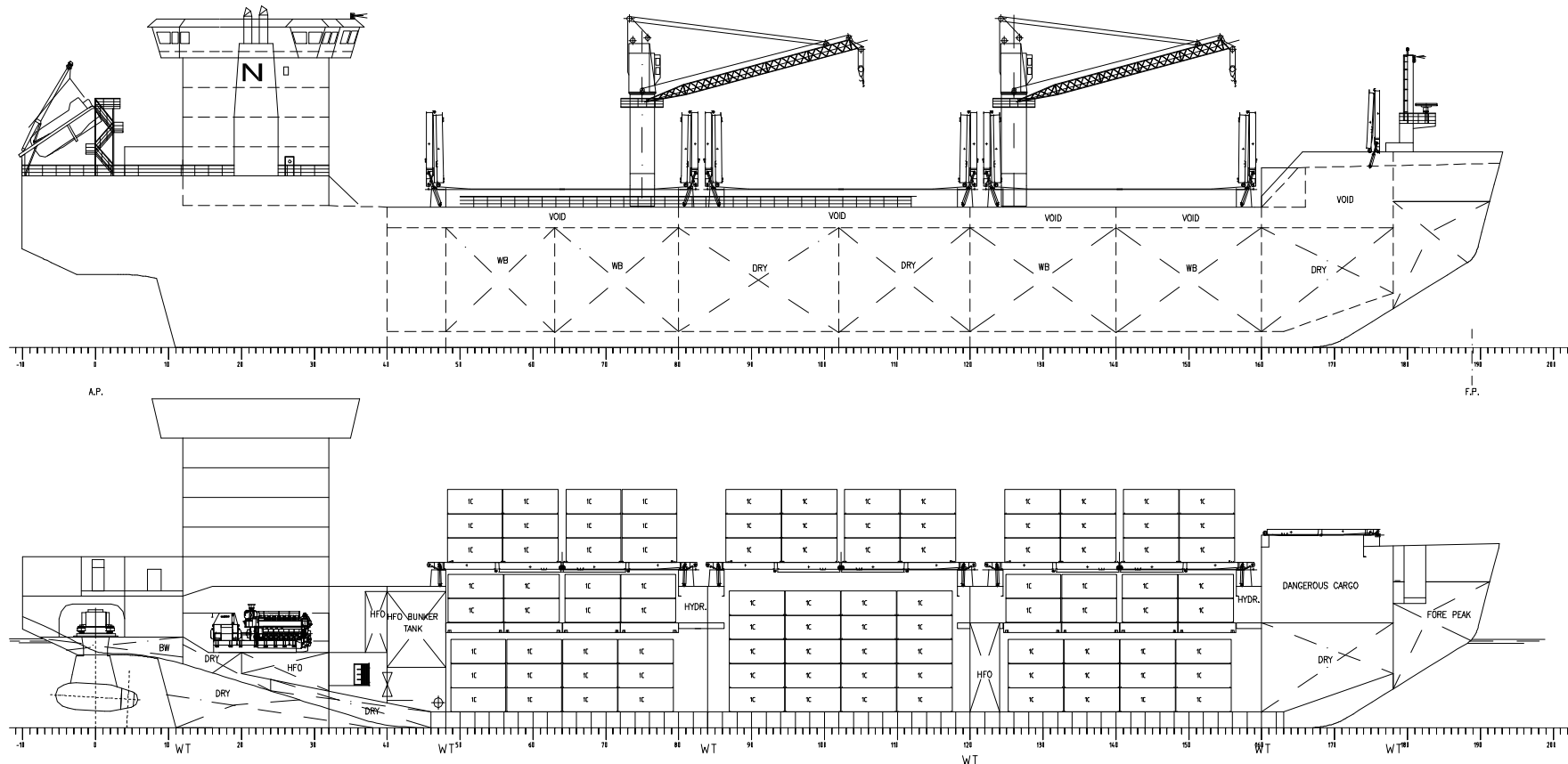
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# DEVELOPMENT of the concept



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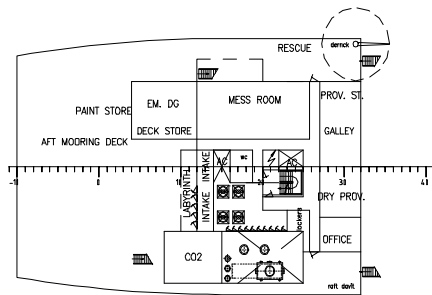


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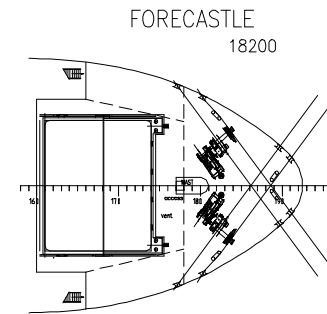


# General Arrangement

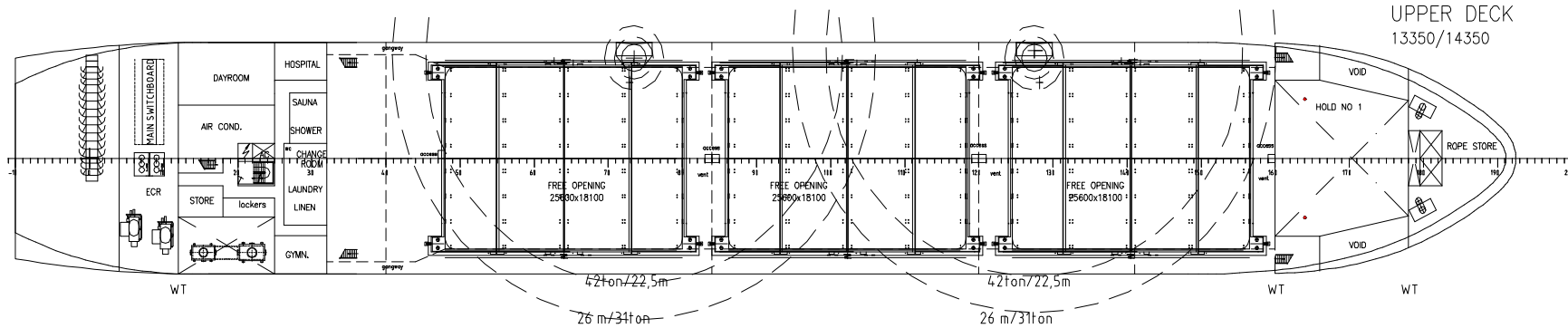
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1st POOP DECK  
17350



FORECASTLE  
18200



UPPER DECK  
13350/14350

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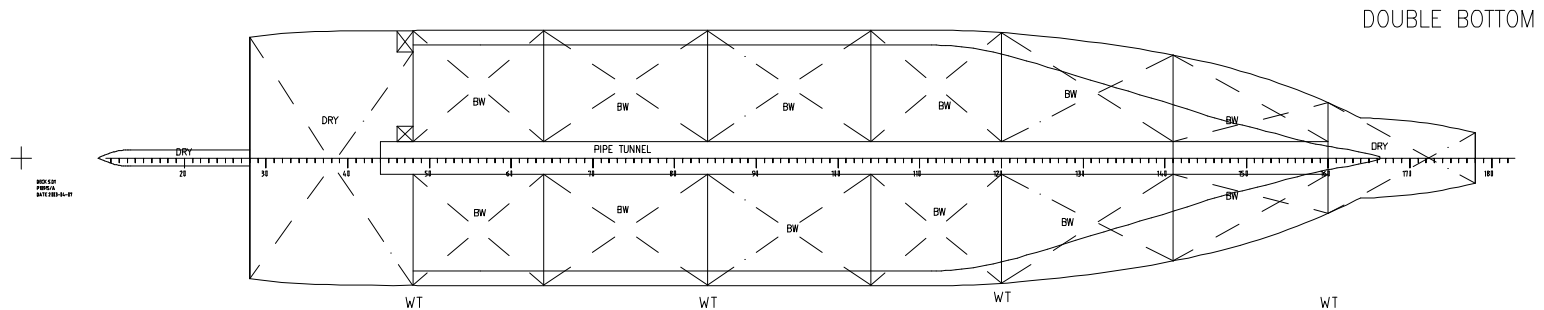
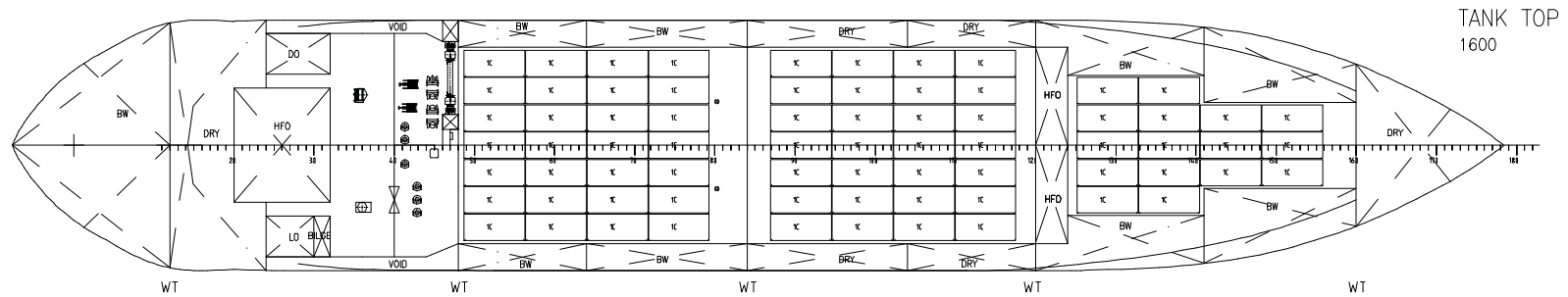
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# General Arrangement

## DEVELOPMENT of the concept



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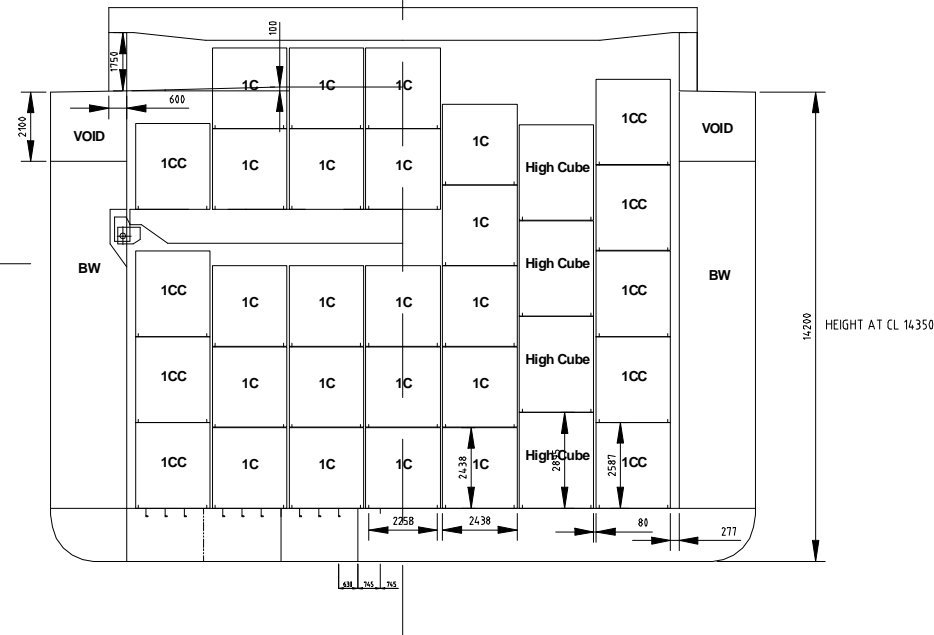
# DEVELOPMENT of the concept

## Cross Section

§ Various combinations of different container sizes can be carried

§ Design loads:

Tank top	13 t/m <sup>2</sup>
Tween deck	4.5 t/m <sup>2</sup>
Weather deck hatch covers	1.75 t/m <sup>2</sup>



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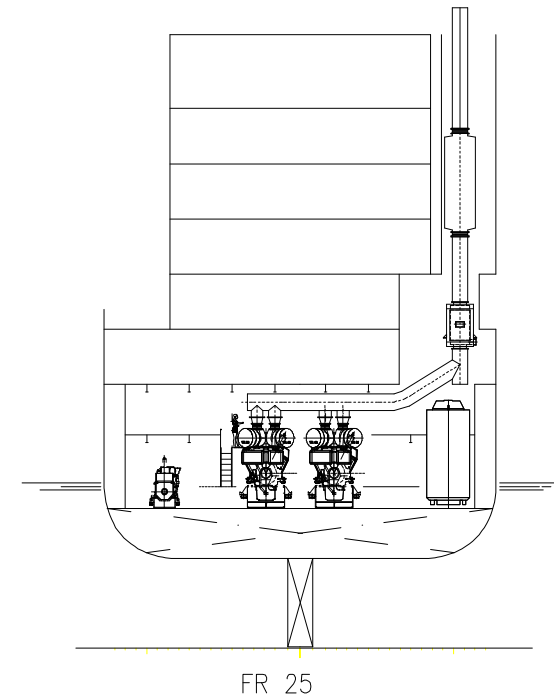
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# Machinery

## DEVELOPMENT of the concept

§ Twin main engines, 6 720 kW each

§ Option: Three main engines 2 x 3 680 kW + 5 520 kW



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yards.

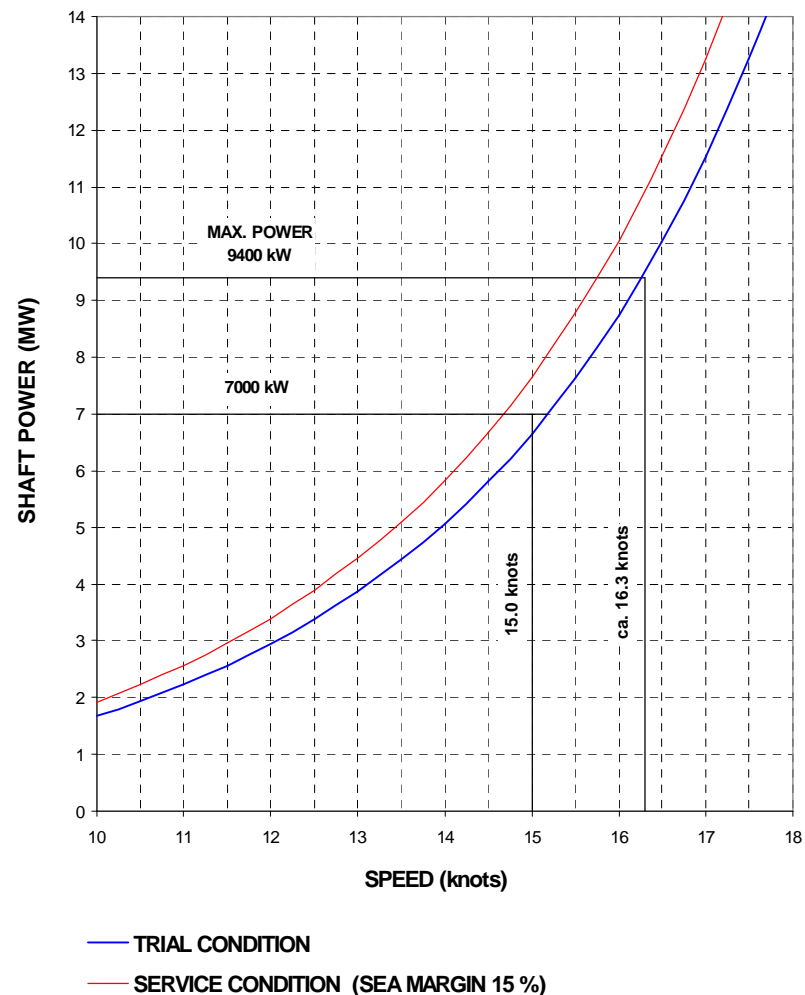
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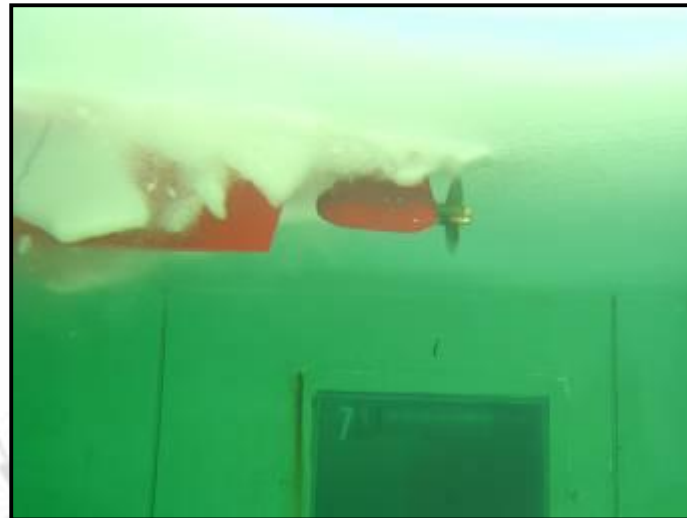
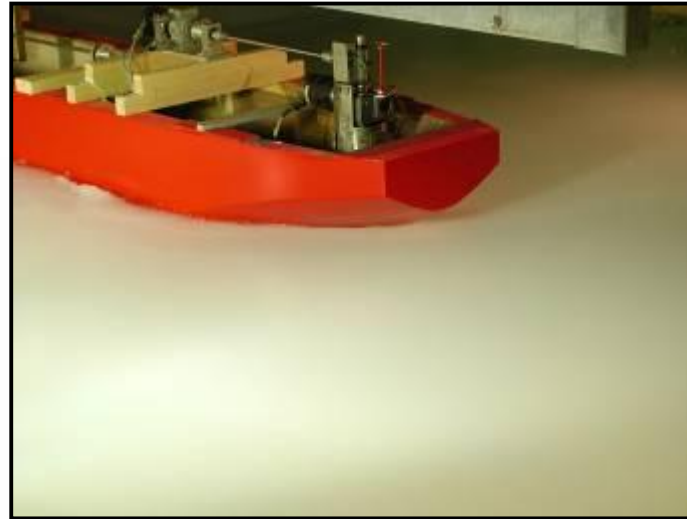
## Speed and power

### Power Prediction Diagrams

- § The hull lines are designed for optimal propulsion performance taking into account
  - Operation in ice conditions
  - Fuel economy in open sea
  - Excellent manoeuvrability
  - Good seakeeping characteristics
- § Speed in trial conditions 15 knots with 7 MW shaft power
- § Max. speed in trial conditions ca. 16.3 knots

## DEVELOPMENT of the concept





## DEVELOPMENT of the concept

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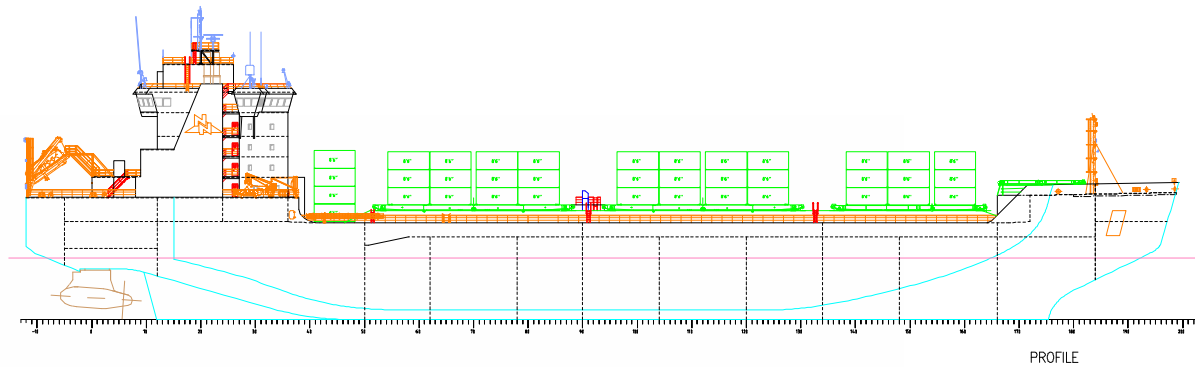
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# SHIP BUILT



## MAIN DIMENSIONS

LENGTH over all 169.50m  
BREADTH 23.10m  
DRAUGHT dwl 9.00m  
DRAUGHT swl 10.00m  
HEIGHT bhd deck 14.20m

## MACHINERY

ME TYPE  
TOTAL POWER  
PROPULSION POWER (POD)  
SERVICE SPEED  
ICEBREAKING CAPABILITY

## CAPACITIES

DWT, ice wl 14 928 ton  
DWT, swl 18 486 ton  
TEU containers 648 pcs  
Life saving appl. 25 pers.

3xW12V32  
18000 kW  
13000 kW  
16.1 kn  
1.5 m, 2 kn

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## SHIP BUILT



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# PERFORMANCE TESTS

## Purpose of the tests

The main purpose of the tests was to verify the performance point of the vessel in the shipbuilding contract:

1.5 m level ice and 2 knots

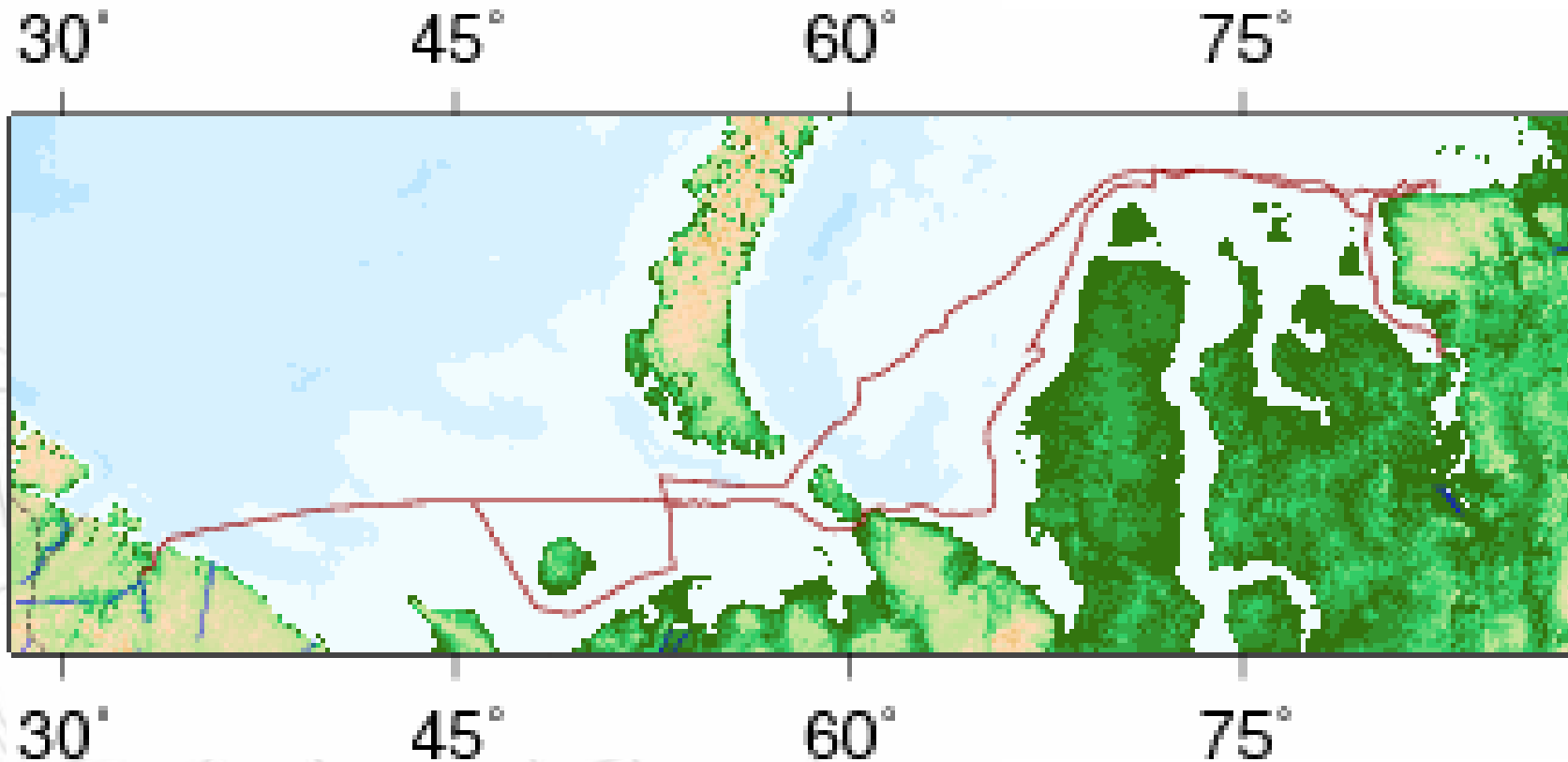
in addition all possible information to be collected during the voyage:

- » transit behaviour
- » pod measurements

## PERFORMANCE TESTS

### Route

The journey from Murmansk started on March 14, 2006



The journey ended in Murmansk started on March 26, 2006

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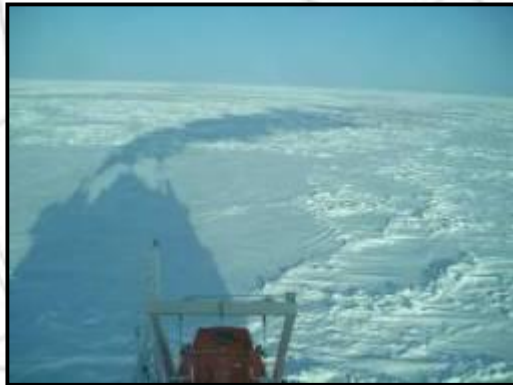


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# Transit Through Kara Sea

# PERFORMANCE TESTS

Area	Mode of operation	Ice condition	Mode	Power MW	Speed m/s
Kara Sea	Behind Yamal	channel	ahead	~9.5	6.5-7.5
	Alone	0.5m/ridges	ahead	12.8	5.3
	Alone	0.5m/ridges	astern	12.8	4.7
Gulf of Yenisey	Alone	ridges 5-8m	astern	13	0.7
	Alone	old frozen ch. 3days	astern	12.3	3.2
	Alone	old frozen ch. 3 days	ahead	12.6	4.2
	Alone	old frozen ch. 1-2days	ahead	11.9	4.1
Kara Sea	Alone	0.5m/ridges	ahead	12.3	4.9
	Alone	Polynya	ahead	10-12	7.2
	Alone	ridges 8-10m	astern	12.5	0.7



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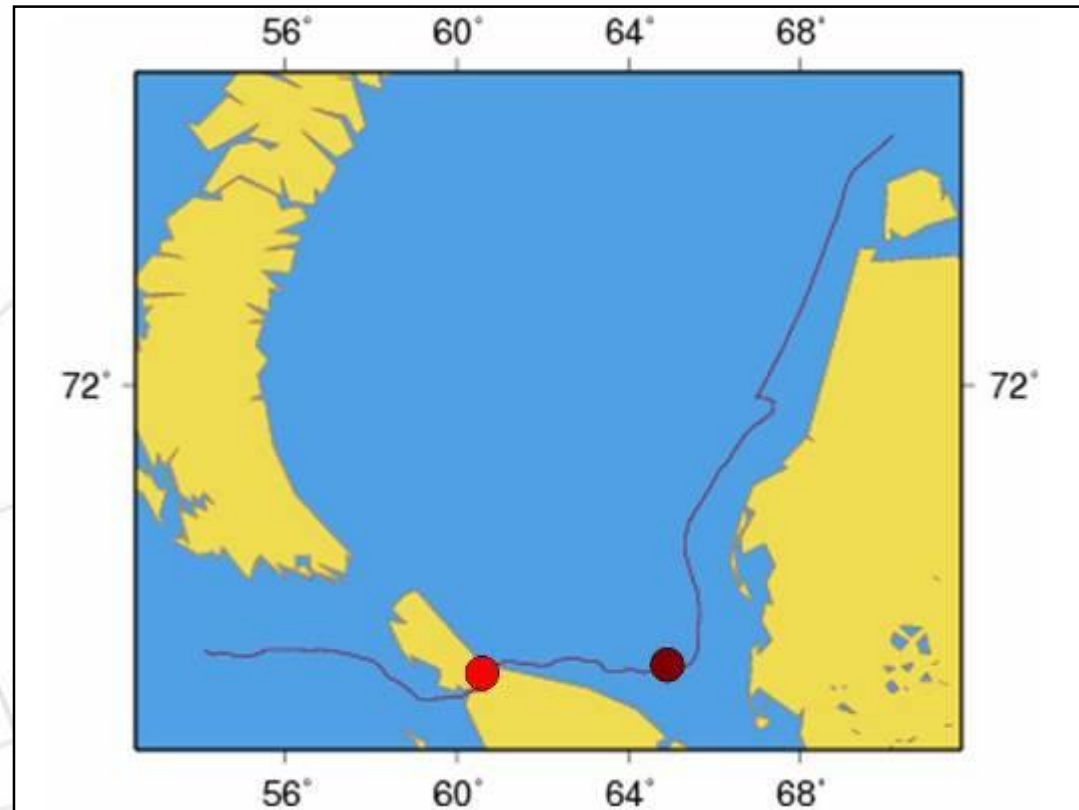
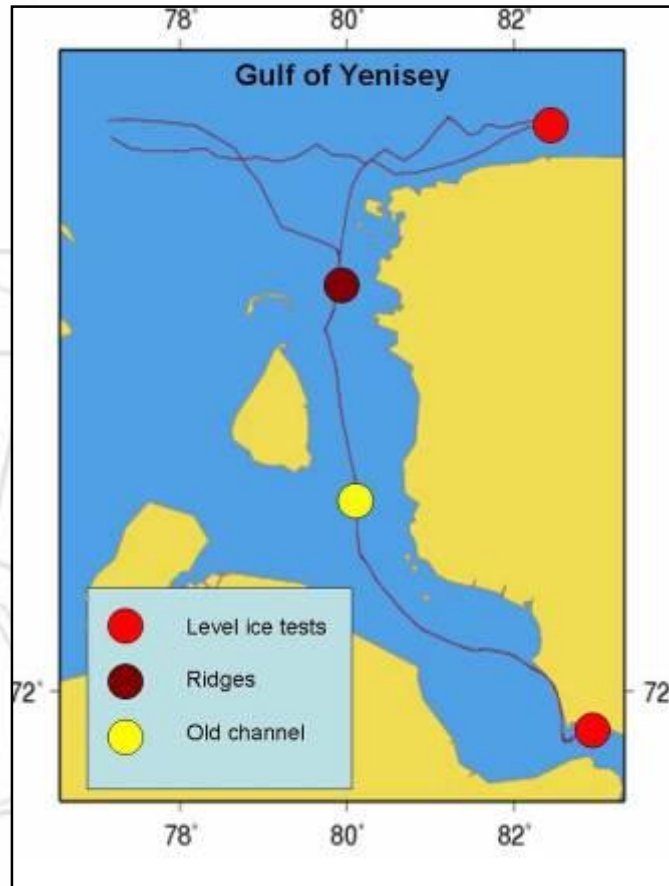


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## Performance in level ice

## PERFORMANCE TESTS

### § Test areas



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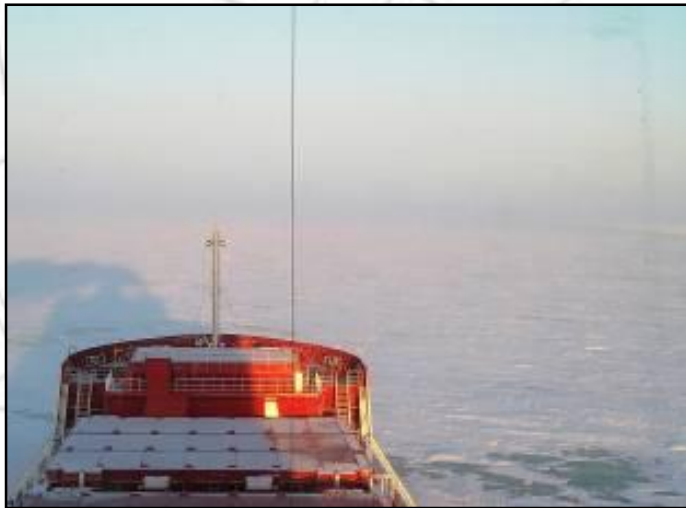
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## Level ice



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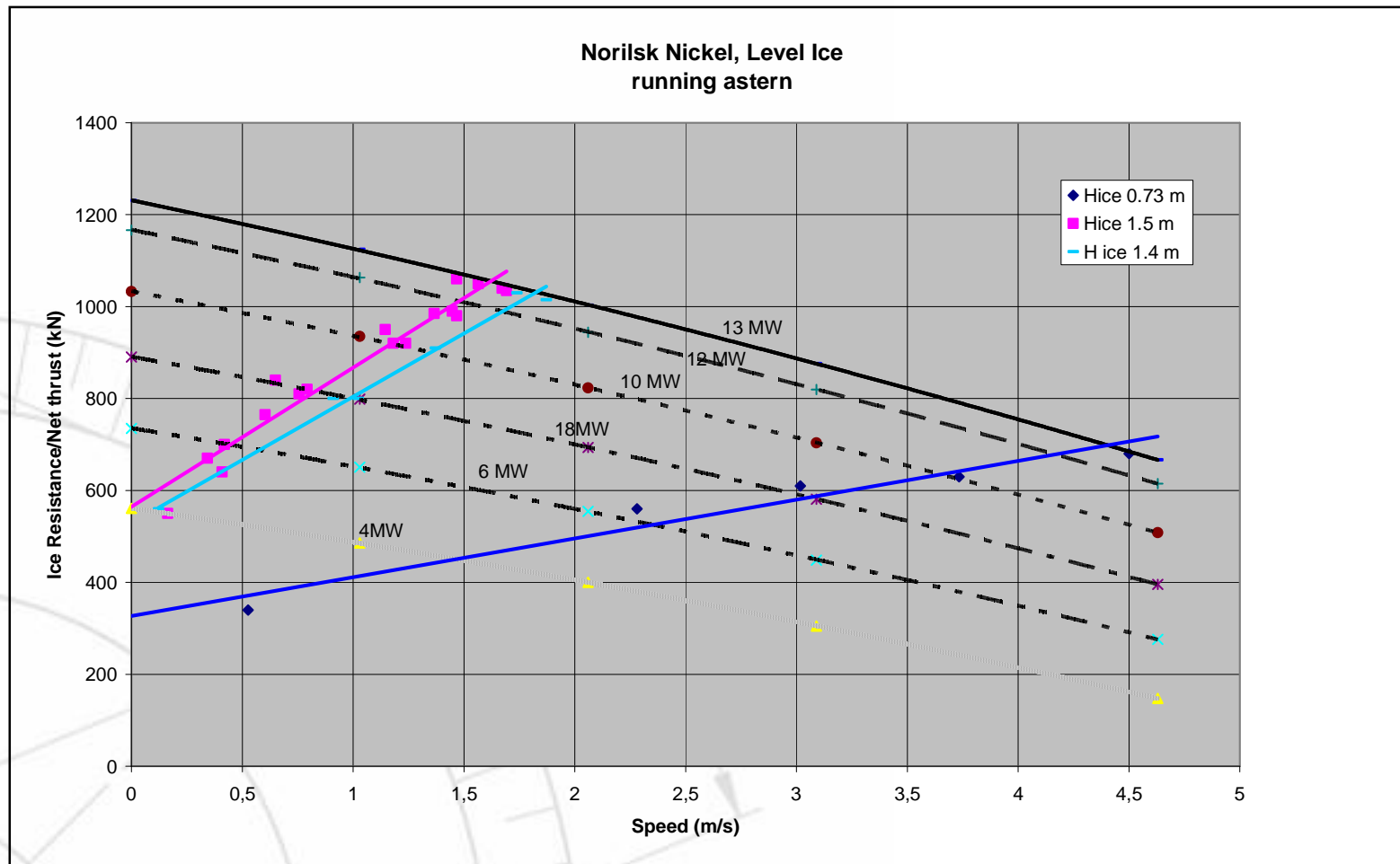
## PERFORMANCE TESTS



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# PERFORMANCE TESTS

## Level ice, astern



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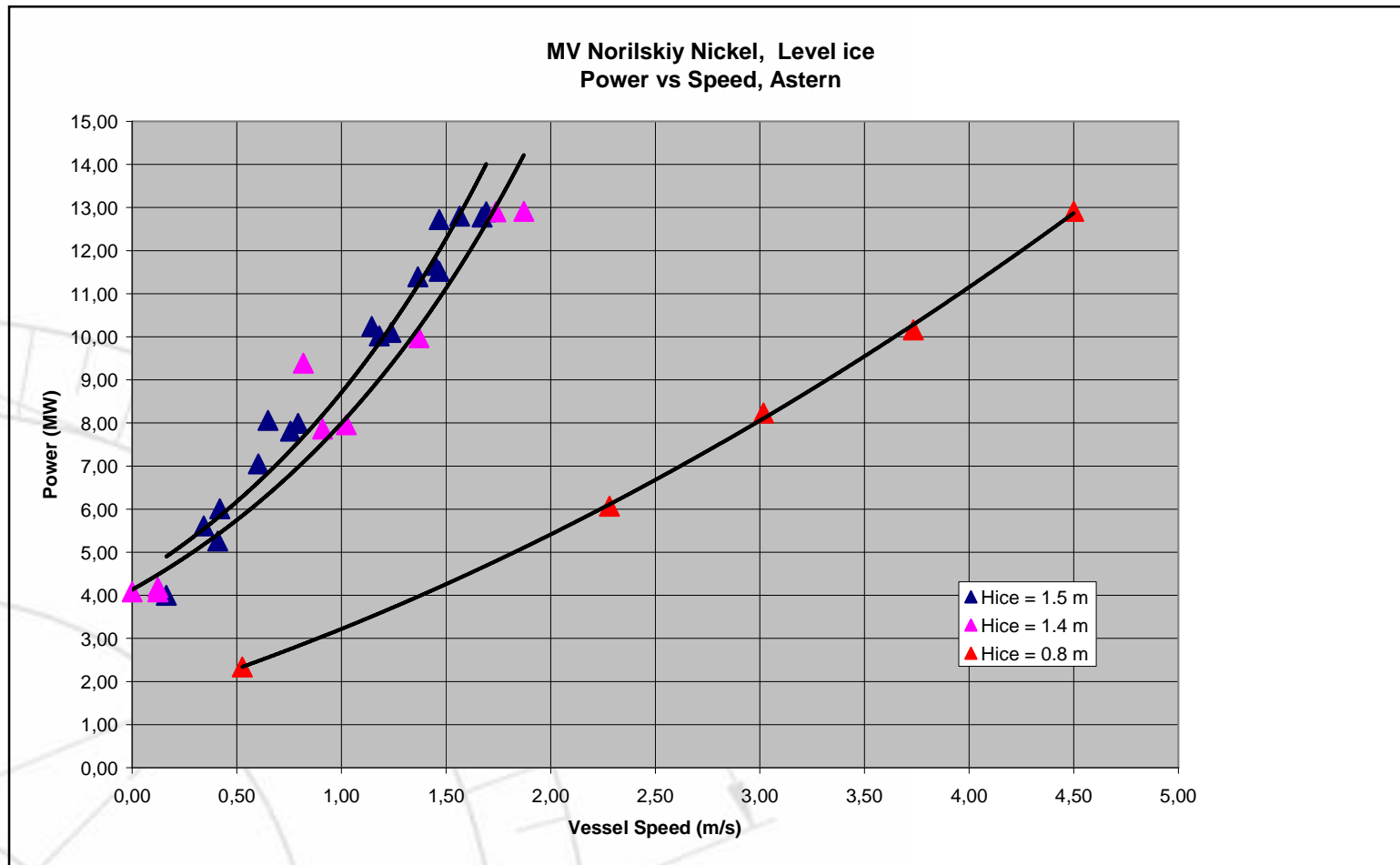
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# PERFORMANCE TESTS

## Level ice, astern



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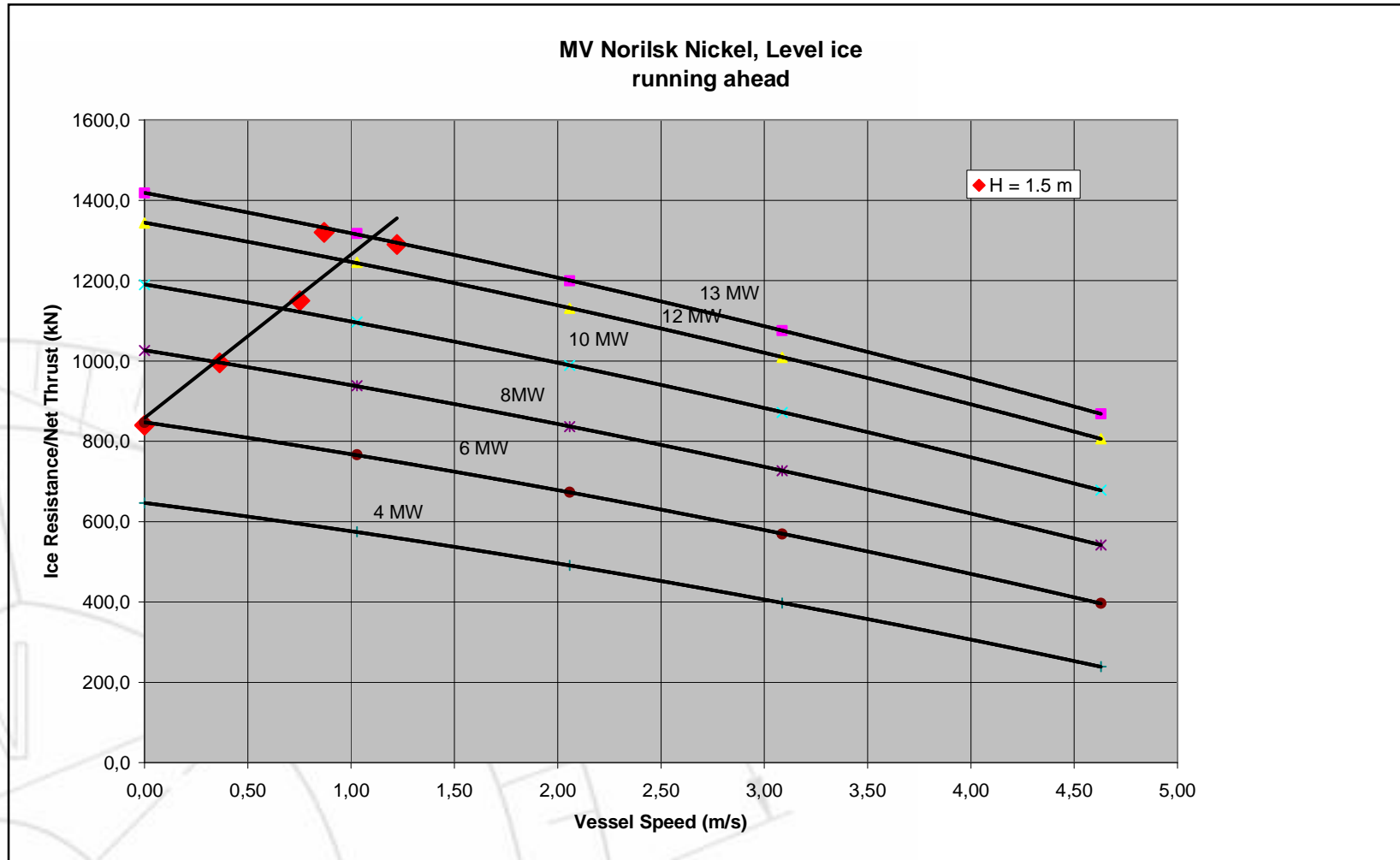
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# PERFORMANCE TESTS

## Level ice, ahead



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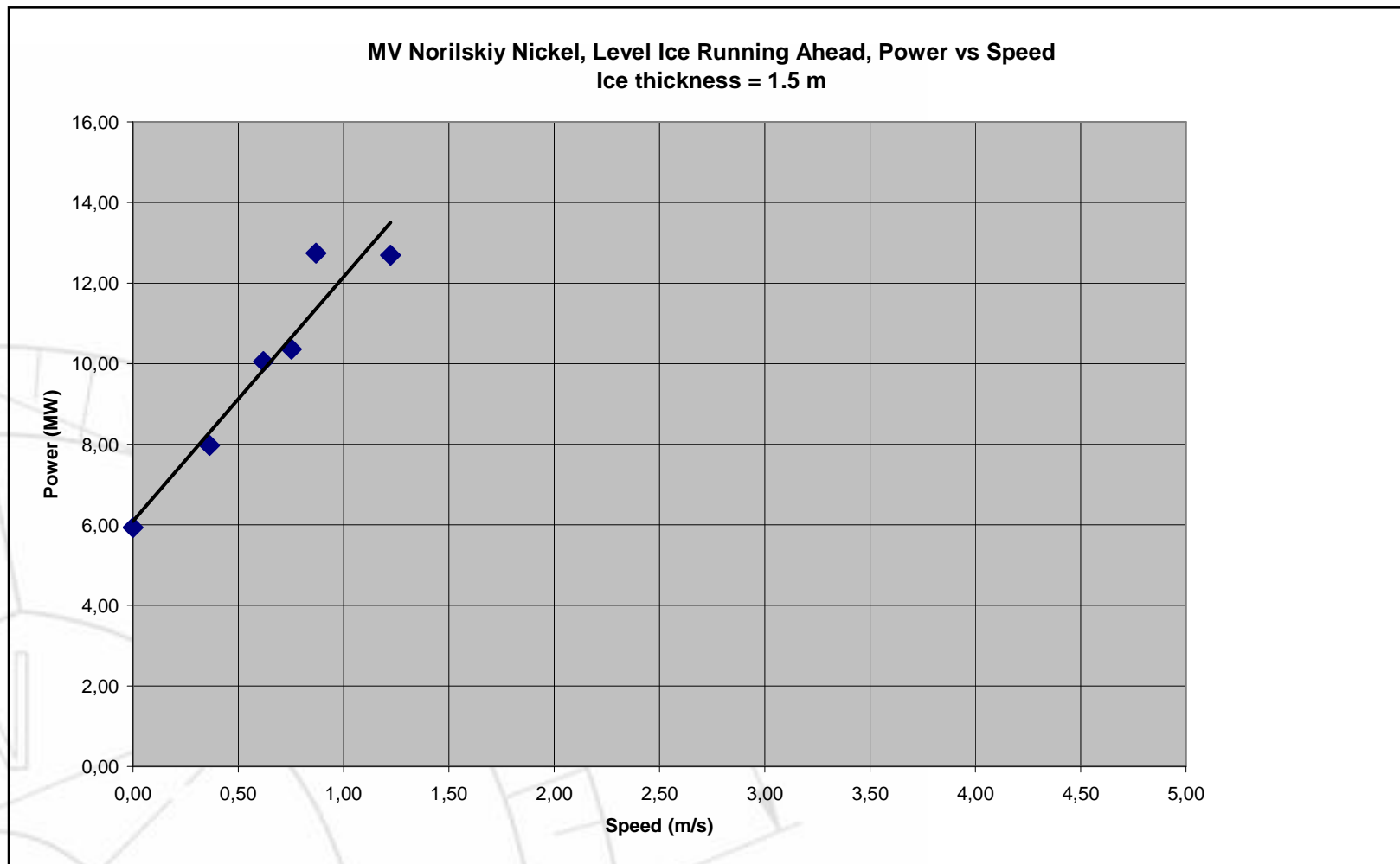


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# PERFORMANCE TESTS

## Level ice, ahead



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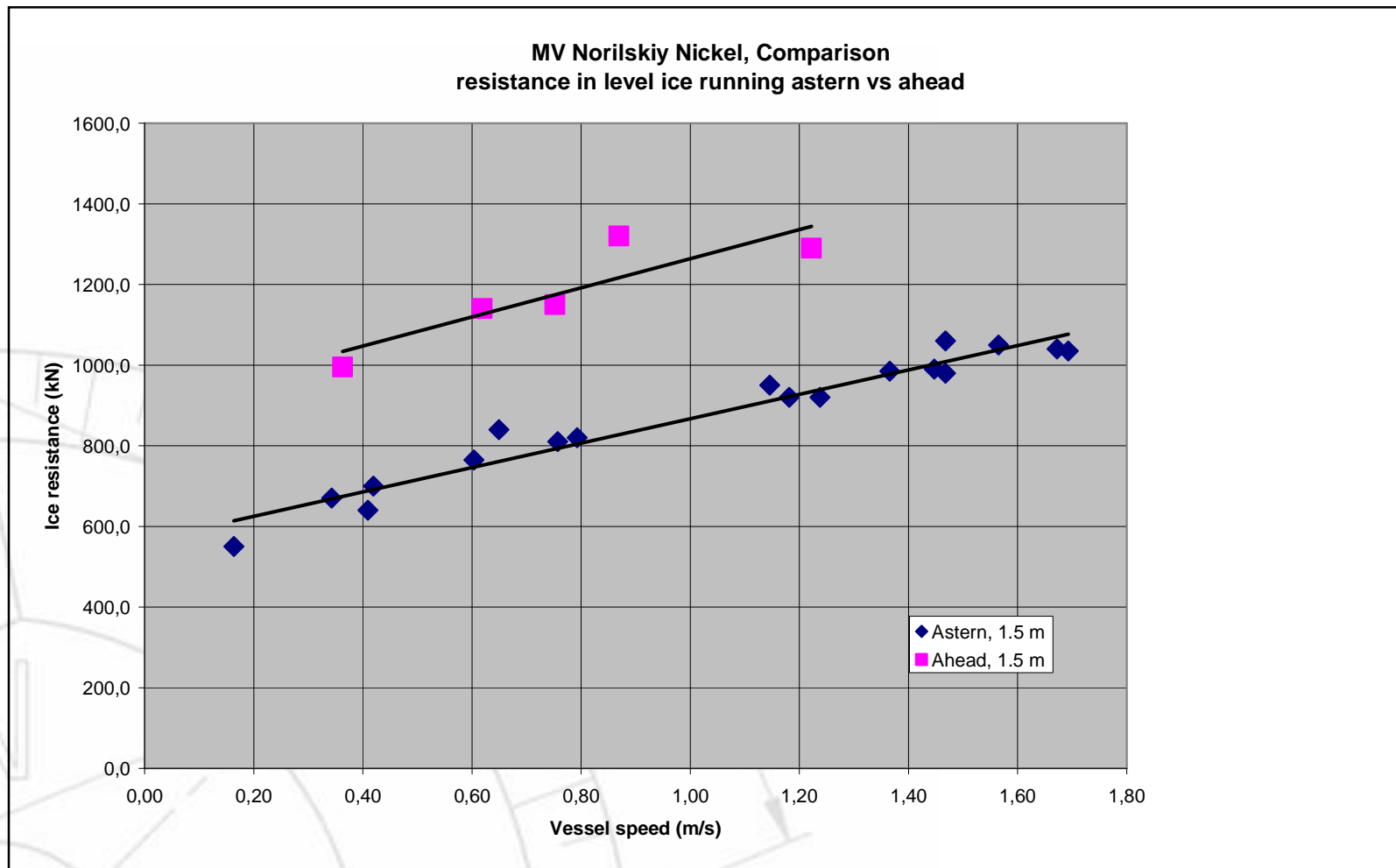


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# Level ice, comparison astern/ahead

# PERFORMANCE TESTS



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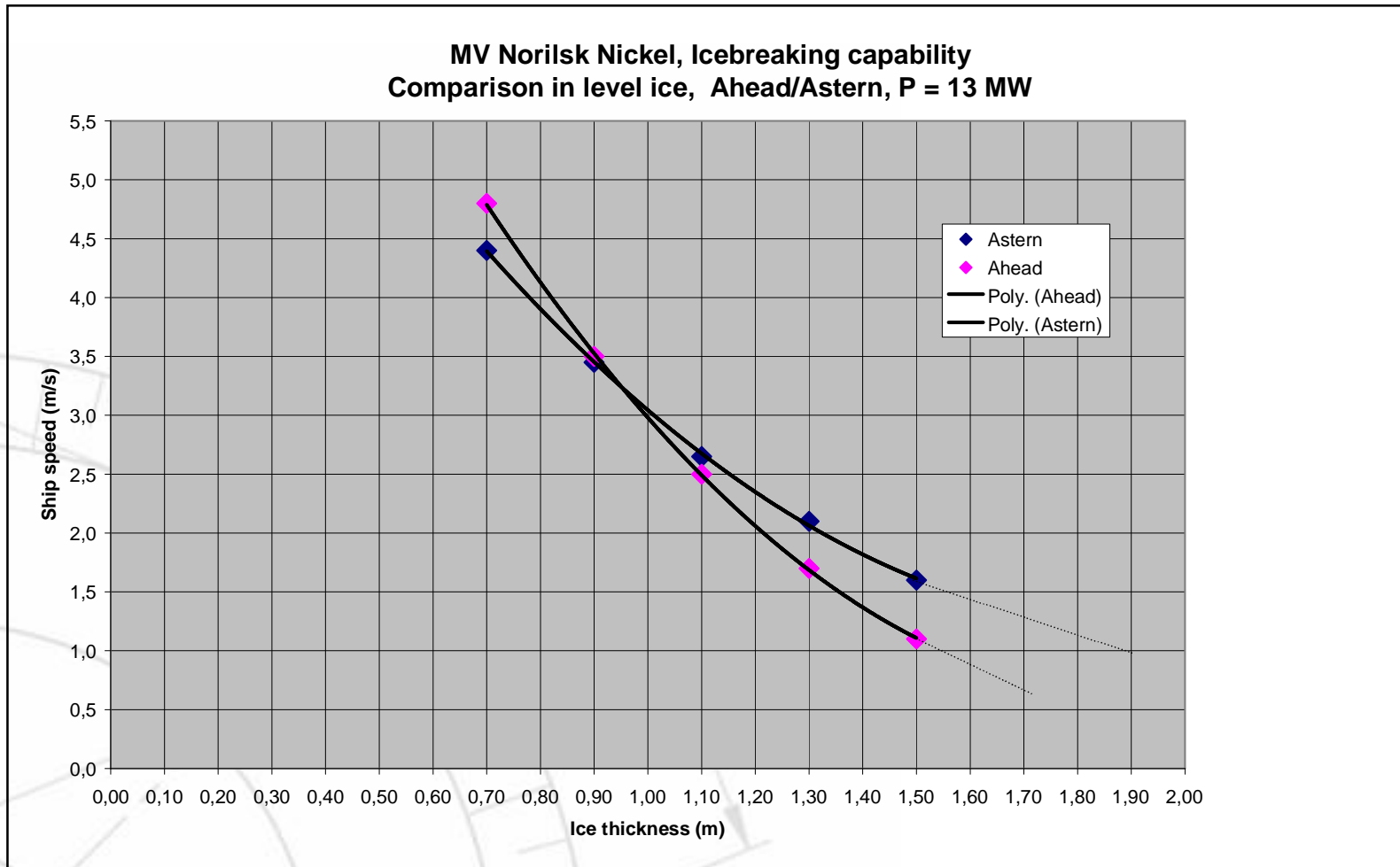
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# Level ice, comparison astern/ahead

# PERFORMANCE TESTS



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## Conclusion

- **Successful project**
- **In general the vessel performed beyond expectations**
- **The performance in all test conditions was excellent.**
- **1.5m thick level ice running astern with a speed of 3 knots and running ahead 2.5 knots**
- **The limit in running astern is over 1.7 m with 2 knot speed and running ahead the limit is close to 1.6m.**

**Difficult task**

**Good co-operation between the parties**

**Faith in NEW TECHNOLOGY SOLUTIONS**

**Four (4) more units to be built**



## A Solution for the Future

- § What is the ideal solution?
- § What is technically feasible?
- § What is economically profitable?
- § What offers the best reliability?

***The best way to  
predict the future  
is to create it***

