WINMOS
WINTER NAVIGATION
MOTORWAYS OF THE SEA

Activity 2.1

A database of existing icebreakers in the world

Authors:

Harri Eronen, ILS OY

Leena Vedenpää ILS OY

5.6.2014

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

Table of contents

Introduction

This report is a part of a larger WINMOS project that is co-financed by the European Union. The main objective of the WINMOS project is to ensure sustainable and efficient maritime transports all-year-around and diminish the barrier caused by the sea ice in the Baltic Sea. The project consists of a number of measures that are needed today and within the following years, but also measures that are needed in order to make strategic decision for the period 2020-2030.

The ultimate goal of activity 2 is to obtain knowledge of different icebreaker concepts to optimize the composition of a possible jointly operated icebreaker fleet between the Baltic Sea countries, especially Estonia, Finland and Sweden. The actions of this activity include the model tests of the Urho/Atle-class and the development of new icebreaker concepts for the Baltic Sea icebreaking needs and then compare them with the Urho/Atle-class.

Operational requirements of icebreakers vary between sea areas and assisted traffic and on the other hand there are various existing and new concepts for icebreaking ships. Thus, in sub activity 2.1, the world's icebreaker and icebreaking supply vessel fleet was studied and documented. The vessels suitable for the Baltic Sea icebreaking assistance conditions were studied further and the technical parameters of those ships were documented. The icebreaking needs of the Baltic Sea are presented along with an icebreaker categorization.

Summary of the contents

This report is divided into following main sections:

1. List of icebreakers, icebreaking supply ships and ice capable research/patrol ships worldwide

- List presented in table format gives the main dimensions and the ice going capability of each vessel
- The list includes both existing ships and ships under construction

2. Summary of vessels suitable for Baltic Sea icebreaker use

This section contains:

- List of vessels suitable for the Baltic Sea use selected from worldwide list of vessels
- Datasheets of these vessels including general arrangement and lines drawing if published

3. Considerations of the suitability of different vessel types for Baltic Sea icebreaker use

3.1 General analysis on the requirements for Baltic Sea icebreakers

- Winter Navigation system
- The composition of icebreaker fleet
- Environmental issues

3.2 Summary of different icebreaker types suitability for Baltic Sea use

- Existing vessel performance/efficiency compared to requirements for Baltic Sea use
- Summary of suitability of different existing ships and ships under construction for Baltic use
- Icebreakers and icebreaking vessels under construction

1. List of icebreakers, icebreaking supply ships and ice capable research/patrol ships worldwide

A list of icebreakers, icebreaking supply ships and ice capable research/patrol ships of the world was compiled and can be found attached to this report. The list includes main parameters of the ships and their ice-going capabilities. Note also that the list is as exhaustive as possible, but there can still be some vessels missing or some errors in the figures. See attachment 1 for the list. (ILS, 2011)

2. Summary of vessels suitable for Baltic Sea icebreaker use

Of the complete set of icebreakers, icebreaking supply vessels and ice capable research/patrol ships in the world, those that would be suitable to the Baltic Sea conditions were selected for further analysis. (Also Baltic multipurpose icebreakers Fennica, Botnica, Tor Viking, Eva 316 and the new Finnish icebreaker under construction were included as yardstick vessels.) Of these vessels, technical data was collected to individual datasheets of the vessels. These datasheets can be found attached to this report (attachment 2). The vessels for which a datasheet is available are:

- **Existing:**
  Akademik Fedorov
  Akademik Tryoshnikov
  Araon
  Arctik Ivik
  Brage Viking
  Botnica
  EVA-316
  Fennica
  Fesco Sakhalin
  Healy
  Louhi
  Mackinaw
  Moskva
  Pacific Endeavour
  Polar Pevek
  Robert Lemeur
  Svalbard
  Svitzer Sakhalin
  Talagi (Canmar Kigoriak)
  Toboy
  Tor Viking
  Varandey
  Vitus Bering
  Vladimir Ignatyuk
  Vladislav Strizhov

- **Under construction:**

  AOPS
  Baltika
  John G. Diefenbaker
  Kemin Karhu
  Kronprins Haakon
  LK-60
  Murmansk
  Rescue icebreaker, Russia
  Sikuliaq
  New Finnish IB

- **Concepts:**

  Aurora Slim
  Chinese project

See attachment 2 for the datasheets.

3. Considerations of the suitability of different vessel types for Baltic icebreaker use

3.1. General analysis on the requirements for Baltic icebreakers

3.1.1. Winter Navigation system

The winter navigation system in Finland and Sweden consists of several interacting factors that are:

i. Number and capacity of icebreakers escorting all ships fulfilling the traffic restrictions;

ii. Ice classed merchant ships that have some ice performance;

iii. Actions of the maritime authorities (traffic restrictions, ice class rules, fairway dues etc.)

iv. Operators' skill onboard and ashore

The balance that is to be found in this system is between the number of icebreakers, ice performance requirements of merchant ships and the waiting times / turnaround times of merchant ships. If the merchant ships had less ice performance, more icebreakers would be required to keep the turnaround times reasonable and this would push the fairway dues up. The measure of the operability of the winter navigation system is considered to be the average length of waiting time for an icebreaker (this is the average of non-zero waiting times) and at the same time the percentage of ships that are not waiting at all. The average waiting time should be less than 4 hours and more than 90% of ships should not need to wait at all. (ILS, 2012)

3.1.2. The composition of icebreaker fleet

The severity of winter varies around the coast of Baltic Sea. On the Finnish coast, maximum level ice thicknesses vary from about 30 cm in the southwestern sea area to about 80 cm in the northernmost Baltic Sea. The variation along the Swedish coast is even larger as parts of the coast are ice free. The Pärnu Bay and Gulf of Riga ice conditions can vary from ice free up to 50- 70 cm of ice. Compression poses challenges for all coastal areas, but especially for the Bothnian Bay, Quark area, Gulf of Finland and Gulf of Riga. It is evident that different sea areas need different types of icebreakers. This is reflected in the present composition of icebreaker fleets: Finland and Sweden have bigger icebreakers that can operate in difficult ice conditions and small icebreaking ships that operate well closer to the ice edge. Estonia has managed well with EVA-316 in the Pärnu Bay/Gulf of Riga area and with the addition of Botnica, the Tallinn region icebreaking needs are also met.

The current icebreaker fleet of Finland, Sweden and Estonia is presented in Table 1. It has to be noted that Sweden's charter agreement for Tor Viking II ends in 2014 and for Balder Viking in 2015.

Table 1. The current icebreaker fleet of Finland, Sweden and Estonia.

Name	Delivery	Beam [m]	Bollard pull [t]	Power P [MW]	P/B [MW/m]	Ice performance h_i/v [m/knot]	Crew in ice breaking
Finland							
Voima	1954, 1979	18.7	113	10.2	0.55	1.2/2	21
Urho, Sisu	1975, 1976	22.5	185	16.2	0.72	0.8/8.5	21
Otso, Kontio	1986, 1987	23.4	160	15	0.64	0.8/10	20
Fennica, Nordica	1993, 1994	25.2	234	15	0.60	0.8/9.5	21
Zeus	1995	14.6	101	5.4	0.37	-	-
Sweden							
Ale	1973	13.0	48	3.5	0.27	-	12
Atle, Frej, Ymer	1974, 1975, 1977	22.5	185	16.2	0.72	0.8/8.5	18
Oden	1989	31.2	240	17.7	0.57	1.8/3	18
Tor Viking II, Balder Viking,	2000 2001	18.0	200	13.4	0.74	0.6/11	14
Estonia							
Botnica	1998	23.1	117	10	0.43	0.8/8	21
Tarmo	1963	21.2	108	8.8	0.41	0.85/2	-
EVA-316	1980/2005	12.2	45.3	4.4	0.36	0.65/3	-

The fleet composition is also reflected in the icebreaker categories defined by Finnish authorities for the Baltic Sea icebreaking needs. The categorization is as follows:

- **Category A:** Icebreaker can assist ships in all difficult ice conditions.
    - Beam, B min = 24 m
    - Power Pmin = 15 MW and must be able to proceed with constant 2 knots speed in 1.5 m thick level ice
    - Draught T max = 9.0 m
    - Bollard pull = 150 ton
    - Ship must have towing winch and a towing notch.
    - Ship must be able to turn 180 deg at the spot in 0.7 m thick level ice in 3 mins
    - The performance astern must be as close as possible to that forward
- **Category B:** Icebreaker can assist ship in all less difficult ice conditions.
    - Beam, B min = 17.5 m
    - Power Pmin = 10 MW and must be able to proceed with constant 3 knots speed in 1.2 m thick level ice
    - Draught T max = 8.0 m
    - Bollard pull = 90 ton
    - Ship must have towing winch and a towing notch.
- **Category C:** Icebreaker can assist ship in all ice less difficult ice conditions and the archipelago
    - Beam, B min = 12 m
    - Power Pmin = 5 MW and must be able to proceed with constant 3 knots speed in 0.8 m thick level ice
    - Draught T max = 7.0 m
    - Bollard pull = 70 ton

At present the fleet compositions are as follows:

	Finland	Sweden
Category A	6	4
Category B	2	2
Category C	1	1

The categorization is more suited for the Finnish and Swedish needs, whilst in Estonia the needs of different category ships vary. Of Estonia's icebreakers, Botnica can be categorized as B and Tarmo in C class. EVA-316 does not quite meet the category C requirements, but does well the job for which it is needed in the Pärnu Bay/Gulf of Riga.

3.1.3. Environmental issues

Environmental issues have become even more important in the past years and new regulation has been introduced, such as the Environmental Efficiency Design Index (EEDI). An adequate ice performance of ships requires certain minimum power – this is the background of the ice performance requirements in the Finnish-Swedish Ice Class Rules. The EEDI regulations that regulate the environmental impact of ships will force ship owners to regulate the maximum power of new ships. If the maximum power based on EEDI value calculations is lower than the required ice class minimum, a conflicting situation ensues. This is illustrated in Figure 1. This ship fulfills roughly the phase 0 requirements but not the phase 3 EEDI requirements where the allowed power decreases by roughly 30%.

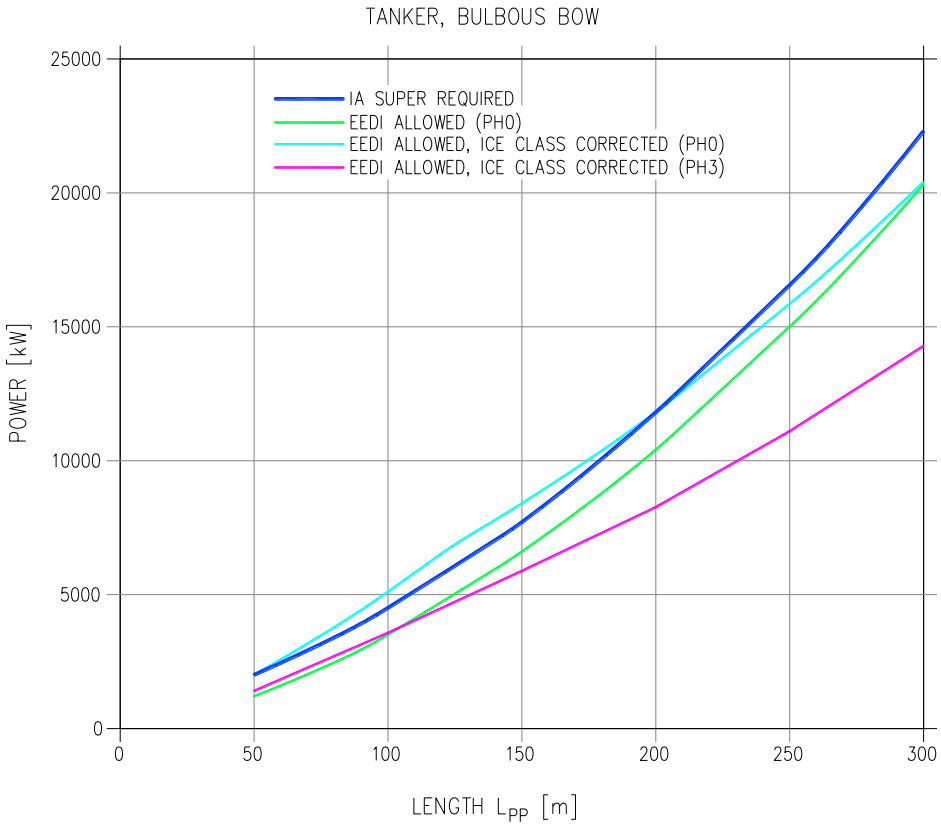


Figure 1 The allowed power according to EEDI regulations (ph0) and (ph3) together with a curve of the minimum required power based on ice class IA Super for a typical Baltic tanker with a bulbous bow.

Analysis of the ship design means to reduce the attained EEDI has shown that only up to about 10% decrease can be achieved – a further about 20% decrease will be achieved if LNG is used as fuel. This situation raises the question about the future balance in the winter navigation system: is the solution to lower the ice performance requirements for merchant ships – and thus deploy more icebreakers? This will lead to savings in merchant ship operational costs, but the total costs and emissions from the winter navigation system must be looked as a whole, taking into account both merchant ships' and icebreakers' CAPEX, OPEX and emissions.

For EEDI the overall energy and environmental efficiency of merchant vessels is achieved by using suitable hull forms and propulsion technology. The composition of merchant fleet doesn't influence the icebreaker type selection, providing large bulk- and tankers' proportion of whole traffic doesn't change much. However, as the maximum installable power is limited by future stricter EEDI power limits, resulting reduction of independent ice going capacity of merchant vessels will effect required amount of assistance and number of icebreakers. This should be carefully taken into account when considering future ice-restriction policies, incentives and formulating EEDI regulation for cargo-vessels not yet covered by EEDI. In general, when considering the required future ice-breaking capacity, a holistic approach, taking into

account the CAPEX, OPEX and environmental issues should be used to assure a safe and efficient winter navigation system. (ILS, 2012)

3.2. Summary of different icebreaker types suitability for Baltic Sea use

In Figure 2 and Figure 3, the icebreakers and icebreaking supply vessels that were studied for this report are presented according to their propulsion power/breadth- ratio and bollard pull versus their icebreaking capabilities. The icebreaking capability is presented as ice thickness with the corresponding speed for each vessel. The lines in the figures show the minimum values required for the icebreaker categorization (A, B, C) presented above. The red dots represent the current icebreakers of Finland, Sweden and Estonia. Also the new Finnish icebreaker under construction is included. (For some of the vessels the data was not available and thus they are omitted from the figures.)

These tables give a straightforward characterization of the vessel's ability and efficiency to break ice compared to the requirements for the Baltic Sea use.

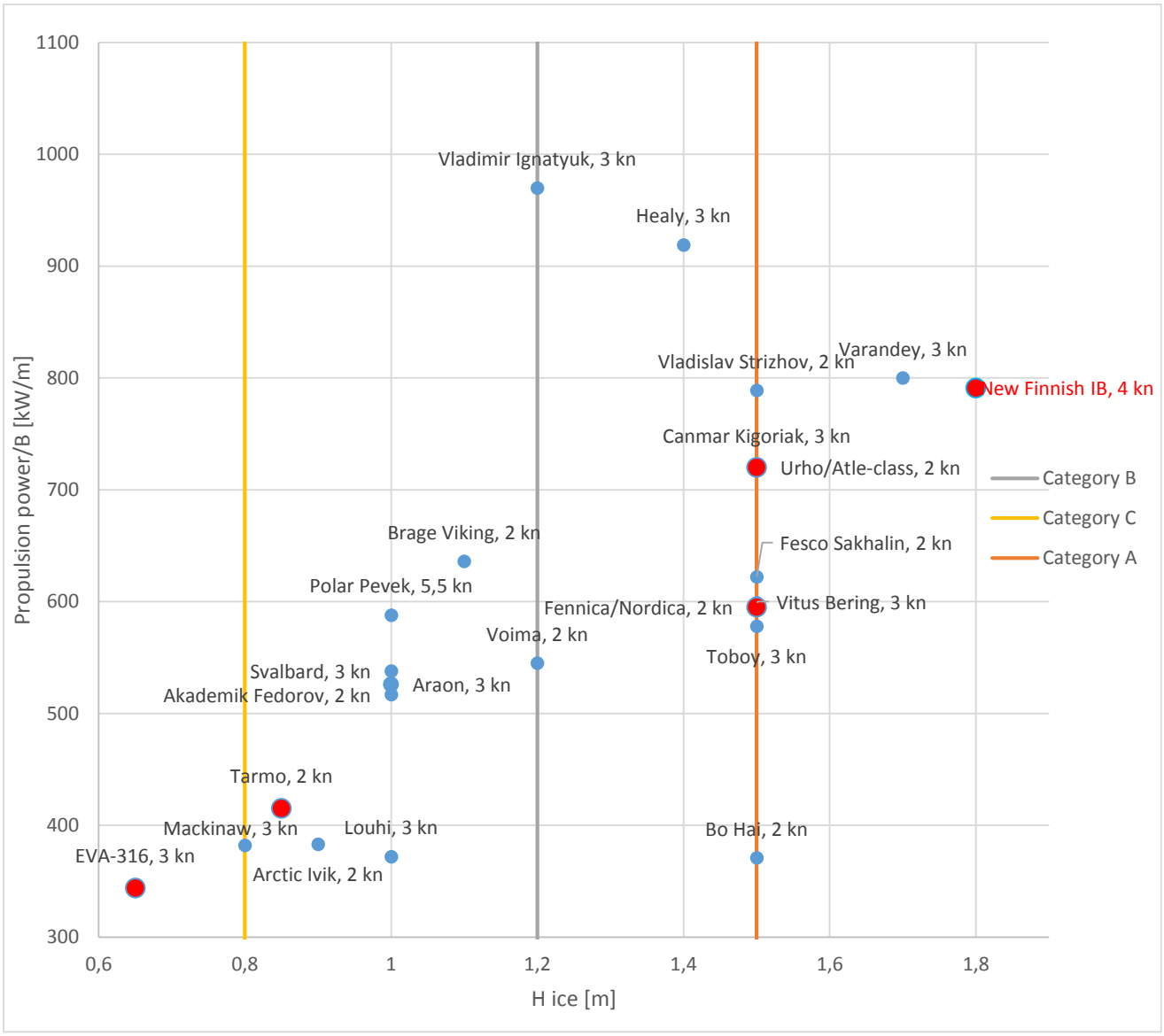


Figure 2. The propulsion power/breadth ratio vs. Icebreaking capabilities

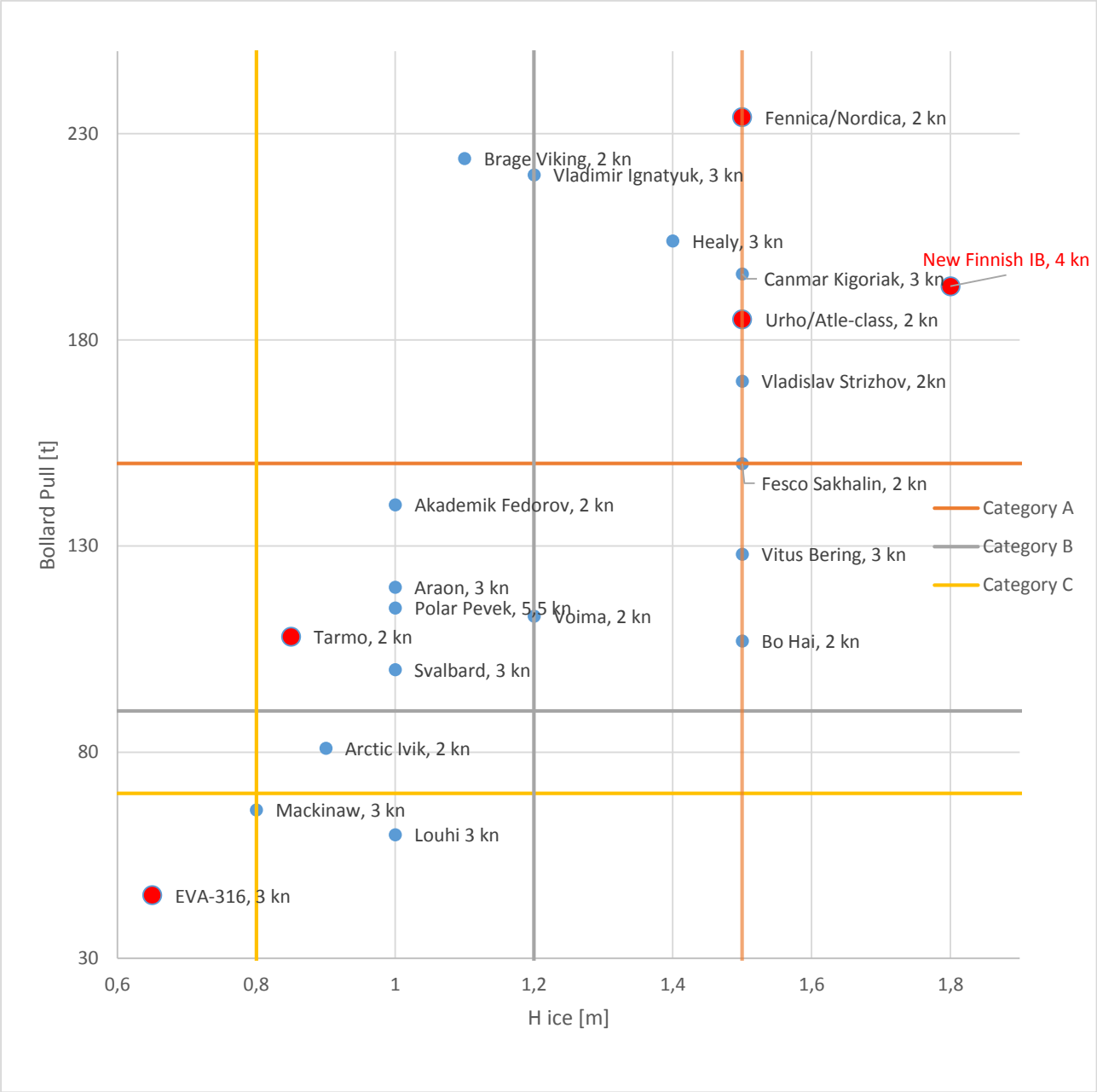


Figure 3. Bollard pull vs. Icegoing capability.

Of the current icebreaking vessels in the world, the ones that could be categorized in the Category A are, in addition to the Finnish, Swedish and Russian and Canadian icebreakers, mainly different kinds of icebreaking supply vessels.

It has to be noted that icebreaking capability in itself does not make the vessel a good icebreaker. Good icebreaker has sufficient speed at the operational area's ice conditions and good maneuverability and backing performance in ice in escort operations. Also, the breadth of the icebreaker is crucial for its ability to create a wide enough channel for the escorted vessels.

Multipurpose supply vessels often have ice-going capabilities matching those of the category A Swedish/Finnish icebreakers, but they are mostly too narrow for this category (breadth demand for category B is fulfilled though). They can also be missing a towing notch etc. (The breadth problem was solved in Fennica-class and Botnica with wider forebody/reamers, and towing notch can be removable like in Fennica and Tor Viking classes.)

The DAT principle could be used even category A/B icebreakers, but in order to have the best assisting capabilities, the icebreaking capabilities have to be at the same level in both directions. For example Fesco Sakhalin operates with the Double Acting-principle, breaking ice with the stern as the bow is optimized for open water.

Candidates for category B include mainly supply vessels that have reasonable ice-going capabilities. These include AHTS-vessels like Vladimir Ignatyuk (+ sister vessels) and Brage Viking (+sister vessels) that have high bollard pull and propulsion power. This is also reflected in their icebreaking capabilities. Even if Brage Viking and her sister ships have a bulbous bow, the vessel's ice tests showed their decent performance in moderate ice conditions. Still, the bulbous bow limits their ramming capability in heavy ridges. Also the power needed for icebreaking is higher than with an icebreaker bow shape. This kind of vessels could perform icebreaking duties temporarily mainly in the Gulf of Finland, whilst the ice conditions in the Bay of Bothnia in the middle of winter could be too difficult. This class of vessels could also suit the Estonian icebreaking needs.

Category C-type vessels include mainly research vessels, patrol vessels and tugs. The research vessels and patrol vessels are mainly open water ships that have some icebreaking capability. Research vessels such as Araon are used for the research of the Arctic and Antarctic areas and thus have quite good icebreaking abilities. Patrol vessels with ice capabilities patrol often in areas that have one year ice in the winter. Louhi is one example of a vessel type that could operate as category C icebreaker. EVA-316 can be categorized to the C class, and it has proved in the recent years that it can operate well in the Pärnu Bay ice conditions even on hard winters.

3.3.1. Icebreakers and icebreaking supply vessels under construction

There are several icebreaking vessels under construction at the time of writing. Especially the increased activities in the Russian Arctic have increased the demand for rescue and salvage ships with icebreaking capabilities. At the time of writing, 4 icebreaking salvage vessels were under construction for Russia. Two of these vessels are built at Nordic Yards Wismar, scheduled for delivery in 2015.

Also, special concepts have been introduced: one of the four salvage vessels, oblique multipurpose icebreaking emergency and rescue vessel Baltika, is to be delivered from the Arctech Helsinki shipyard in spring 2014. The vessel can perform icebreaking duties also sideways and will thus be able to open a wider

channel than traditional icebreakers, up to 50 meters. Baltika is also equipped to perform multiple duties of rescue and salvage and environmental protection. The icebreaking capabilities of Baltika are 3 knots in 1 m level ice both ahead and astern and sideways in 60 cm level ice.

Several multipurpose icebreaking supply vessels have also been built in the last years. Two of those are Vitus Bering and Aleksey Chirikov built by Arctech Helsinki Shipyard for Sovcomflot. These vessels will be operating in the Sakhalin area and are able to operate in 1.7 meter ice independently. Arctech shipyard is currently also contracted to build a developed version of these vessels to be delivered in 2016. It will be able to operate in 1.5 thick ice independently.

Russia will also receive in 2015 from the Baltic Shipyard a DAS icebreaker that has the ability to move 2 knots in 2 meter ice, both ahead and astern. The vessel (referred as LK-25 (also named Viktor Tschernomyrdin) will have 25 MW of power and a breadth of 29 meters with the price of 210 million US dollars. Another pure icebreaker project in Russia worth mentioning is the LK-60 nuclear icebreaker that will be launched from the Baltiysky Zavod shipyard in 2017 and will operate in the Arctic and the Siberian rivers. The vessel would be able to break 3 meter thick ice. The estimated price of this vessel is around 1,2 billion US dollars.

In Canada, different types of icebreaking vessels are either being built or in design phase. The Royal Canadian Navy will receive in 2018 a multiseason patrol ship that will be patrolling the Canadian Arctic waters. The Canadians are also investing for a new 1,3 billion dollar icebreaker (John G. Diefenbaker) for the Canadian Coast Guard. The icebreaker would have 42 MW of power with diesel engines and move 3 knots in 2,5 m ice, which is in the range of the Russian nuclear icebreakers.

Of these new vessels, the icebreaking supply vessels have ice-going capabilities that match those of the Finnish/Swedish icebreakers. They have usually 19-21 meters breadth and as discussed earlier limit their use as category A icebreakers. However new innovations like Baltika type oblique icebreaker concept can break ice sideways in moderate ice conditions. Of the other icebreaking ships being built, LK-25 is the closest one to match the Finnish/Swedish icebreaking needs.

References:

ILS Oy (2011): The world icebreaker, ice breaking supply and research vessel fleet. Baltic Icebreaking Management.

ILS Oy (2012): Analysis of requirements for a new generation icebreaker for the Baltic.

THE WORLD ICEBREAKER, ICE BREAKING SUPPLY AND RESEARCH VESSEL FLEET

First by ILS Oy, 2011
Updated May 2014

CONTENTS

1. THE LIST OF ICEBREAKERS, ICE BREAKING SUPPLY SHIPS AND ICE CAPABLE RESEARCH SHIPS

The icebreaker and ice breaking supply vessel fleet is compiled into the tables below. An icebreaker is a ship that is intended to break ice in order to escort merchant vessels, to do ice management or to carry out some other special task in ice. Usually these kinds of vessels are pure icebreakers, ice breaking supply vessels or cruise ships (modified usually from icebreakers). The borderline between different vessels is not exact and if there are some omissions, they are not made on purpose.

The list has been done considering each country in itself. This division into countries has been done based on the operational area – not necessarily based on the nationality of the owner. The owner of the vessel is sometimes not clear and sometimes instead of the owner, the operator is mentioned in the list.

The ship length and beam are those at the waterline but some information does not mention whether the data is referring to waterline or length overall. The bollard pull is also mentioned in the list. The bollard pull characterises the ship's ability to break ice – naturally together with a hull form suitable for ice breaking. The bollard pull information can also be related to the force required to keep an AFRAMAX tanker stationary in a storm – at least 100 t bollard pull is required. An AFRAMAX tanker requires two icebreakers to escort her in more severe ice conditions. The propulsion power, propeller and propulsion system influence the bollard pull. It is here estimated from the data on power and propellers, and if possible checked with some other public data. Overall, some caution is necessary concerning the bollard pull or the ice breaking capability.

The ice breaking performance in level ice reflects the capability of the ship in ice. This breaking performance solely does not make a good icebreaker. The requirements for a good icebreaker include a sufficient speed in the ice conditions of the operational area (in the Gulf of Bothnia for example 10-12 knots in 80 cm thick ice) and good manoeuvrability in ice for escort operations. Additionally it can be observed that even a technically good icebreaker is not performing well in escort services if the crew cannot use all the capability invested into their ship. The high average escort speed is one of the main measures of a good, smooth winter navigation system. The ice breaking capability and the bollard pull help in assessing the capability of a ship in escort operations.

The world's icebreaker and ice breaking supply vessel fleet is seemingly large in this list format; more than 80 ships – partly because many of the ice breaking research vessels like RV Polarstern are included in the list. The ships included in the list are divided into very different ship types. The supply vessels are intended to operate in various tasks at offshore oil and gas fields and thus they are not intended to be used in escort duties – this is reflected for example in that these supply vessels do not have a towing notch. An example of the necessity for an icebreaker to have a notch is given by the addition of a notch into the Estonian icebreaker EVA – 316. The bridge of a supply ship is not suitable for escort operations as a large visibility sector astern is required for icebreakers. Apart from research and supply ships the list includes some ships used in cruising in polar waters.

Note: The data that is estimated is marked with **bold**.

ARGENTINA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Almirante Irizar (1)	Argentinean Navy	1978	113.4	24.8	9.5	11.95	138	1.0 / 3	2 x FPP	Towing notch but not meant to escort duties. Fire in the auxiliary generator room, in shipyard at least year 2008.

AUSTRALIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Aurora Australis (1)	Antarctic Shipping Ltd (P&O Polar)	1989	88.4	20.3	7.9	10	NA	1.23 / 2.5	1 x CPP	Antarctic supply and oceanographic research, nozzle

GREAT BRITAIN										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
James Clark Ross (1)	British Antarctic Survey	1991	90.0	18.9	6.4	6.3	**74**	NA	1 x FPP	Antarctic supply and oceanographic research, nozzle

CANADA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Louis S. St. Laurent	Canadian Coast Guard	1969	101.9	23.8	9.9	17.7	202	1.2 / 3	3 x FPP	Modernized in 1988
Pierre Radisson (1)	Canadian Coast Guard	1978	88.9	19.2	7.2	10.1	115	1.1 / 2	2 x FPP	R-class
Amundsen (1)	Canadian Coast Guard	1979	88.9	19.2	7.2	10.0	115	1.1 / 2	2 x FPP	R-class, Ex. Sir John Franklin, research vessel
Des Groseilliers (1)	Canadian Coast Guard	1982	88.9	19.2	7.2	10.0	115	1.1 / 2	2 x FPP	R-class
Terry Fox (1)	Canadian Coast Guard	1983	80.6	17.2	8.3	17.7	190	1.2 / 7	2 x CPP	Previously a Beaufort Sea supply vessel
Arctic Shiko, Seaforth Atlantic		1984	60.9	14.5	5.9	9.0	125	1.05 / 2	2 x CPP	Sold to Maersk (Maersk Trader and Maersk Tracker) but sold further
Arctic Ivik (1)	Canadian Coast Guard	1985	64.7	14.0	5.8	5.3	81	0.9 / 2	2 x CPP	Beaufort Sea supply vessel, no towing notch.
Henry Larsen	Canadian Coast Guard	1987	94.1	19.4	7.2	12.0	115	1.2 / 2	2 x FPP	
Under construction 2014										
Arctic Offshore Patrol Ship	Royal Canadian Navy	2018?	98	19	5,75	9	NA	NA	2	

CHILE										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Almirante Viel	Chilean Navy	1969	89.2	19.1	6.3	8.8	112	0.9 / 2	2 x FPP	No towing notch, ex. CCG Norman McLeod Rogers

CHINA										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Bo Hai (1)	Bohai Bay Oil Company	1982	73.0	18.0	7.5	7.1	107	1.5 / 2	2 x CPP (nozzles)	Ex. Beaufort Sea supplier Robert LeMeur

DENMARK										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Danbjörn	Danish Navy	1965	68.0	17.0	6.0	8.7	96	1.0 / 2	2+2 x FPP	
Isbjörn	Danish Navy	1966	68.0	17.0	6.0	8.7	96	1.0 / 2	2+2 x FPP	
Thorbjörn	Danish Navy	1980	57.6	15.0	4.7	4.6	55	NA	2 x FPP	
Brage Viking (1), Loke V., Njord V., Magne V.	Viking Supply Ships	2010-2012	76.2	22.0	7.00 7.60	14	224	1.1/2	1 CPP in nozzle	Icegoing multipurpose AHTS-vessel

ESTONIA										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Tarmo	Veteede Amet	1963	82.0	21.2	7.4	8.8	108	0.85 / 2	2+2 x FPP	
EVA-316 (1)	Veteede Amet	1980 / 2005	48.6	12.2	3.8	4.4	45.3	0.65 / 3	2 x FPP (Rolls Royce)	In use at the Pärnu Bay, modified Finnish ex. Lonna
Botnica (1)	Arctia Offshore Oy	1998	77.9	23.1	7.2	10	117	0.6 / 8	2 x FPP (Azipod)	Multipurpose offshore/icebreaking

FINLAND										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Voima (1)	Arctia Icebreaking Oy	1954, 1979	83.5	18.7	7.0	10.2	113	**1.2 / 2**	2+2 x FPP	Modernized in 1979
Urho, Sisu (1)	Arctia Icebreaking Oy	1975, 1976	96.0	22.5	7.3	16.2	185	0.8 / 8.5	2+2 x FPP	
Otso, Kontio (1)	Arctia Icebreaking Oy	1986, 1987	90.0	23.4	7.3	15	160	0.8 / 10	2 x FPP	
Fennica, Nordica (1)	Arctia Offshore Oy	1993, 1994	96.7	25.2	8.4	15	234	0.8 / 9.5	2 x FPP (Rolls Royce)	Multipurpose offshore/icebreaking
Zeus (1)	Alfons Håkans Oy	1995	42.0	14.0	6.66	5.4	101	NA	1 x CPP	Tug, towing notch
Louhi (1)	SYKE(oper. Finnish Navy	1998	2011	14.5	5.0	5.4	60	0.5 / 8	2 x FPP (R-R)	Multipurpose vessel (oil/chem. recovery emergency towing, transport)
Under construction 2014										
Kemin Karhu	Arctia Karhu	2014	37,8	12,8 [B]	4,7	3600	NA	0,7/3	2 x FPP (R-R azimuth)	Harbour icebreaker, tug,
New Icebreaker	FTA	2015	110 [Loa]	24	8	22	193	4/1,8	3 x FPP [azimuth)	

GERMANY										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Polarstern (1)	Alfred Wegener Institute (BMBF)	1982	109.2	24.0	11.2	14	NA	1.5 / 5	2 x FPP	Antarctic supply and oceanographic research, nozzles
Neuwerk (1)	Wasser- und Schifffahrts-amt Cuxhaven	1998	78.9	18.6	5.8	5.8	115	0.5 / 5	2 x FPP (Schottel)	Standby and oil combating ship
Maria S. Merian (1)	Land Mecklenburg-Vorpommern	2005	88.2	19.2	6.5	3.8	NA	NA	2 x FPP Schottel tandem props	Marginal ice zone research vessel

JAPAN										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Soya	Japan Coast Guard	1978	94.0	15.6	5.5	11.5	132	1.0 / 2	2 x CPP	No towing notch
Shirase	Ministry of Defense	1982	124.0	27.0	9.2	22.1	243	1.5 / 3	3 x FPP	Retired
Teshio	Japan Coast Guard	1995	54.9 (OA)	10.2	5.0	2.6	NA	0.55 / 3	2 x CPP	Nozzles
Shirase (1)	Ministry of Defense	2009	126.0	27.0	9.2	22.1	NA	1.5 / 3	2 x FPP	Cruises to Antarctica

KAZAKSTAN										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Arcticaborg,. Antarcticaborg (1)	Wagenborg (ENI)	1998	57.7	16.6	4.4	3.2	32	0.6 / 3	2 x FPP (Azipod)	Supply ship in the Caspian Sea
Tulpar (1)	BUE Marine Ltd	2003	87.3	21.0	4.0	4	NA	0.6 / 2	2 x FPP (Schottel)	Supply ship in the Caspian Sea
Mangystau-1,…,5 (1)	JSC Circle Marine Invest	2010,2011	61.9	16.4	3.0	4.8	52	0.6 / 4	3 x FPP (Schottel)	Kashagan field in the Caspian Sea
Armanborg (1)	Wagenborg	conv.2009	42.56 WL	12.5	3.12	2.15	24	0.80/1.5	1 x FPP	Supply Ship in Caspian Sea (lengthened), ex Arppe

LATVIA										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Varma	Port of Riga	1968	82.0	21.2	7.4	8.8	108	0.85 / 2	4 x FPP	

NETHERLANDS										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Sanaborg, (1) Serkeborg	Wagenborg	2012	65.85 WL	14.0	3.15	3.5	36.3	0.6/4	2xFPP (Wärtsilä Icepods)	Icebreaking Multipurpose Support and Supply Vessel

NORWAY										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Svalbard (1)	Royal Norwegian Navy	2001	89.0	19.1	6.5	10	NA	1.0 / 3	2 x FPP (Azipod)	Coast guard vessel, no towing notch
Polarbjorn (1)	Polar Ship Management	2001	80.4	18.0	7.25/ 7.85	7.07	-	-	1 CPP in nozzle	Icegoing multipurpose research vessel
Under construction 2014										
Kronprins Haakon	Norwegian Institute of Marine Research	2016	>100	21	NA	NA	NA	NA	NA	NA

RUSSIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Karu	(RosMorPort)	1958	68.3	16.7	5.8	5.5	70	0.7 / 2	2+2 x FPP	Ex. Karhu
Ivan Kruzen-shtern, Yuriy Lisyanskiy, Fyodor Litke, Semen Dezhnev	RosMorPort	1964, 1965, 1970, 1971	62.0	17.5	6.2	3.5	54	0.7 / 2	2+1 x FPP	Port icebreakers
Tor	(RosMorPort)	1964	79.5	20.5	6.2	8.7	108	0.8 / 2	2+2 x FPP	Formerly Swedish
Dudinka	OJSC MMC Norilsk Nickel	1970	79.5	20.5	6.2	8.7	108	0.8 / 2	2+2 x FPP	Ex. Apu

Jermak	RosMorPort	1974	130.0	25.6	11.0	26.5	320	1.8 / 2	3 x FPP	
Admiral Makarov, Krasin	Fesco	1975, 1976	130.0	25.6	11.0	26.5	320	1.8 / 2	3 x FPP	
Kapitan M. Izmaylov, Kapitan Kosolapov	RosMorPort	1976	52.2	15.6	4.5	2.5	36	0.6 / 2	2 x FPP	Port icebreakers

RUSSIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Kapitan Plakhin	Severo-Zapadny Flot	1977	71.0	16.0	3.5	3.3	42	0.7 / 2	3 x CPP	River icebreaker
Kapitan Sorokin (1)	RosMorPort	1977/1991	130.2	30.5	8.5	16.2	181	1.9 / 2	3 x FPP	Bow changed to Thyssen Waas bow
Kapitan Zarubin	RosMorPort	1978	74.4	16.3	3.5	3.3	42	0.7 / 2	3 x CPP	River icebreaker
Kapitan Bukaev, (1) Kapitan Chadayev, Kapitan Krutov	(RosMorPort)	1978	71.0	16.0	3.3	3.3	42	0.7 / 2	3 x FPP	River icebreakers. Kapitan Krutov operates in the Sea of Azov.
Talagi (1)	(Rosneft)	1978	84.2	17.3	8.4	12.2	196	1.5 / 3	1 x CPP	Ex. Canmar Kigoriak, Beaufort Sea supply ship, no towing notch, nozzle
Kapitan Nikolaev	Murmansk Shipping Co.	1978/1990	125.8	25.6	8.5	16.2	181	1.8 / 2	3 x FPP	Bow changed to conical bow. Changed to be also as a rescue ship.
Kapitan Dranitsyn	Murmansk Shipping Co.	1980	121.3	25.6	8.5	16.2	181	1.3 / 2	3 x FPP	In use as a research and cruise ship
Kapitan Khlebnikov	Fesco	1981	121.3	25.6	8.5	16.2	181	1.3 / 2	3 x FPP	In use as a cruise ship
Magadan	Fesco	1982	78.5	20.0	6.0	7.0	87	1.0 / 2	2 x FPP	In the Okhotsk Sea
Smit Sakhalin, Smit Sibu	Smit Singapore (FEMCO)	1982	75.5	16.6	7.5	11.2	165	1.2 / 4	2 x CPP	Ex. Miscaroo and Ikaluk, Beaufort Sea supply ships

Svitzer Sakhalin (1), Svitzer Aniva, Svirter, Svitzer Busse, Svitzer Korsakov	Svitzer	2007	34.5	13.0	5.7	4.8	75	NA	2 x CPP (Rolls Royce)	Icebreaking terminal tugs for Sakhalin

RUSSIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Mudyug (1)	RosMorPort	1982/1989	89,8	20.0	6.0	7.0	87	1.5 / 2	2 x CPP	Changed to have a Thyssen Waas bow
Vladimir Ignatjuk(1)	Murmansk Shipping Co.	1983	80.6	17.2	8.0	17.1	200	1.2 / 3	2 x CPP	Ex. (Arctic) Kalvik, Beaufort Sea supply ship, no towing notch
Dikson	(RosMorPort)	1983	78.5	20.0	6.0	7.0	87	1.0 / 2	2 x CPP	In the White Sea
Kapitan Yevdokimov, (1), Kapitan Demidov, Kapitan Moshkin	(RosMorPort)	1983, 1984, 1986	73.0	16.0	2.5	3.8	41	0.9 / 2	4 x FPP	River icebreakers, Kapitan Demidov and Kapitan Moshkin operate in the Sea of Azov.
Akademik Feodorov (1)	AARI	1987	139.0	23.5	8.5	13.9	140	1.0 / 2	1 x FPP	Antarctic supply and oceanographic research
Rjurik, Askold	Sovfraht	2004, 2005	36.5	12.8	5.9	4.0	64	0.7 / 2	2 x CPP	LU5 class tugs, nozzles
Fesco Sakhalin (1)	Fesco	2005	93.5	21.2	7.5	13.0	150	1.5 / 2	2 x FPP (Azipod)	Supply vessel in the Okhotsk Sea, no towing notch
Pacific Enterprise,(1) Pacific Endeavour, Pacific Endurance	Swire Offshore	2006	77.6	19.0	7.5	14.0	158	1.5 / 4	2 x FPP (Rolls Royce)	Supply vessel in the Okhotsk Sea, no towing notch, Russian flag
Polar Pevek (1)	Rieber Shipping	2006	74.4	17.0	6.5	10	115	NA	2 x FPP (Azipod)	Supply vessel in the Okhotsk Sea, at Dekastri terminal, no towing notch

RUSSIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Yuri Topchev,(1) Vladislav Strizhov	Sevmornefte-gaz (Gazprom)	2006	84.4	19.0	8.0	15.0	163	1.7 / 2	2 x FPP (Azipod)	Originally aimed for the Pechora Sea but Vladislav Strizhov at present in the Okhotsk Sea, no towing notch
Svetlyy, Vz morye	Lukoil Kaliningrad-morneft	2007	65.0	15.0	4.3	5.3	60	NA	2 x CPP	AHTS ships in Caspian Sea
Toboy (1)	Lukoil	2008	73.3	18.5	9.1	10.4	NA	1.5 / 3	2 x FPP (SteerProp)	Pechora Sea supply / icebreaker
Varandey (1)	Lukoil	2008	88.8	21.0	10.5	16.8	NA	1.7 / 4	2 x FPP (SteerProp)	Pechora Sea icebreaker / supply
Moskva (1) Sankt Petersburg	RosMorPort	2008, 2009	97.2	26.5	8.5	16.0	NA	NA	2 x FPP (SteerProp)	
Langepas, Kogalym, Svetlyy, Vzmore	Lukoil	2009, 2010	62.4	15.0	4.3	5.3	60	NA	2 x CPP	Korchagin field in the Caspian Sea
Nuclear powered icebreakers										
Lenin	AtomFlot	1959	124.0	26.8	10.5	28.8	330	1.6 / 2	3 x FPP	Retired, museum
Arktika, Sibir, Rossija, Sovetskiy Soyuz, Yamal	AtomFlot	1974-1992	136.0	28.0	11.0	49.0	480	2.3 / 2	3 x FPP	Arktika and Sibir not in use

RUSSIA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Taimyr, (1) Vaigach	AtomFlot	1989, 1990	140.6	28.0	8.0	32.5	295	2.0 / 2	3 x FPP	Shallow draught
50 Let Popedy (1)	AtomFlot	2007	145.6	28.0	11.0	49.0	480	2.7 / 2	3 x FPP	Arktika class with improved bow form
Under construction 2014										
Baltika	Russian Marine Emergency Rescue Service	2014	72,1	20,5 [B]	6,3	9,0	NA	1.0/ 3	3 x FPP (Azimuth)	Oblique icebreaker
Murmansk	Rosmorport	2015	119,8 [Loa]	27,5 [B]	8,5	27	NA	1,5/3,5	2 x FPP (Azimuth)	
LK-25	FSUE Rosmorport	2015	142 [Loa]	29 [B]	9,5	25	NA	2/2	3 x FPP (2x Azipod, 1 x FPP)	
2 Rescue Icebreakers	Russia's State Maritime Rescue Coordination Centre	2015	86	19	NA	NA	NA	NA	2 x FPP (Azipod)	

SOUTH AFRICA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
S.A. Agulhas (1)	Smit Amandla Marine Ltd.	1977	112.0	18.1	6.05	4.48	NA	NA	1 x CPP	Antarctic supply / oceanographic research

SOUTH KOREA										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Araon (1)	KOPRI	2009	95.0	19.0	6.8/7.6	10000	120	1.0/3	2xFPP R-R	Icebreaking Research vessel, Antarctic/Arctic

SWEDEN										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Ale (1)	Sjöfarts-verket	1973	47.0	13.0	5.0	3.5	48.0	NA	2 x CPP	Lake icebreaker
Atle, Frej, Ymer (1)	Sjöfarts-verket	1974, 1975, 1977	96.0	22.5	8.3	16.2	185	1.4 / 2.5	2+2 x FPP	Same as Urho- class
Oden (1)	Sjöfarts-verket	1989	100.2	31.2	8.5	17.7	240	1.8 / 3	2 x CPP	
Tor Viking II (1), Balder Viking, Vidar Viking	Viking Supply Ships AS / Sjöfarts-verket	2000, 2000, 2001	75.2	18.0	7.2	13.4	200	NA	2 x CPP	Removable notch, nozzles, multipurpose offshore/icebreaker

USA										
Ship	Owner (or operator)	Completed	L_{wl} [m]	B_{wl} [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Polar Star, Polar Sea (1)	US Coast Guard	1973, 1976	107.3	23.8	8.5	44.8	454	1.8 / 3	3 x CPP	
Nathaniel B. Palmer	Edison Chouest (NSF)	1992	85.3	18.3	9.1	9.5	NA	0.9 / 3	2 X CPP	Research vessel, Kort nozzles
Healy (1)	US Coast Guard	1999	120.9	24.4	8.5	22.4	204	1.4 / 3	2 x FPP	Research vessel, no towing notch
Mackinaw (1)	US Coast Guard	2006	73.2	17.7	4.9	6.7	66	0.8 / 3	2 x FPP (Azipods)	Great Lakes ice-breaker, no towing notch
Under construction 2014										
Sikuliaq	National Science Foundation	2014	72	16	5,7	4,3	NA	0,76/2	2 x FPP (Wärtsilä Icepod)	Research vessel

AUSTRIA										
Ship	Owner (or operator)	Completed	L_{pp} [m]	B [m]	T [m]	P [MW]	T_B [t]	h_i [m] / v [kn]	Propulsion	Remarks
Röthelstein (1)	Österreichhishe Donau Kraftverke	1995	42.3 Loa	10.0	2.0	1.12	120	0,7	2xFPP (Azipod)	River Icebreaker

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Akademik Fedorov**
Owner/Operator:	Arctic and Antarctic Research Institute AARI
Builder:	Rauma shipyard
Year of Construction:	1987
Contract price:	
Ship Type:	Research vessel
Operation Area:	Russian Arctic
Class Notation:	KM * ULA [2]A2
Ice Class:	KM ULA
Stem Angle:	29°
L_{OA}	141,2 m
L_{PP}	
L_{WL}	128,6 m
B_m	23,5 m
B_{WL}	23,2 m
H	13,3 m
T_{design}	8,5 m
$T_{scantling}$	
Displacement	16200 t
DWT	7200 t
Accommodation:	80 crew + 160
Open Water Speed:	16 kn
Main Engine Type/Power:	2 x Wärtsilä 16V32D, 2x6000 kW =12000 kW
Propulsion Type/Power:	2 x 6000 =12000 kW
Propellers, Type, Dia:	One FP, 4 detachable blades
Bollard Pull:	140 t
BP/B_{WL}:	6,03 t/m
Prop. Power/Bwl:	517 kW/m
Ice Performance Ahead:	2 kn in 1.0 m ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	

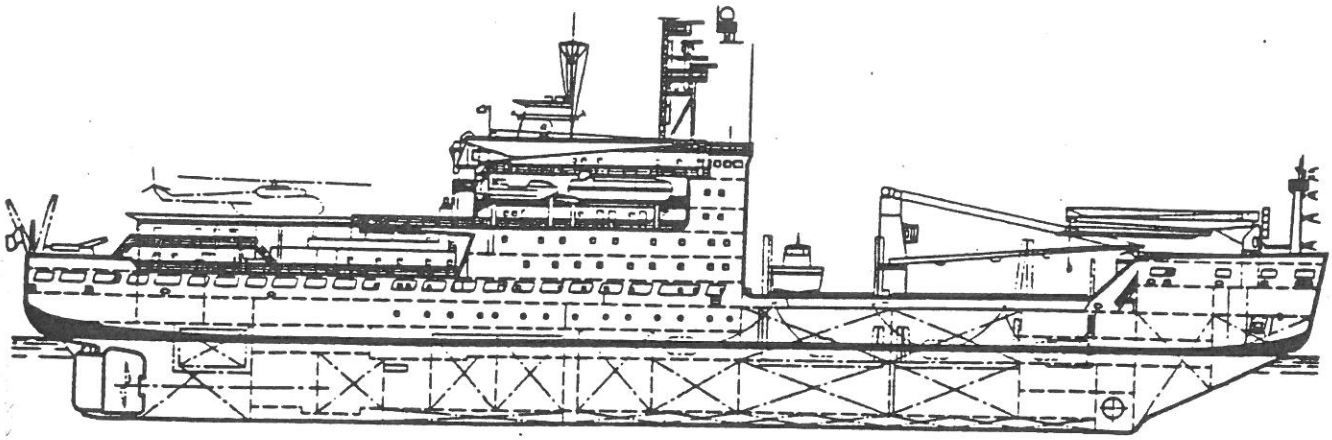
Miscellaneous: ATTACHED LINEDRAWING

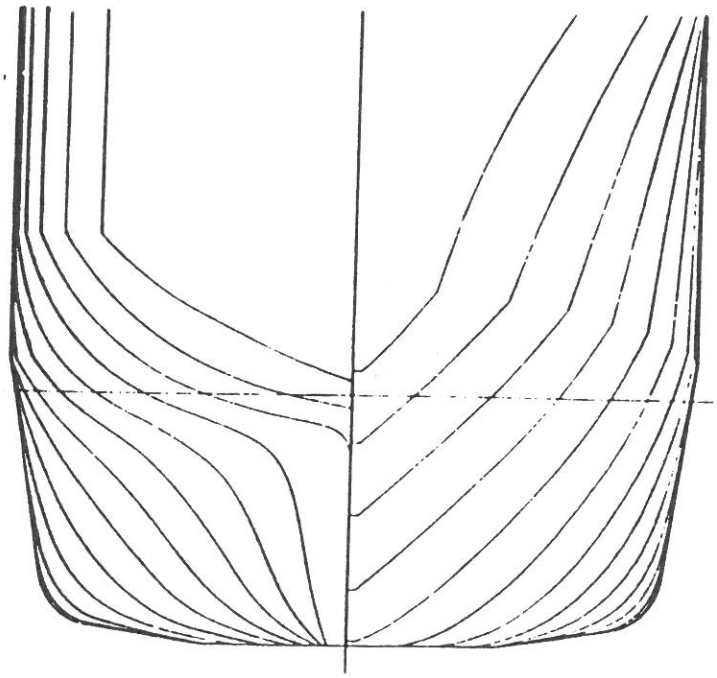
References:

AARI: Akademik Fedorov. Available at: http://www.ipyeaso.aari.ru/fedorov_tech.htm

Haapanen, M.E. Antarctica, as seen by a Shipbuilder. 1989. POAC'89, Vol. 2, p. 975-982.

RV AKADEMIK FEDOROV





L_{WL}	= 128.6 m
B_{WL}	= 23.2 m
T_{WL}	= 8.5 m
Δ	= 15 600 t
Shaft power	= 12 000 kW

Data from Haapanen (1989).

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Akademik Tryoshnikov**
Owner/Operator:	Federal Service for Hydrometerology and environmental Monitoring, Russia
Builder:	Admirality Shipyards, Russia
Year of Construction:	2012
Contract price:	
Ship Type:	Research Vessel
Operation Area:	Antarctic
Class Notation:	Research vessel class LU7 KM [2] A2 (CM Arc7 [2] Aut2)
Ice Class:	LU7
Stem Angle:	
L_{OA}	133,53 m
L_{PP}	123,24 m
L_{WL}	
B_m	23,25 m
B_{WL}	
H	13,5 m
T_{design}	8,5 m
$T_{scantling}$	
Displacement	16539 t
DWT	6634 t
Accomodation:	60 crew, 80 special personnel
Open Water Speed:	16 kn
Main Engine Type/Power:	2 x W9L38B 6525 kW, 1 x 6L38B 4350 kW = 16854 kW
Propulsion Type/Power:	2*7000=14000 kW
Propellers, Type, Dia:	2 FP, 4 blades
Bollard Pull:	N/A
BP/B_{WL} :	
Prop. Power/(Bwl) Bm:	602 kW/m

Ice Performance Ahead:

Ice Performance Astern:

Other Icebreaking Characteristics:

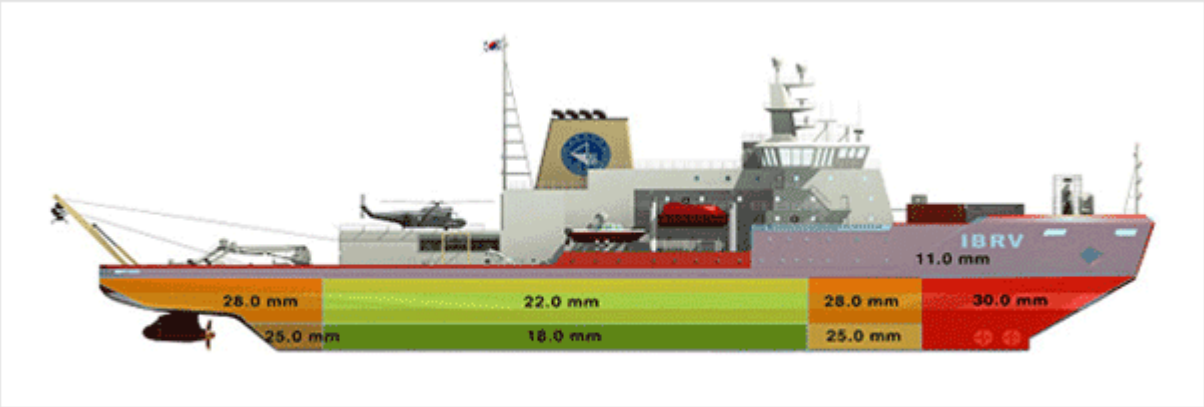
Miscellaneous: -

References: http://en.wikipedia.org/wiki/Akademik_Tryoshnikov

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Araon**
Owner/Operator:	KOPRI (Korean Polar Research Institute)
Builder:	Hajin Heavy Industries & Construction Co Korea
Year of Construction:	2009
Contract price:	108 billion KRW
Ship Type:	Icebreaking research vessel
Operation Area:	Antarctic & Arctic
Class Notation:	KR + KRS1-special purpose ship (Research) PL10, DAT(-30°), HMS1/ +KRM1-UMA3, DPS2, NBS2
Ice Class:	DNV Polar 10
Stem Angle:	32°
L_{OA}	111m
L_{PP}	95 m
L_{WL}	
B_m	19 m
B_{WL}	
H	9,9 m
T_{design}	6,8 m
$T_{scantling}$	7,6 m
Displacement	9071 t
DWT	3070 t
Accommodation:	85 person (25 crew)
Open Water Speed:	Max 16 knots
Main Engine Type/Power:	4 STX Engine/MAN B&W 7132/40 (4*3378kW?)
Propulsion Type/Power:	2 Rolls Royce FP Azimuth thrusters 5000 kW =10 MW
Propellers, Type, Dia:	2 FP Azimuth
Bollard Pull:	120 t
BP/B_{WL} :	6,32 t/m
Prop. Power/Bm(Bwl):	526 kW/m
Ice Performance Ahead:	3 knots at 1 meter multiyear ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	

Miscellaneous: GA, linedrawing available



References: Significant Ships of 2009
Non-public: ILS OY: RV Araon Operational Guidelines

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**ARCTIC IVIK**
Owner/Operator:	Canadian Coast Guard
Builder:	
Year of Construction:	1983
Contract price:	
Ship Type:	Heavy Gulf (and Arctic) Icebreaker, supported first operations in the Beaufort Sea, designed as supply vessel in ice
Operation Area:	Worldwide, Arctic
Class Notation:	
Ice Class:	
Stem Angle:	24,5°
L_{OA}	67,4 m
L_{PP} -	
L_{WL}	64,7 m
B_m	
B_{WL}	14,0 m
H	5,8 m
T_{design}	4,27 m
$T_{scantling}$	
Displacement	2375 t
DWT	
Accomodation:	Complement 24 persons
Open Water Speed:	
Main Engine Type/Power:	5370 kW
Propulsion Type/Power:	2 shafts
Propellers, Type, Dia:	2 CP-propellers in nozzles+2 rudders
Bollard Pull:	81 t
BP/B_{WL} :	5,5 t/m
Prop. Power/Bwl:	383 kW/m
Ice Performance Ahead:	0,9 m/2 kn level ice
Ice Performance Astern:	

Other Icebreaking Characteristics:

Miscellaneous: Lines available

References: Keinonen, Arno: Development of Icebreakers. (Lines) MIT, 1986.

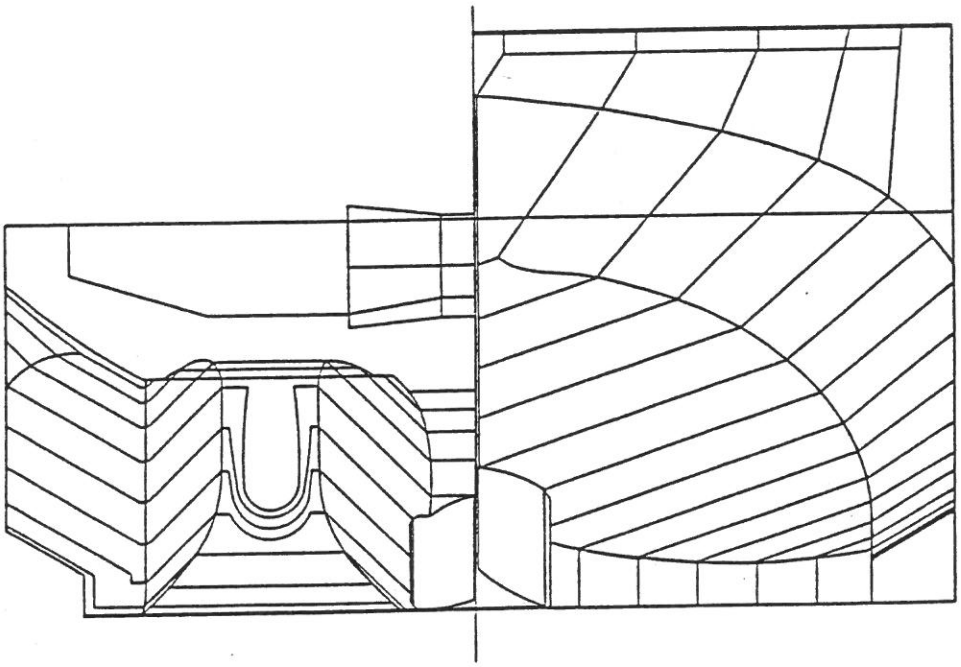


FIG. 3f

BODY PLAN, FORE AND AFT CONTOURS OF ARCTIC IVIK

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Botnica**
Owner/Operator:	Tallinna Sadam
Builder:	Aker Finnyards Rauma
Year of Construction:	1998
Contract price:	Sold to Estonia for 50 mil euros
Ship Type:	Multipurpose icebreaker and platform supply vessel
Operation Area:	Port of Tallinn
Class Notation:	DNV +A1- Supply vessel, SF-HELK-E0, Icebreaker ICE 10, DYNPOS AUTRO RPS
Ice Class:	ICE 10
Stem Angle:	14°
L_{OA}	96,7 m
L_{PP}	77,9 m
L_{WL}	
B_m	24 m
B_{WL}	
H	
T_{design}	**7,2 m**
$T_{scantling}$	7,8 m
Displacement	
DWT	1000 tonnes (icebreaker)
Accommodation:	21 crew, 72 berths
Open Water Speed:	15 kn
Main Engine Type/Power:	12 x Cat 3512B, 15 MW
Propulsion Type/Power:	2 x 5 MW Azipods
Propellers, Type, Dia:	FPP 3,8 m
Bollard Pull:	105 t
BP/B_{WL} :	4,375 t/m
Prop. Power/Bwl:	416 kW/m
Ice Performance Ahead:	8 kn in 0,6 m ice, 4 kn in 1,2 m ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous:	GA available

References:

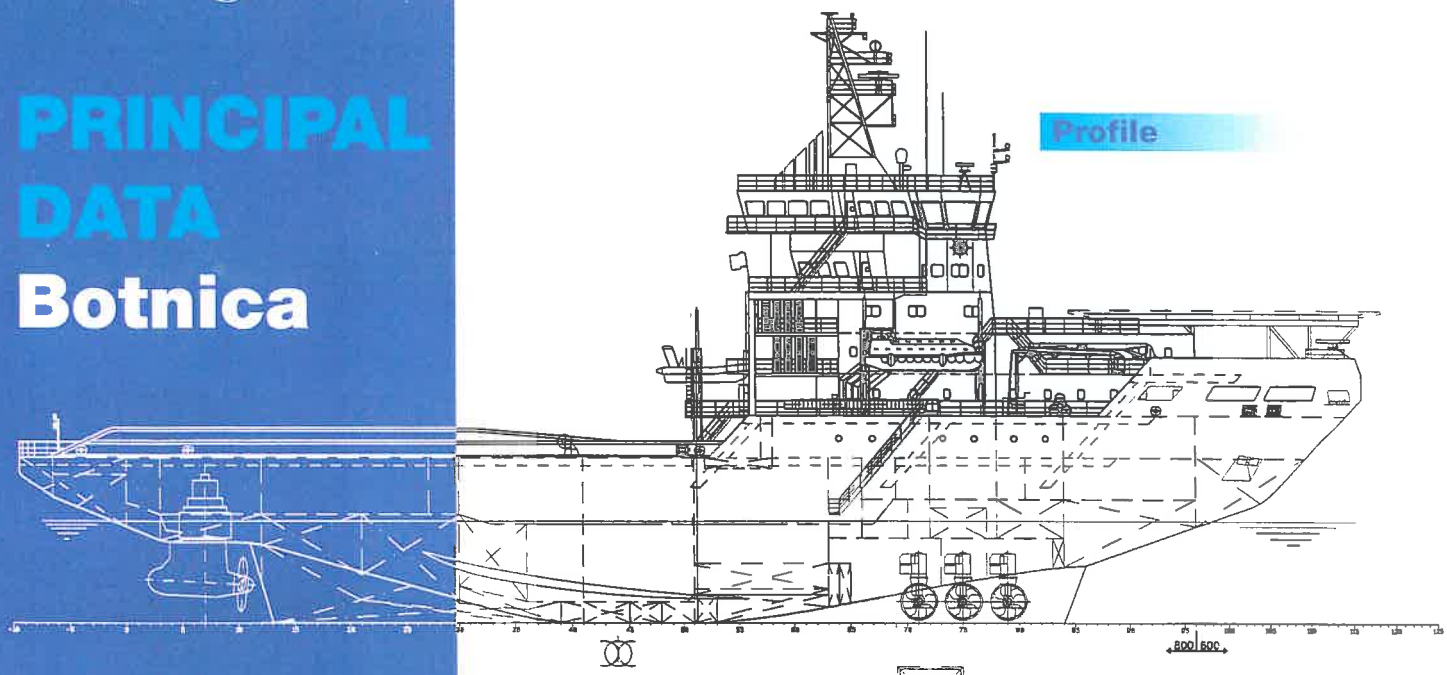
Breaking Barriers: Botnica primed for Baltic Winters and North Sea summers.

PRINCIPAL DATA

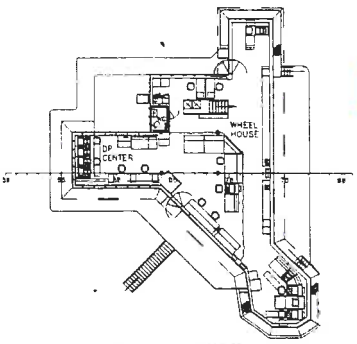
Botnica

Length, oa	96.70m
Length, bp	77.90m
Breadth, mld	24.00m
Depth, main deck	11.70m
Draught, scantling (icebreaker)	7.80m
Draught, design (icebreaker)	7.20m
Draught, scantling (offshore)	8.50m
Deadweight, icebreaker	1,000 tonnes
Deadweight, offshore	2,850 tonnes
Main engines	12 x Cat 3512B
Output, MCR	15MW
Propulsion (diesel-electric)	2 x 5MW Azipods
Bollard pull	105 tonnes
Speed, open water	15 knots
Speed, 0.6m ice	8 knots
Speed, 1.2m ice	4 knots
Crew (maritime)	21
Berths	72
Class	DNV: +A1-Supply Vessel SF-HELK-EO, Icebreaker Ice 10 DYNPOS AUTRO RPS

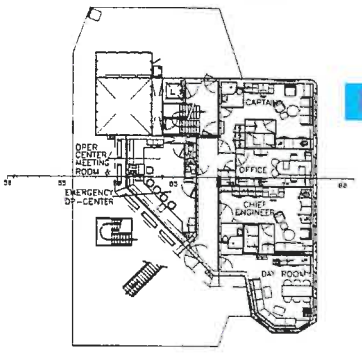
Profile



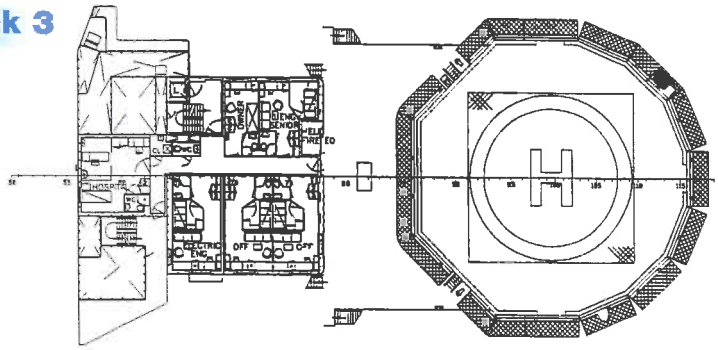
Bridge Deck



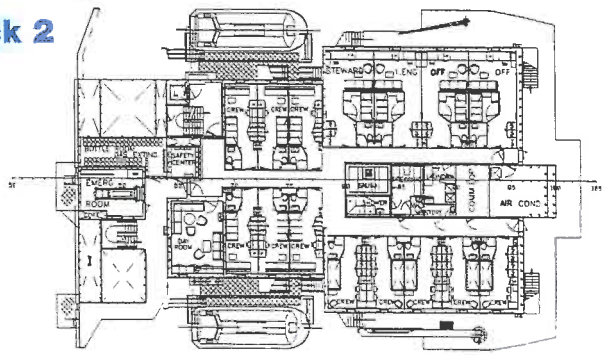
Bridge Deck 4



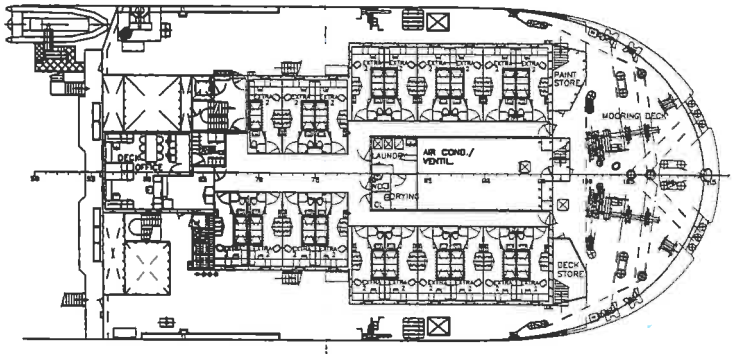
Bridge Deck 3



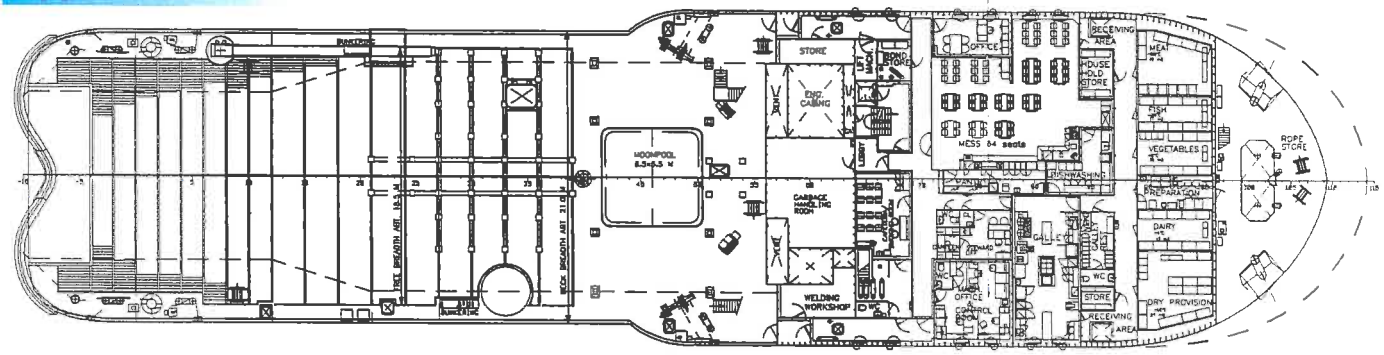
Bridge Deck 2



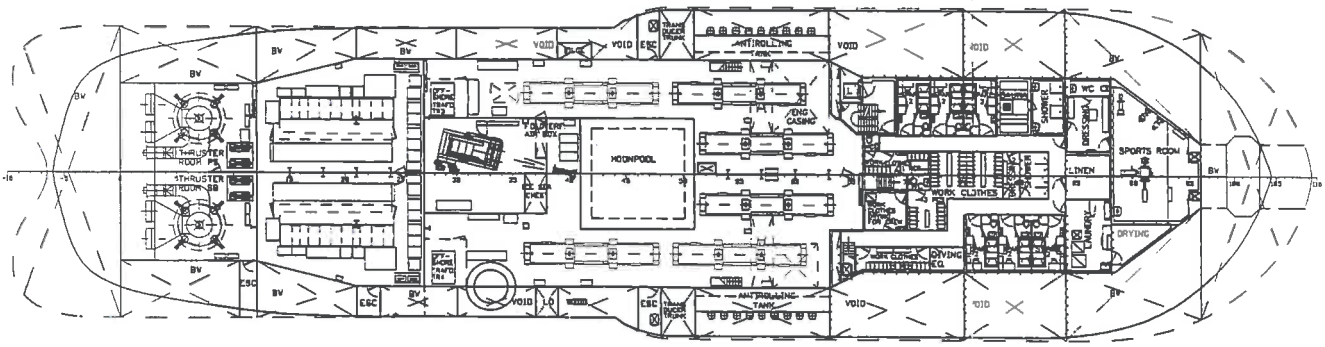
Bridge Deck 1



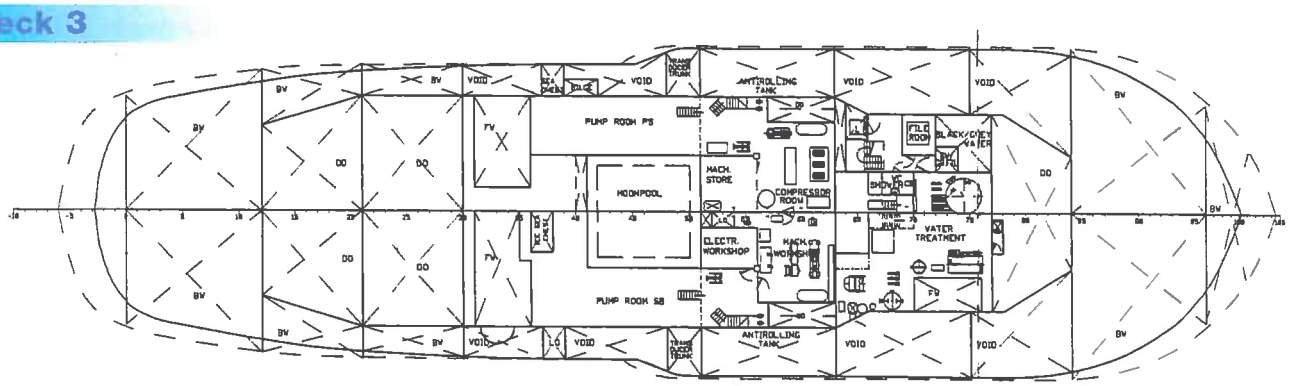
Upper Deck



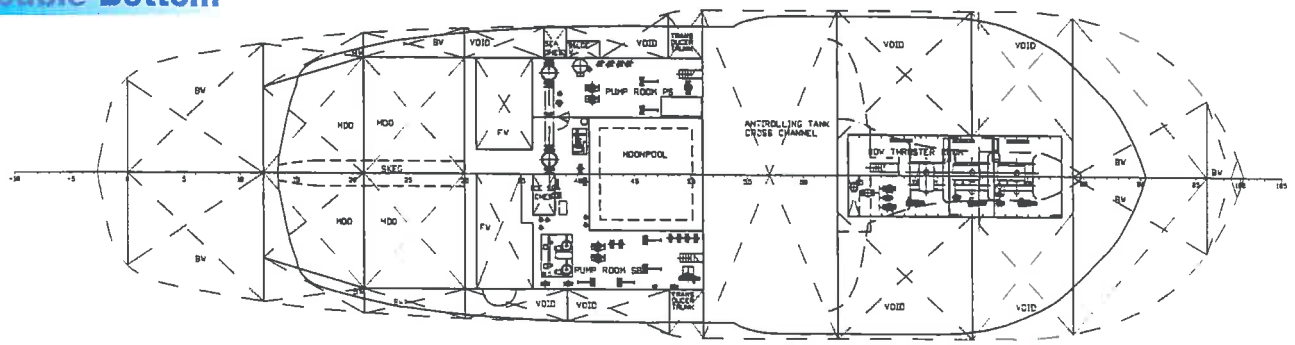
Deck 2



Deck 3



Double Bottom



DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**BRAGE VIKING** Sister Ships Loke Viking, Njord Viking, Magne Viking
Owner/Operator:	Viking Supply Ships
Builder:	Zamakona, Spain
Year of Construction:	2010-2012
Contract price:	
Ship Type:	Icegoing multipurpose AHTS-vessel, clean design, type VS4622CD-AHTS
Operation Area:	Worldwide
Class Notation:	DnV, +1A1, ICE 1A, Tug Supply Vessel, Fire Fighter II, OILREC, SF, E0, DYNPOS-AUTR, NAUT-OSV(A), CLEAN DESIGN, COMF-V(3), DEICE, T-MON, BIS, DK(+), HL(2,8), LFL*
Ice Class:	1A
Stem Angle:	Bulbous bow
L_{OA}	85,2 m
L_{PP}	76,2 m
L_{WL}	
B_m	22,0 m
B_{WL}	22,0 m
H	9,0 m
T_{design}	6,0 m
$T_{scantling}$	7,6 m
Displacement	
DWT	4500 t
Accomodation:	45 persons
Open Water Speed:	17 kn
Main Engine Type/Power:	2 x MAK 4000 kW+2 x MAK 3000 kW Total 14 000 kW
Propulsion Type/Power:	two shafts 14 000 kW
Propellers, Type, Dia:	CP-propellers in nozzles, Dia 4250 mm + 2 rudders (70^o)
Bollard Pull:	224 t
BP/B_{WL} :	10,2 t/m
Prop. Power/Bwl:	636 kW/m
Ice Performance Ahead:	1,1 m/2 kn level ice
Ice Performance Astern:	

Other Icebreaking Characteristics:

Miscellaneous: - Cargo deck 750 m^2, 10-15 t/m^2, 1000 t
- 1x 830 kW azimuth thruster and 2x830 kW tunnel thruster forward, 2x830 kW tunnel thruster aft
- Rolls-Royce/ Brtattvaag Anchor handling/towing winch, split stern roller, sliding cranes
- Oil rec., FW, Drill water, Brine,Liquid mud, Dry bulk, Base oil, methanol, urea tanks

References: Brage Viking ice trials presentation, Harri Eronen.
Vessel specification available at: http://www.vikingsupply.com/event/doLink/famid/391925
“Ice class credentials win Barents Sea contract” Offshore Support Journal Annual Review 2010
Non-public: Lines drawing

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Talagi (Canmar Kigoriak)**
Owner/Operator:	Canadian Marine Drilling
Builder:	Saint John Shipbuilding and Drydock
Year of Construction:	1979
Contract price:	
Ship Type:	Icebreaker/Anchor Handling Tug Supply Vessel
Operation Area:	
Class Notation:	Lloyds + 100 A1 Icebreaker Tug
Ice Class:	
Stem Angle:	24°
L_{OA}	90,72 m
L_{PP}	
L_{WL}	85,2 m
B_m	17,3 m
B_{WL}	17,3 m
H	
T_{design}	8,35 m
$T_{scantling}$	
Displacement	6549 t
DWT	1890 t
Accommodation:	20 crew, 14 supernumeraries
Open Water Speed:	15 kn (max 17,25 kn)
Main Engine Type/Power:	2 Sulzer 12V40/48 = 12500 kW
Propulsion Type/Power:	
Propellers, Type, Dia:	2 LIPS CP propeller, 2 CT12 electric driven tunnel type thrusters
Bollard Pull:	196 t
BP/B_{WL} :	11,3 t/m
Prop. Power/Bwl:	722 kW/m
Ice Performance Ahead:	3 kn in 1,5 m level ice
Ice Performance Astern:	

Other Icebreaking Characteristics: Icebreaking hull wash system, special ice-breaking low friction hull coating

Miscellaneous: GA, linedrawing available

References: Nyman, Tapio; Kivimaa, Seppo (1991). Ramming model tests of the MV Canmar Kigoriak. Valtion teknillinen tutkimuskeskus. Tiedoitteita 1251.

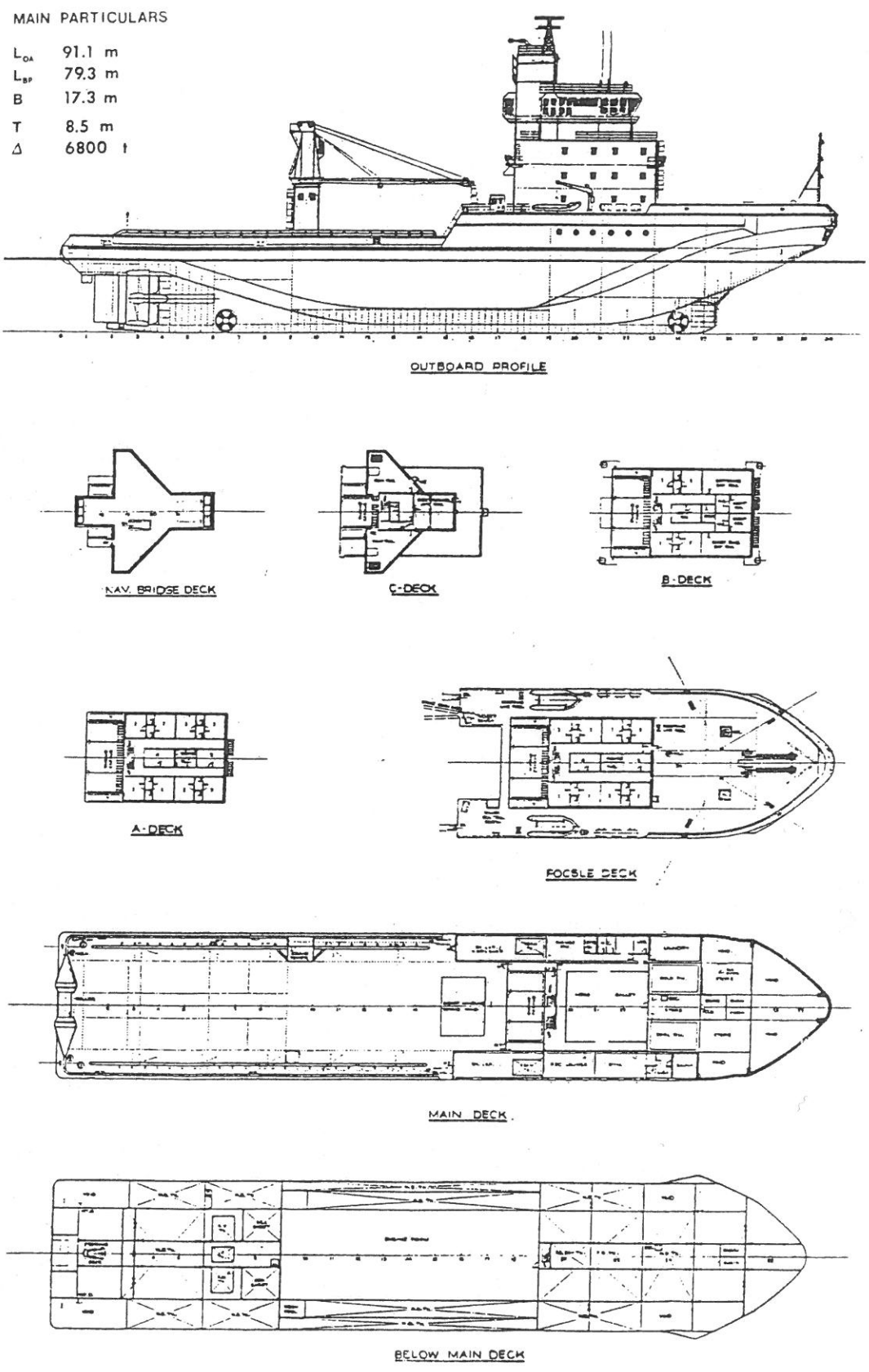


Fig. 1. The general arrangement of the MV Canmar Kigoriak.

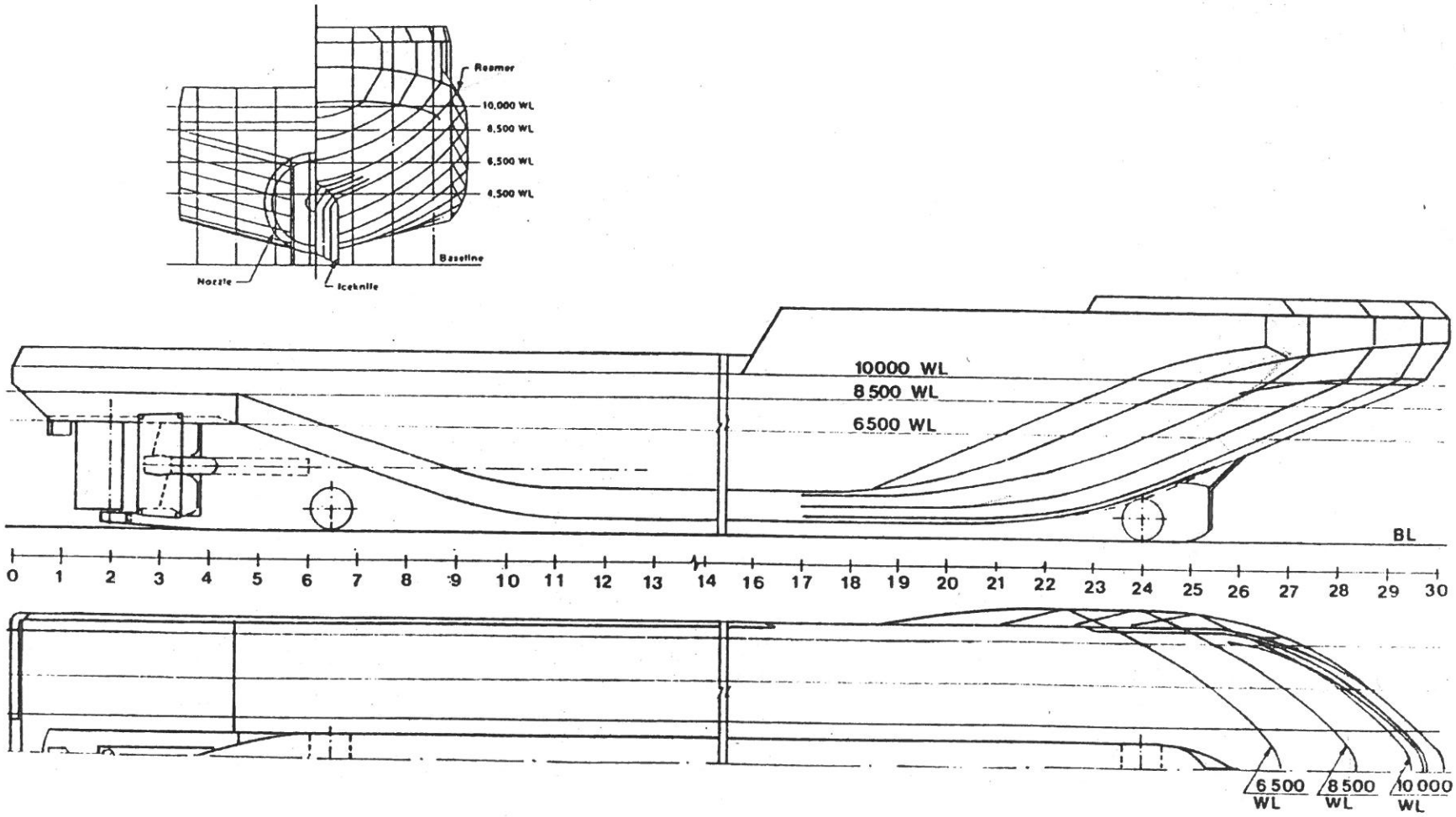


Fig. 2. *The lines drawing of the MV Canmar Kigoriak.*

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**EVA 316**
Owner/Operator:	Estonian Maritime Administration
Builder:	conv. BLRT, Estonia (ex Lonna Conversion)
Year of Construction:	1980/2005
Contract price:	
Ship Type:	Multipurpose Oil Recovery Vessel/Icebreaker; other tasks firefighting, buoy handling
Operation Area:	Baltic Sea
Class Notation:	
Ice Class:	1A Super
Stem Angle:	20^o
L_{OA}	58,2 m
L_{PP}	48,6 m
L_{WL}	52,1 m
B_m	12.2 m
B_{WL}	12,2 m
H	5,0 m
T_{design}	3,8 m
$T_{scantling}$	
Displacement	
DWT	
Accommodation:	
Open Water Speed:	
Main Engine Type/Power:	DE-machinery, 3xCAT 3516 B, 4800 kW (3x1600 kW)
Propulsion Type/Power:	2xZ-drive Azimuth thrusters, Rolls-Royce US305FP; 4200 kW (2x2100 kW)
Propellers, Type, Dia:	FP-propellers
Bollard Pull:	45,3 t
BP/B_{WL} :	3,7 t/m
Prop. Power/Bwl:	344 kW/m
Ice Performance Ahead:	0,65 m/3 kn
Ice Performance Astern:	
Other Icebreaking Characteristics:	

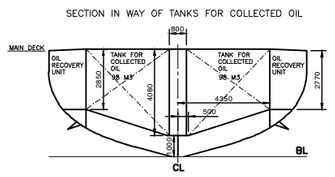
Miscellaneous: - Oil recovery tanks 200 m^3
- Bow tunnel thruster

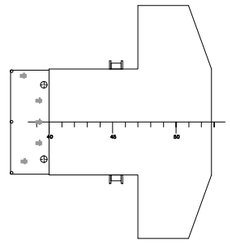
- Towing winch
- Deck crane

GA available

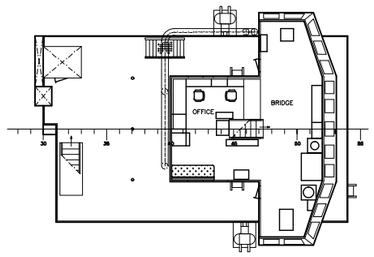
577-0090-001F

SECTION IN WAY OF TANKS FOR COLLECTED OIL

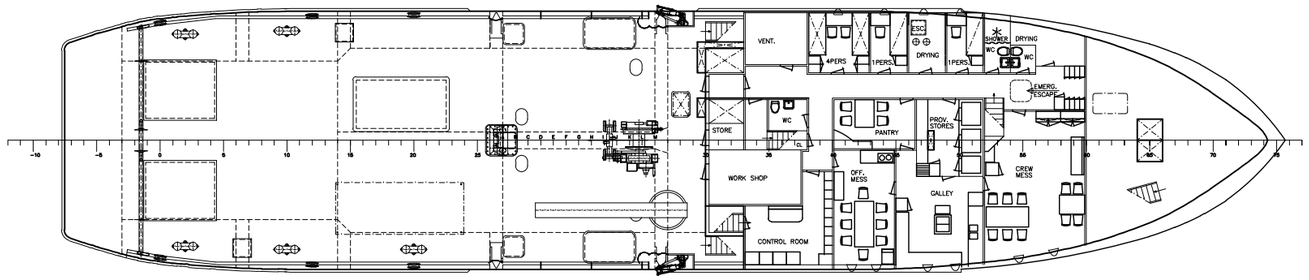




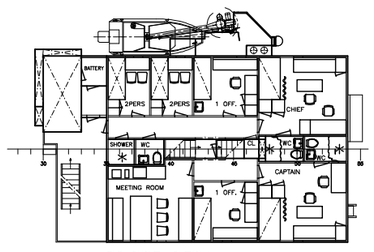
WHEELHOUSE TOP



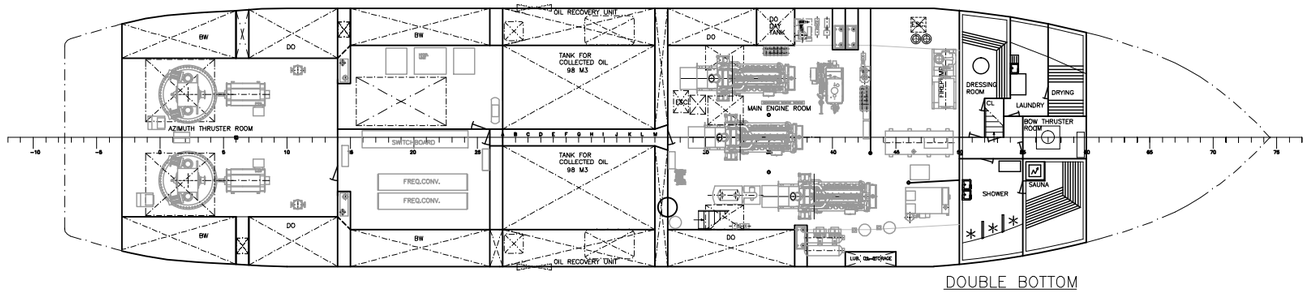
NAVIGATION BRIDGE DECK



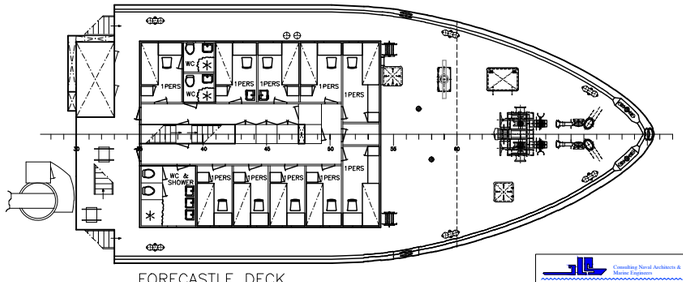
MAIN DECK



BRIDGE DECK



DOUBLE BOTTOM



FORECASTLE DECK

MAIN DIMENSIONS

LENGTH OA ~58.20 m
LENGTH WL ~52.1 m
BREADTH 12.2 m
DEPTH 5.0 m
DRAUGTH 3.8 m
PROPULSION POWER 2x2.1 MW

EVA-316

						APPROVED BY
D						
C						
B						
A						
No	Page	Alt docum	Signature	Date		
Designer						
Checked						
Proj check						
Approved						

577-0090-001-1F

GENERAL ARRANGEMENT

Mass: 1 | Scale: 1:100 (1)

Page | Copies

FILE: 577-0090-001-1F.dwg

ILS OY

Consulting Naval Architects & Marine Engineers
ILS Oy
Piispankatu 45
FIN-20100 Turku, Finland
Tel.:+358-(0)2-41 72 000 E-mail: ils@ils.pp.fi
Fax: +358-(0)2-41 72 220 Web : www.ils.fi

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

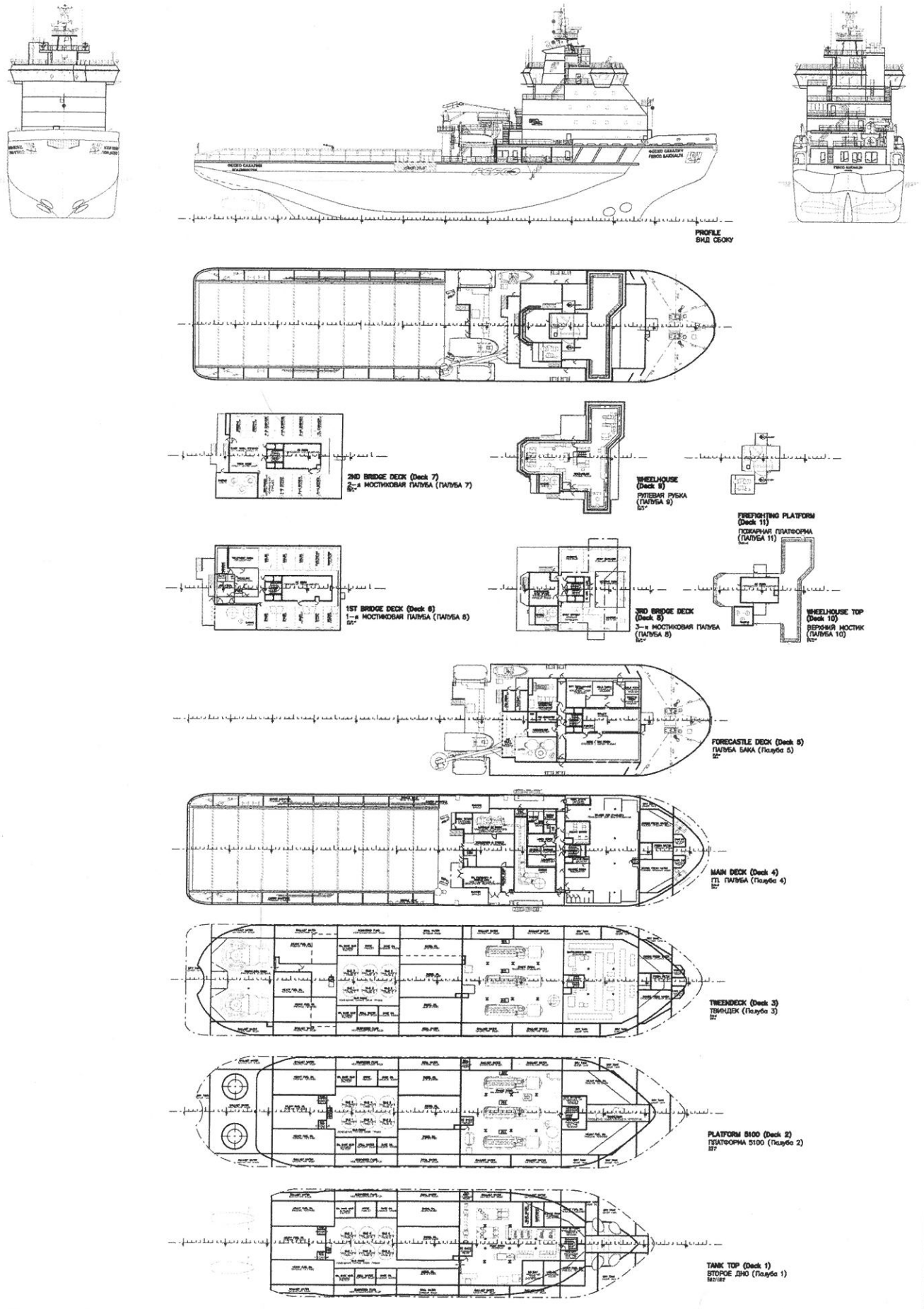
SHIP NAME:	**Fesco Sakhalin**
Owner/Operator:	Far-Eastern Shipping Company
Builder:	Aker Yards Helsinki
Year of Construction:	2005
Contract price:	
Ship Type:	Icebreaking supply and standby vessel
Operation Area:	Sakhalin-1 sector, (Exxon Neftegas)
Class Notation:	DNV +1A1, Ice-10 Icebreaker Supply Vessel, Fire Fighter I, OILREC, SF, De Ice, EO, DYNPOS-AUT, Naut-06, DK(+), HL (2.0)
Ice Class:	Ice-10
Stem Angle:	20°
L_{OA}	99,9 m
L_{PP}	93,5 m
L_{WL}	
B_m	20,9
B_{WL}	
H	11 m
T_{design}	7,5 m
$T_{scantling}$	7,5 m
Displacement	
DWT	4200 t
Accommodation:	40 person max
Open Water Speed:	15 kn
Main Engine Type/Power:	3 x 5800 kW, Wärtsilä 8L38B medium-speed = 17400 kW
Propulsion Type/Power:	Diesel-electric propulsion, Azimuth prop.units 2x6500 kW = 13000 kW, Bow thrusters 2x1100 kW
Propellers, Type, Dia:	2 x FPP (Azipod)
Bollard Pull:	150 t
BP/B_{WL} :	7,2 t/m
Prop. Power/Bwl:	622 kW/m
Ice Performance Ahead:	
Ice Performance Astern:	20 m ridges, 4 m consolidation, 2 kn in 1,5 m level ice

Other Icebreaking Characteristics: DAS

Miscellaneous: GA available

References: Aker Arctic: Icebreaking supply and standby vessel Fesco Sakhalin, vessel brochure.
Fesco Sakhalin: supporting Russia’s growing offshore oil industry. Ship and Boat International, September/October 2005.

General arrangement plans of the combined icebreaker and supply/support ship *Fesco Sakhalin*, built by Aker Finnyards' Helsinki site for the Far Eastern Shipping Co.



DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**USCGC Healy**
Owner/Operator:	United States Coast Guard
Builder:	Avondale shipyard
Year of Construction:	1999
Contract price:	
Ship Type:	Research icebreaker
Operation Area:	
Class Notation:	
Ice Class:	
Stem Angle:	
L_{OA}	128 m
L_{PP}	120 m
L_{WL}	122 m
B_m	25 m
B_{WL}	24,4 m
H	
T_{design}	8,92 m
$T_{scantling}$	
Displacement	17991 t
DWT	
Accomodation:	19 officers, 12 CPO, 54 enlisted, 35 scientists, 15 surge, 2 visitors
Open Water Speed:	17 kn max, 12 kn cruising
Main Engine Type/Power:	4 x Sulzer 12ZAV40S, 34560 kW
Propulsion Type/Power:	Diesel-electric, two shafts, 22,4 MW
Propellers, Type, Dia:	2 FP, 4 bladed, 4,877 m
Bollard Pull:	204 t
BP/B_{WL} :	8,37 t/m
Prop. Power/Bwl:	919 kW/m
Ice Performance Ahead:	3 kn in 1,4m ice;
Ice Performance Astern:	2,44 m ice backing and ramming

Other Icebreaking Characteristics:

Miscellaneous: Ice performance tests presented in POAC ’01 + in Hänninen & Riska, 2001.

References: Hänninen, Saara; Riska, Kaj: Kuvaus USCGC Healyn jäissäkulkukyvystä. Teknillinen Korkeakoulu 2001.

United Stated Coast Guard: USCGC Healy. Available at: http://www.uscg.mil/pacarea/cghealy/default.asp
POAC 2001, several publications.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**LOUHI**
Owner/Operator:	Finnish Environment Institute/Finnish Navy
Builder:	Uudenkaupungin työvene, Finland
Year of Construction:	2011
Contract price:	48 mil EUR
Ship Type:	Oil and Chemical Recovery Vessel/Multipurpose Vessel. Also icebreaking, emergency towing, rescue operations, firefighting, cable laying, fuel transport, deck cargo capacity
Operation Area:	Baltic Sea
Class Notation:	GL100A5**,** E4, NAV-OC, TUG, Marine Pollution Vessel, Chemical Recovery Vessel, MC, E4, AUT, FF1
Ice Class:	1A Super + extra strengthening
Stem Angle:	20^o
L_{OA}	71,4 m
L_{PP}	
L_{WL}	67,4 m
B_m	14,5 m
B_{WL}	14,5 m
H	7,0 m
T_{design}	5,0 m
$T_{scantling}$	5,2 m
Displacement	3450 t
DWT	
Accommodation:	For 36 persons
Open Water Speed:	15 kn
Main Engine Type/Power:	DE-Machinery, 4 pcs Wärtsilä 9L20; 7200 kW (4x1800 kW/1000 rpm)
Propulsion Type/Power:	2xZ-drive Azimuth thrusters, Rolls-Royce US355FP; 5400 kW (2x2700 kW)
Propellers, Type, Dia:	FP-propellers
Bollard Pull:	over 60 t
BP/B_{WL} :	4,2 t/m
Prop. Power/Bwl:	372 kW/m
Ice Performance Ahead:	3 kn/ 1m, 8 kn / 0,5 m level ice
Ice Performance Astern:	

Other Icebreaking Characteristics:

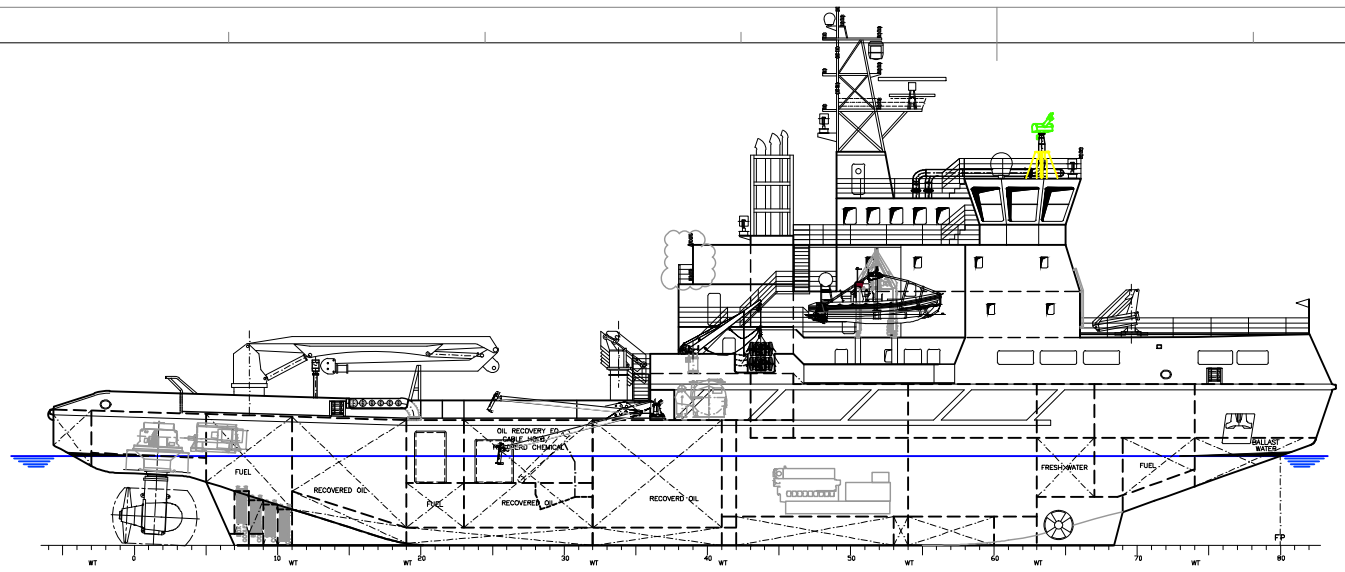
Miscellaneous: - Oil recovery tanks 1250 m^3 including 200m^3 chemical recovery tank
- Bow tunnel thruster
- Towing winch Rolls-Royce TW 1500/400 Constant Tension, brake 150 t
- Deck cranes, aft 18,8 t/5m and 5,5 t/20m, fore 1 t/10m

References:

Lamor: Suomen uusin öljyntorjunta-alus. 2011. Available at: http://www.lamor.com/fi/2011/11/suomen-uusin-oljyntorjunta-alus/

Uudenkaupungin Työvene Oy, vessel brochure.

Louhi GA, by ILS Oy



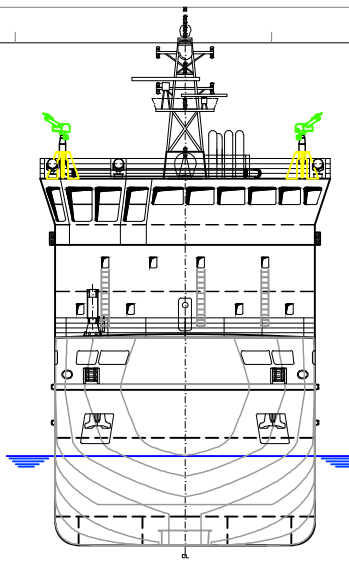
WHEELHOUSE DECK

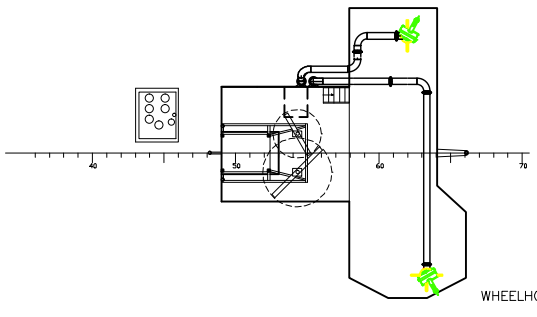
2. BRIDGE DECK

1. BRIDGE DECK

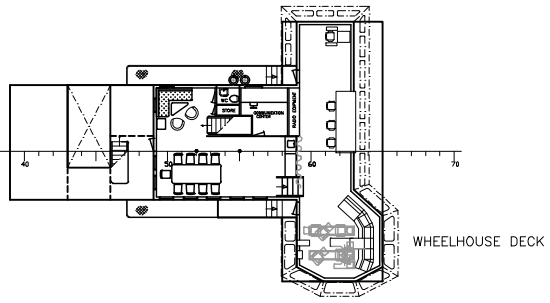
UPPER DECK

MAIN DECK

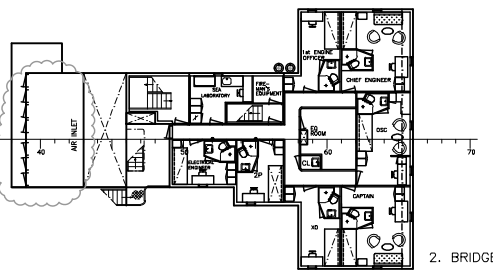




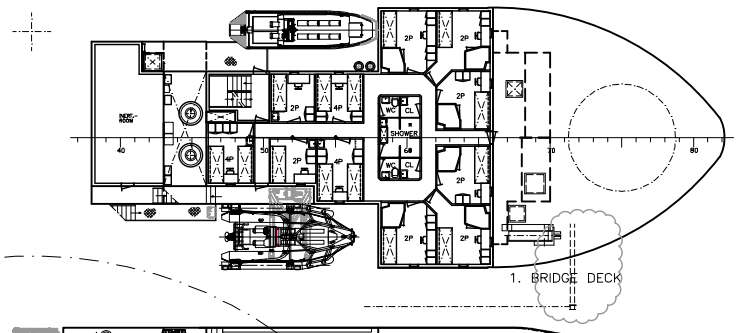
WHEELHOUSE TOP



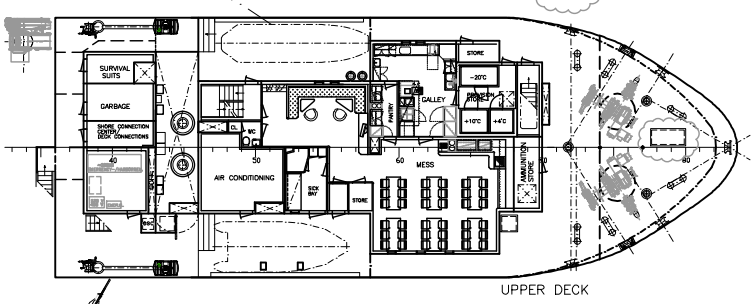
WHEELHOUSE DECK



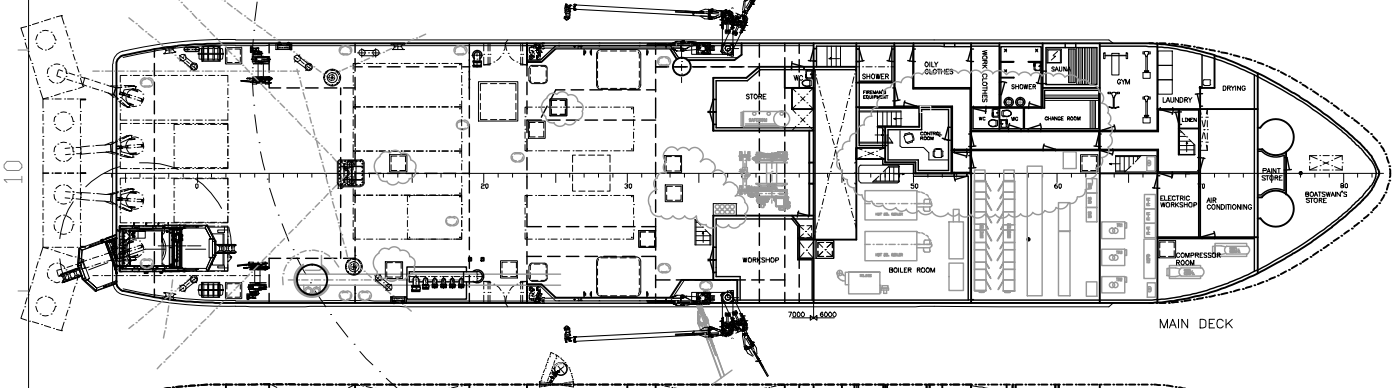
2. BRIDGE DECK



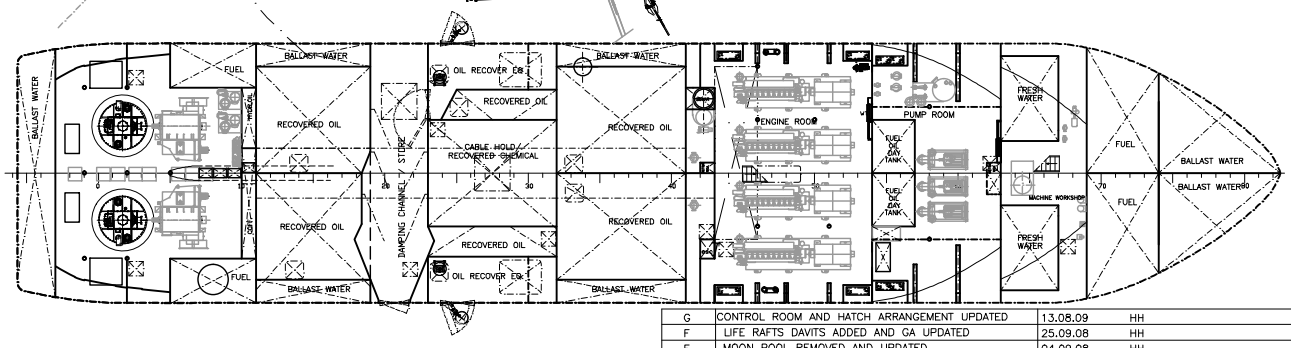
1. BRIDGE DECK



UPPER DECK



MAIN DECK



MAIN DIMENSIONS

L	~71.4 m
Lcwl	~67,4 m
Bmld	=14,5 m
T	=5,0 m
H	=7,0 m
V	=13.5 kn

MAIN ENGINES:
4 x Wärtsilä 9L20 1800kW /engine

MAIN GENERATORS:
4x 2125 kVA

PROPULSION UNITS:
2x Rolls-Royce 2700 kW/unit

Rev.	Muutos / Alteration	Päiväys / Date	Muuttaja / Korvattu	Tarkasti / Checked	Hyväksyi / Approved
G	CONTROL ROOM AND HATCH ARRANGEMENT UPDATED	13.08.09	HH		
F	LIFE RAFTS DAVITS ADDED AND GA UPDATED	25.09.08	HH		
E	MOON POOL REMOVED AND UPDATED	04.09.08	HH		
D	UPDATED	12.08.08	HH		
C	UPDATED	23.04.08	HH		
B	UPDATED	15.04.08	HH		
A	UPDATED	28.01.08	HH		

Consulting Naval Architects & Marine Engineers
ILS Oy P624

Osa / Part | Nimitys / Description | Kpl / Pcs | Aine / Material | Piir. n:o / Dwg no | Paino / Weight | Huom. / Remarks

Suunn. ILS / HH | Jälj. | Tark. | Hyväks. | Stand. | Kokonaismassa
Päiväys 10.01.2008 | puh. | kg

UUDENKAUPUNGIN TYÖVENE OY

Suhde 1:200

Nimitys / Name: Multipurpose vessel
GENERAL ARRANGEMENT
SYKE/NAVY

Metr. | Korvaa / Replaces

Kieli / Lang. D E F R S

Piir.no / Drw.No. 27184-010-001-1

Versio G | Lehti / Page 1 / 1

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**USCGC Mackinaw**
Owner/Operator:	US Coast Guard
Builder:	Marinette Marine Corporation
Year of Construction:	**2005**
Contract price:	
Ship Type:	Multimission Icebreaker
Operation Area:	The Great Lakes
Class Notation:	
Ice Class:	
Stem Angle:	
L_{OA}	73 m
L_{PP}	
L_{WL}	
B_m	17,8 m
B_{WL}	
H	
T_{design}	4,9 m
$T_{scantling}$	
Displacement	3500 t
DWT	
Accommodation:	9 officers, 46 enlisted
Open Water Speed:	16 kn
Main Engine Type/Power:	6,8 MW
Propulsion Type/Power:	
Propellers, Type, Dia:	2 ABB Azipods, fixed pitch, 10’ diameter
Bollard Pull:	66 t
BP/B_{WL} :	3,71 t/m
Prop. Power/Bwl:	382 kW/m

Ice Performance Ahead: 3 knots ahead in 0,8 m level ice, 10 kn in 0,35 m, 3 kn in 0,2 m brash ice

Ice Performance Astern: 2 kn astern in 0,75 m level ice, 2 kn in 0,2 m brash ice

Other Icebreaking Characteristics: Ramming Mode: Average 0.5 knots ahead, backing and ramming in 1,1 m solid level ice. Average 0.5 knots ahead, backing and ramming in 1,5 m refrozen brash ice. Average 0.5 knots ahead, backing and ramming a 3,6 m pressure ridge. Fully penetrate a 3 m pressure ridge in 4 rams or less within 30 minutes.
Escort Vessels and Free Beset Vessels: Cast in a 90 m wide channel with a depth of 6,4 m. Back from existing track in 0,75 m solid level ice and 12' brash ice.

Maneuverability: Turn 180 degrees in a 90 m wide channel in 5 minutes in 0,8 m solid level ice and 0,3 m brash ice. Turn 360 in her own length in 0,6 m solid level ice. Break out of track channel and turn 90 degrees within 30 seconds in 0,8 m solid level ice. Arrive and depart a standard berth in 0,8 m solid level ice and 0,3 m brash ice. Extract herself from a stopped position at the end of rams under her own power

Miscellaneous: -

References: US Coast Guard (2004): Great Lakes Icebreaker Replacement. Available at: http://www.uscg.mil/hq/g-a/awl/bclass/glib/glibspecs.htm

Sheinberg, Rubin; Cleary, Christopher; Minnick, Peter V.; Ashley, Adam R. (2005) U.S. Coast Guard Great Lakes Icebreaker Replacement. SNAME Maritime Technology Conference.

Non-public: Riska, Kaj. Lectures V and VI. (Mackinaw h-v curve). ICE II Autumn 2008.

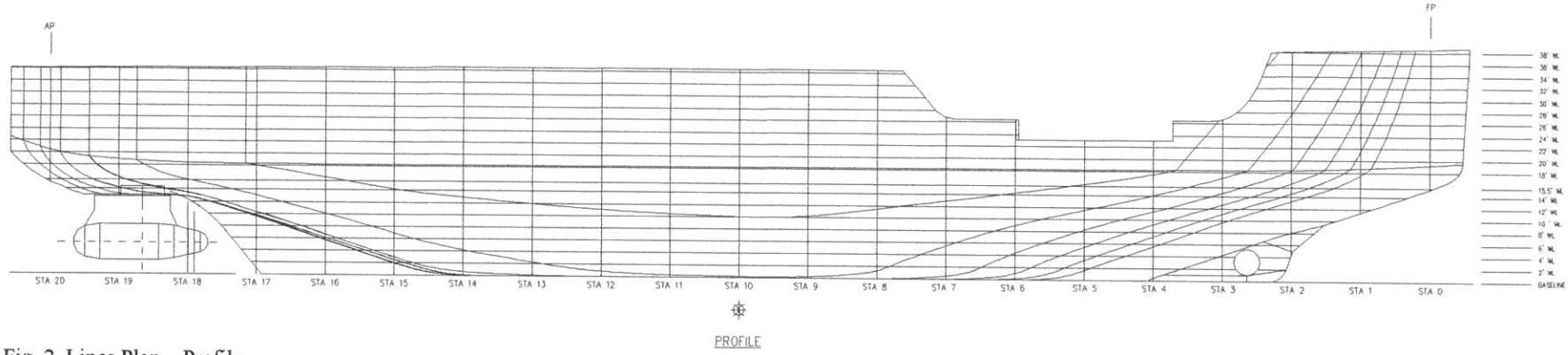


Fig. 2. Lines Plan – Profile

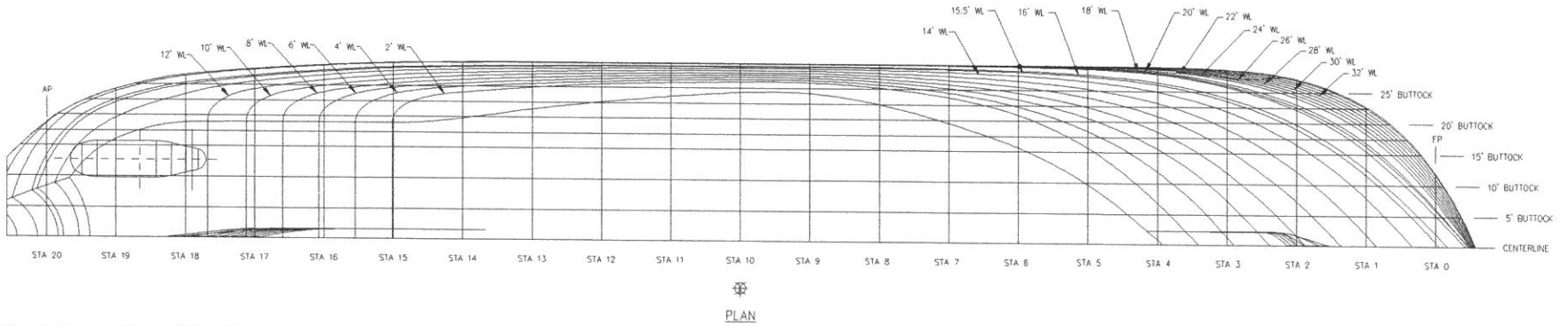


Fig. 3. Lines Plan – Plan View

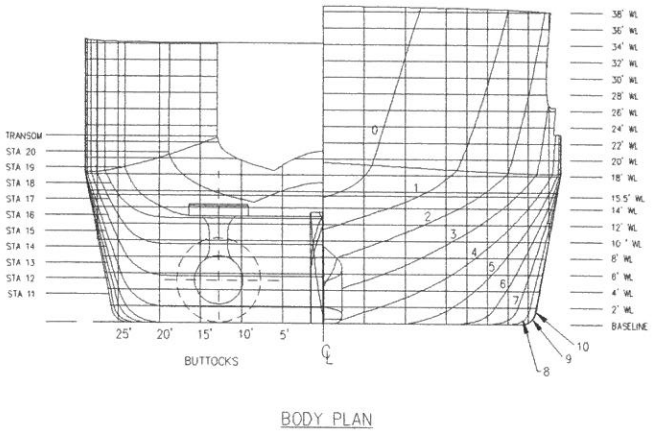


Fig. 4. Lines Plan – Section

Table 3. Hull Characteristics		
Length - Overall	73.2 meters	240 feet
Length - Between Perpendiculars	69.2 meters	227 feet
Beam - Maximum	17.7 meters	58 feet
Beam - Design Waterline	17.4 meters	57 feet
Draft - Design Waterline	4.9 meters	16 feet
Longitudinal Center of Gravity (aft of forward perpendicular)	34.7 meters	114 feet
Longitudinal Center of Flotation (aft of forward perpendicular)	36.3 meters	119 feet
Full Load Displacement (Icebreaking)	3500 tons	
Block Coefficient	0.60	
Midship Section Coefficient	0.95	
Prismatic Coefficient	0.63	

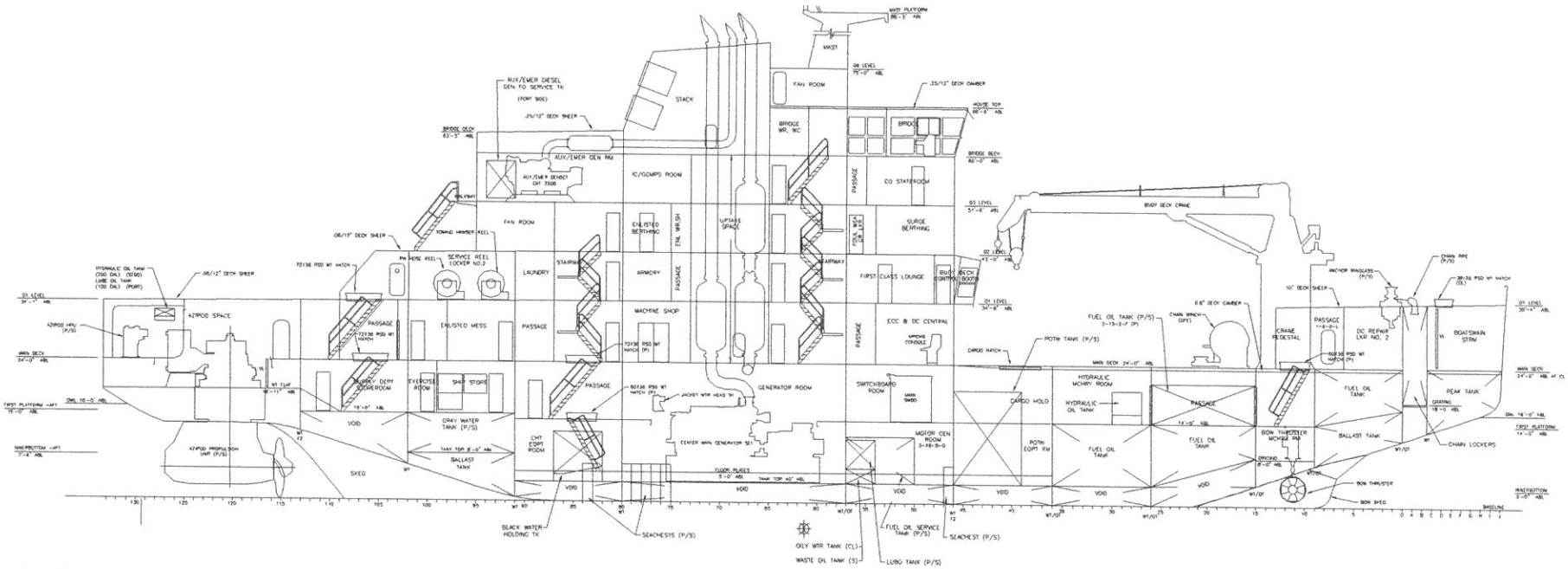


Fig. 5. Inboard Profile

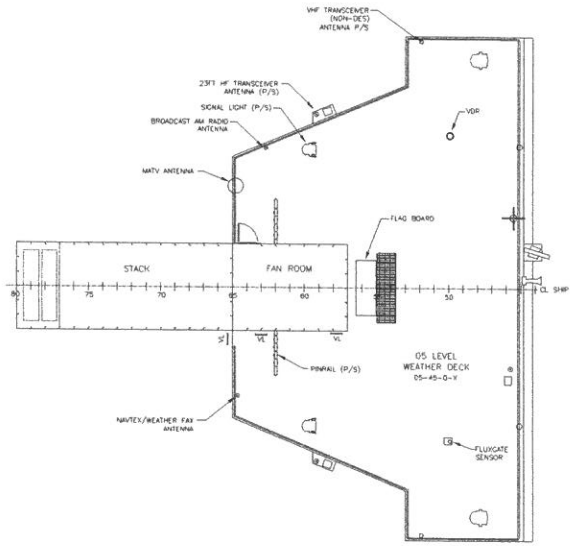


Fig. 6. House Top

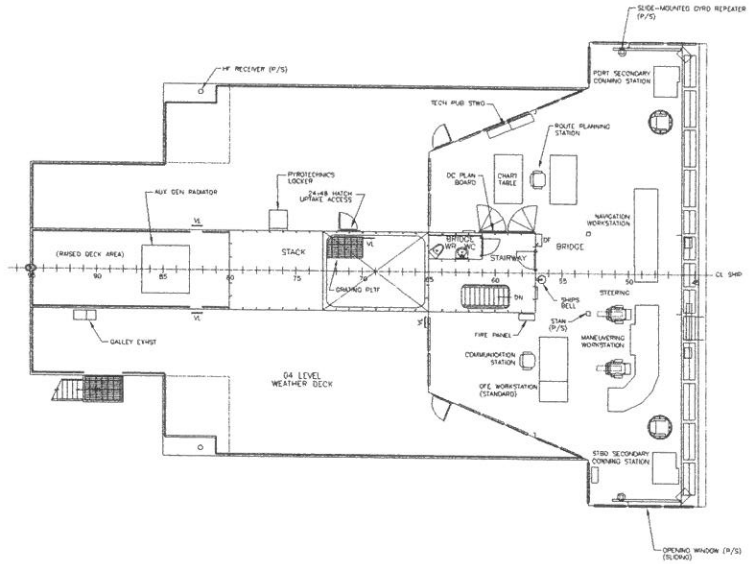


Fig.7. Pilot House

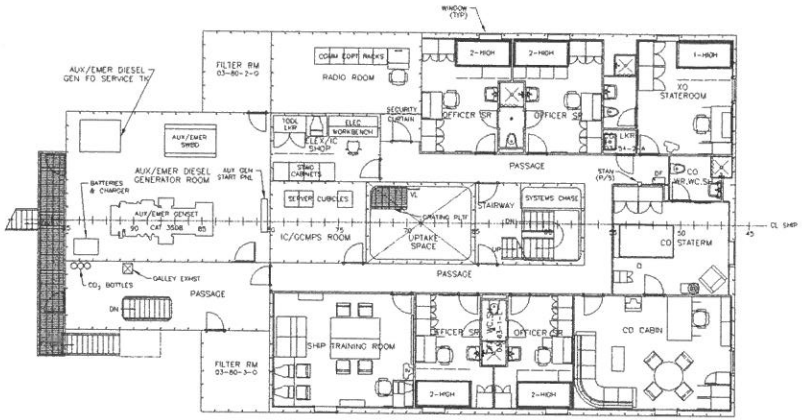


Fig. 8. 03 Level

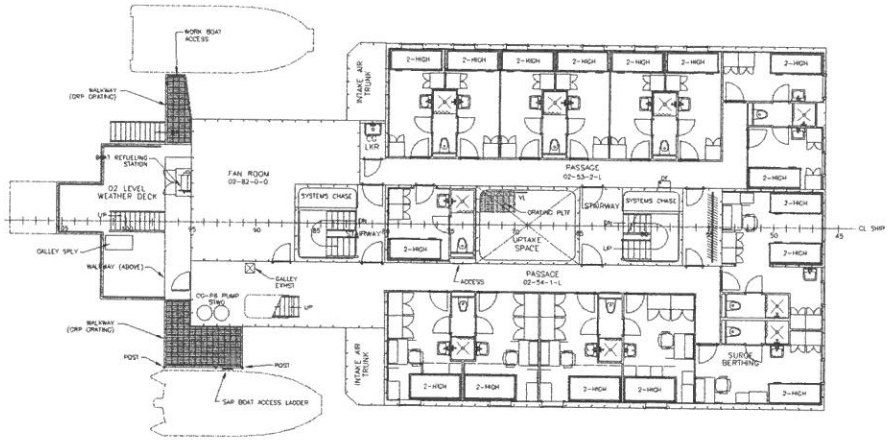


Fig. 9. 02 Level

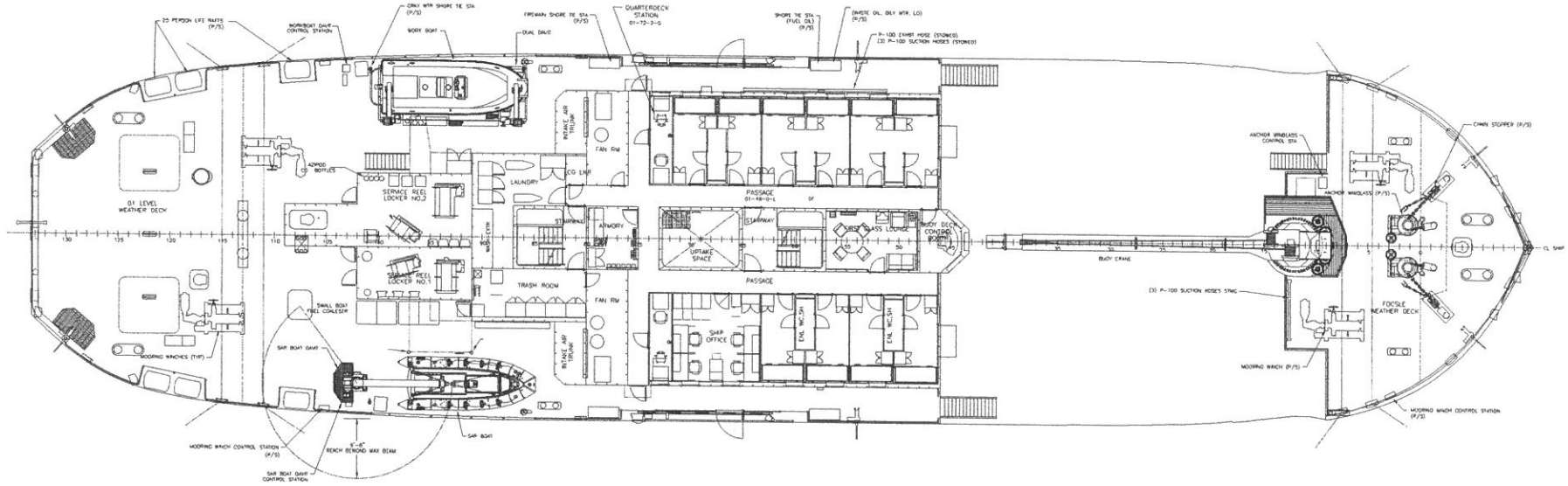


Fig. 10. 01 Level

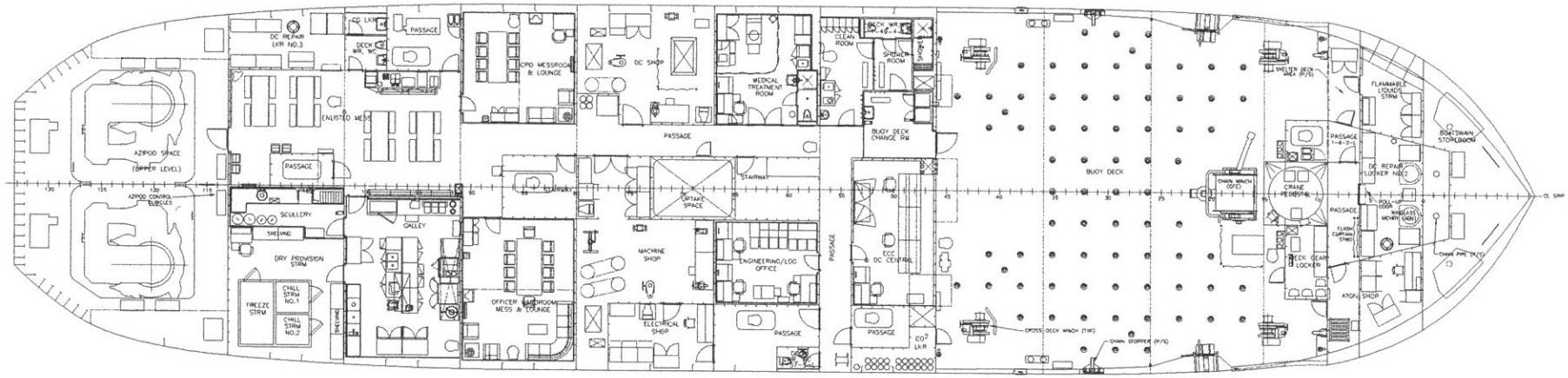


Fig. 11. Main Deck

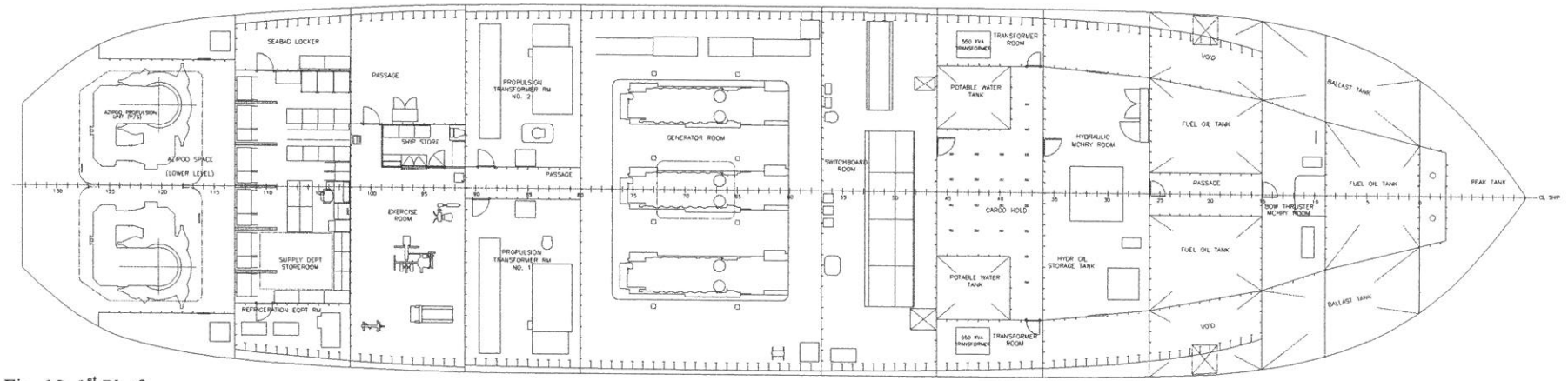


Fig. 12. 1st Platform

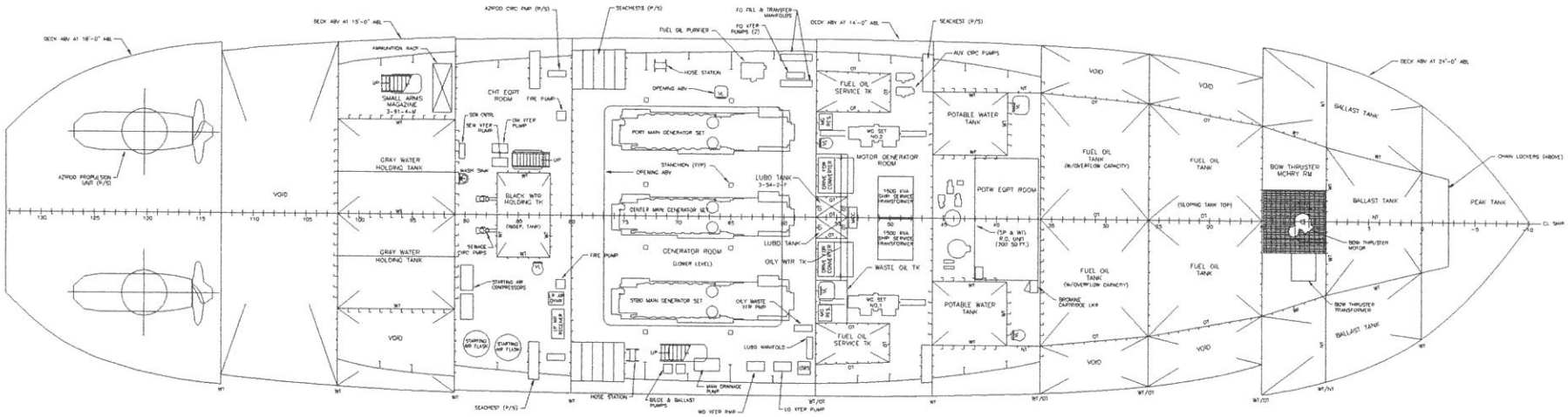


Fig. 13. Inner Bottom

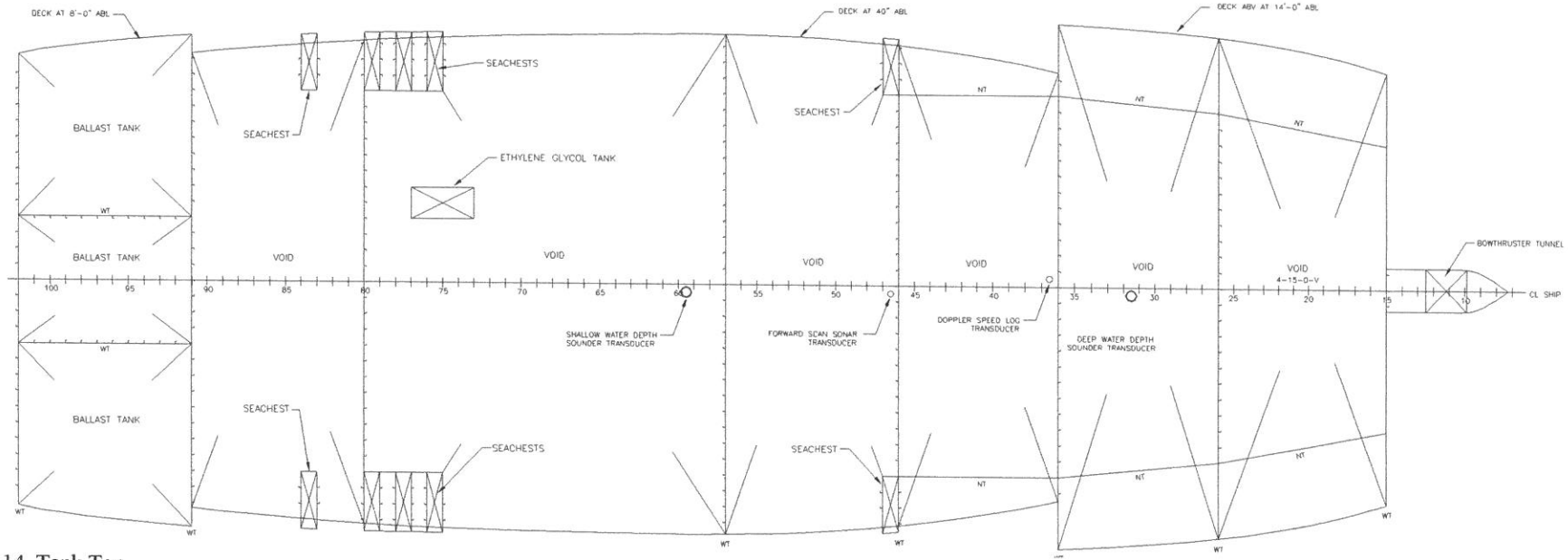


Fig. 14. Tank Top

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Moskva**
Owner/Operator:	Rosmorport
Builder:	Baltiysky Savod JSC, St Petersburg
Year of Construction:	2008
Contract price:	
Ship Type:	Icebreaker
Operation Area:	Baltic Sea
Class Notation:	KM(*) Icebreaker6 [2] AUT1 FF1 EPP
Ice Class:	Icebreaker 6
Stem Angle:	
L_{OA}	114 m
L_{PP}	
L_{WL}	
B_m	27,5 m
B_{WL}	
H	12,4 m
T_{design}	8,5 m
$T_{scantling}$	
Displacement	14300 t
DWT	7243 t
Accomodation:	26 crew
Open Water Speed:	16 kn
Main Engine Type/Power:	2 x two cylinder Wärtsilä 32: 2 x 6000 kw + 2 x 9L32: 2x 4500 kW
Propulsion Type/Power:	16 MW
Propellers, Type, Dia:	2 Steerprop azimuths, 4 blades
Bollard Pull:	N/A
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	**N/A**
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous: -	

References:

New Baltic icebreakers under construction at Baltiysky Zavod. *The Naval Architect*. July/August 2005. P. 32.

Pär-Erik Sjöström: Ready for Baltic ice. *Shipgaz*. No 2, 2009. P. 50

Russian Maritime Register of Shipping: Moskva, vessels details. Available at: http://www.rs-head.spb.ru/app/fleet.php?index=050211&type=book1&language=eng

Steerprop: Press release “Steerprop Ltd delivers the highest power geared azimuth propulsors in the world for a Russian icebreaker”. 2005.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Pacific Endeavour (Sisters: Pacific Enterprise, Pacific Endurance)**
Owner/Operator:	Swire Pacific Offshore
Builder:	Aker Langsten
Year of Construction:	2006
Contract price:	
Ship Type:	Icebreaking PSV
Operation Area:	Russian Far East
Class Notation:	DNV +1A1, E0, Icebreaker ICE-10, DE-ICE, DAT(35), Standby-Vessel (150), DK(+), HL(2,5), DYNPOS AUTR, OIL-REC
Ice Class:	ICE 10
Stem Angle:	
L_{OA}	91,5 m
L_{PP}	77,6 m
L_{WL}	
B_m	19 m
B_{WL}	
H	10 **m**
T_{design}	Summer: 8,25 m; Ice: 7,5 m
$T_{scantling}$	
Displacement	
DWT	4482 t
Accommodation:	
Open Water Speed:	15 kn
Main Engine Type/Power:	4 x RRM Bergen B32:40L9A, 4x4320 kW = 17 MW
Propulsion Type/Power:	2 x RRM Aquamaster ARC 2x7000 kW =14 MW
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	736 kW/m
Prop. Power/Bwl:	
Ice Performance Ahead:	> 13 kn in 0,5 level ice, 1,5 kn in 1,5 m level first year ice
Ice Performance Astern:	

Other Icebreaking Characteristics: Turning circle: 180 degrees in less than 90s in 0,5 m level first year ice, escort channel 70 m wide in 0,5m level first year ice

Miscellaneous: -

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Polar Pevek**
Owner/Operator:	Polar Pevek Ltd/Exxon Neftegaz
Builder:	Aker Yards Langsten
Year of Construction:	2006
Contract price:	
Ship Type:	Icebreaker
Operation Area:	
Class Notation:	1A1 ICE-10 Icebreaker Tug Fire Fighter SF DEICE RP e0 NAUT-AW
Ice Class:	
Stem Angle:	
L_{OA}	74,36 m
L_{PP}	64,45 m
L_{WL}	
B_m	17 m
B_{WL}	
H	8/8,6 m
T_{design}	6,5 m
$T_{scantling}$	6,25 m
Displacement	
DWT	1324 t
Accomodation:	15 crew
Open Water Speed:	
Main Engine Type/Power:	4 x RR Bergen Diesel C25:33L9A, 4 x 2505 kW
Propulsion Type/Power:	2 x ABB V16 Azipod, 2 x 5000 kW
Propellers, Type, Dia:	
Bollard Pull:	115 t
BP/B_{WL} :	6,76 t/m
Prop. Power/Bwl:	588 kW/m
Ice Performance Ahead:	12 kn in 0,3m ice+10 cm snow, 5,5 kn in 0,9m ice+20 cm snow, 1,6 kn in 1,5
ice+ 20 cm snow	
Ice Performance Astern:	

Other Icebreaking Characteristics:

Miscellaneous: -

References: Sakhalin icebreakers delivered. *Ship & Boat International*. May/June 2007. P. 8.

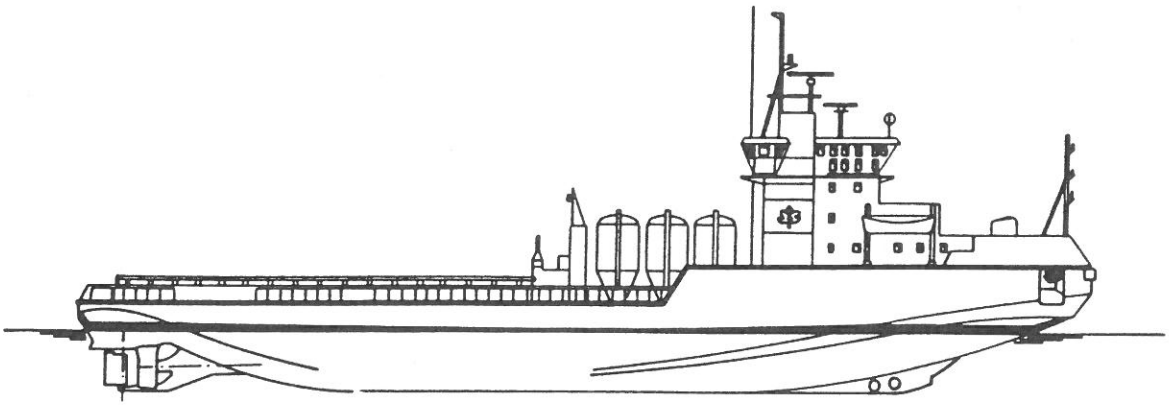
DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

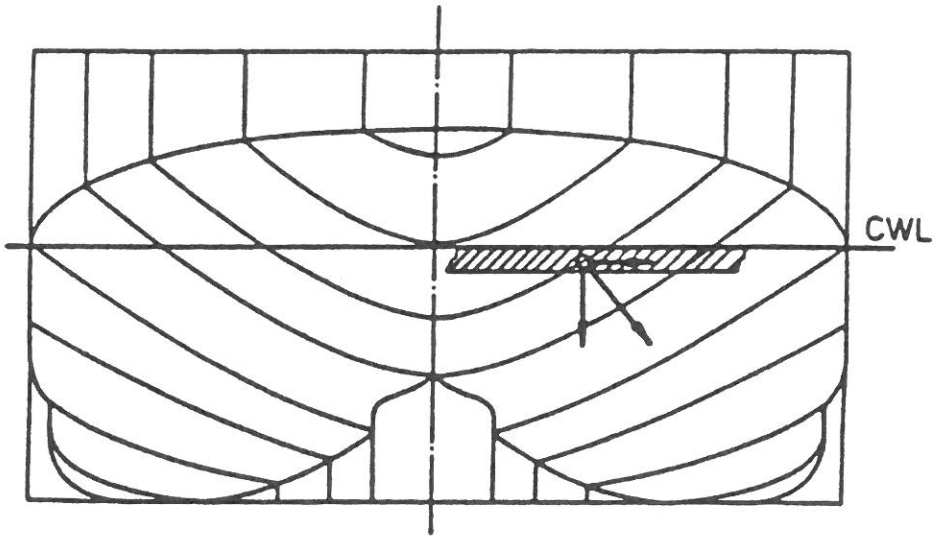
SHIP NAME:	**BO HAI (EX ROBERT LEMEUR)**
Owner/Operator:	Bohai Bay Oil Company
Builder:	
Year of Construction:	1982
Contract price:	
Ship Type:	Supported first operations in the Beaufort Sea, designed to supply vessel in ice.
Operation Area:	Worldwide, Arctic
Class Notation:	
Ice Class:	CASPPR 3
Stem Angle:	20^o
L_{OA}	82,2 m
L_{PP}	73,0 m
L_{WL}	79,1 m
B_m	18,0 m
B_{WL}	19,03 m over reamers, reamer width 0,5 m
H	7,5 m
T_{design}	
$T_{scantling}$	5,5 m
Displacement	5538 t
DWT	
Accommodation:	
Open Water Speed:	
Main Engine Type/Power:	7 060 kW
Propulsion Type/Power:	2 shafts
Propellers, Type, Dia:	2 CP-propellers in nozzlez+2 rudders
Bollard Pull:	107 t
BP/B_{WL} :	5,6 t/m
Prop. Power/Bwl:	371 kW/m
Ice Performance Ahead:	1,5 m/2 kn level ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	

Miscellaneous: Lines drawing available

References: Schwarz, J. (1986). Some latest developments in icebreaker technology. Journal of Energy Resources Technology. Vol. 108, June 1986, p. 161-167.

IB ROBERT LEMEUR





L_{WL} = 79.1 m

B_{WL} = 19.0 m

T_{WL} = 5.7 m

Δ = 5 853 t

Shaft power = 7 065 kW

Data from Schwarz (1986).

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Fennica, Nordica**
Owner/Operator:	Arctia Offshore
Builder:	Finnyards, Rauma
Year of Construction:	1993
Contract price:	
Ship Type:	Icebreaker & multipurpose Support
Operation Area:	Worldwide
Class Notation:	DNV +1A1, Tug, Supply Vessel, SF, Icebreaker Polar-10, HELDK, EPR, E0, DYNPOS AUTR
Ice Class:	Polar- 10
Stem Angle:	22°
L_{OA}	116m
L_{PP}	
L_{WL}	96,7 m
B_m	26 m
B_{WL}	
H	
T_{design}	7/8,4 m
$T_{scantling}$	
Displacement	12800 t
DWT	1650/4800 t
Accommodation:	Total 77 persons
Open Water Speed:	16,5 kn
Main Engine Type/Power:	2 x Wärtsilä 16V32D, 2x Wärtsilä 12V32D (2x6000 kW, 2x 4500 kW)=21 MW
Propulsion Type/Power:	2 x Aquamaster US ARC 1, 2x 7500 kW = 15 MW
Propellers, Type, Dia:	2 azimuthing
Bollard Pull:	234 t
BP/B_{WL} :	9 t/m
Prop. Power/Bwl:	576 t/kW
Ice Performance Ahead:	9 kn in 0,8 meter level ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	

Miscellaneous: -

References:

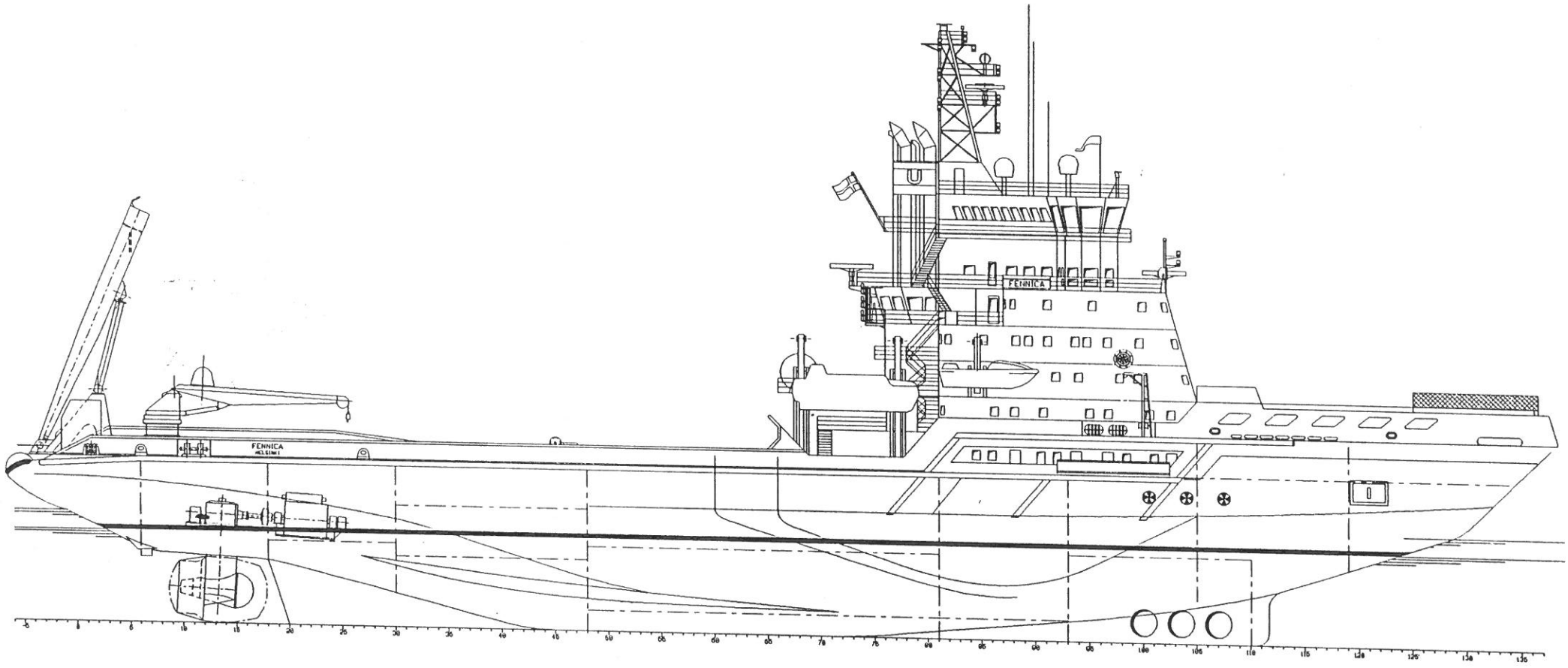
Soininen, Harri; Nyman, Tapio; Riska, Kaj; Lohi, Paavo; Harjula, Arjo (1993): The Ice capability of the Multipurpose Icebreaker ”Fennica” – full-scale results. POAC ’93 proceedings.

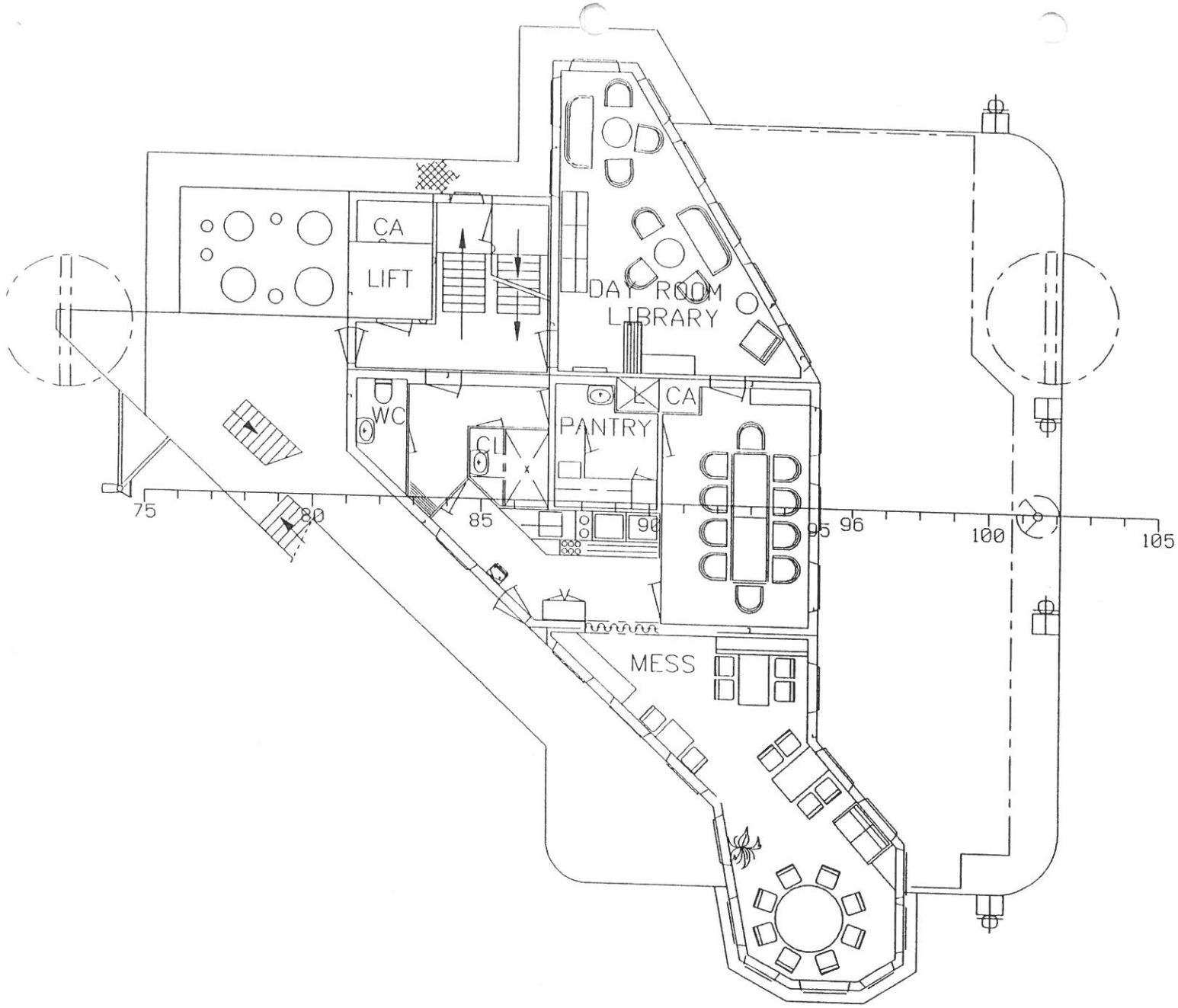
Lohi, Paavo; Soininen, Harri; Keinonen, Arno (1994): MSV Fennica, a novel icebreaker concept. Icetech ´94.

Harjula, Arjo; Eronen, Harri (1994): MSV Fennica, new operational profile for an icebreaker. Icetech ’94.

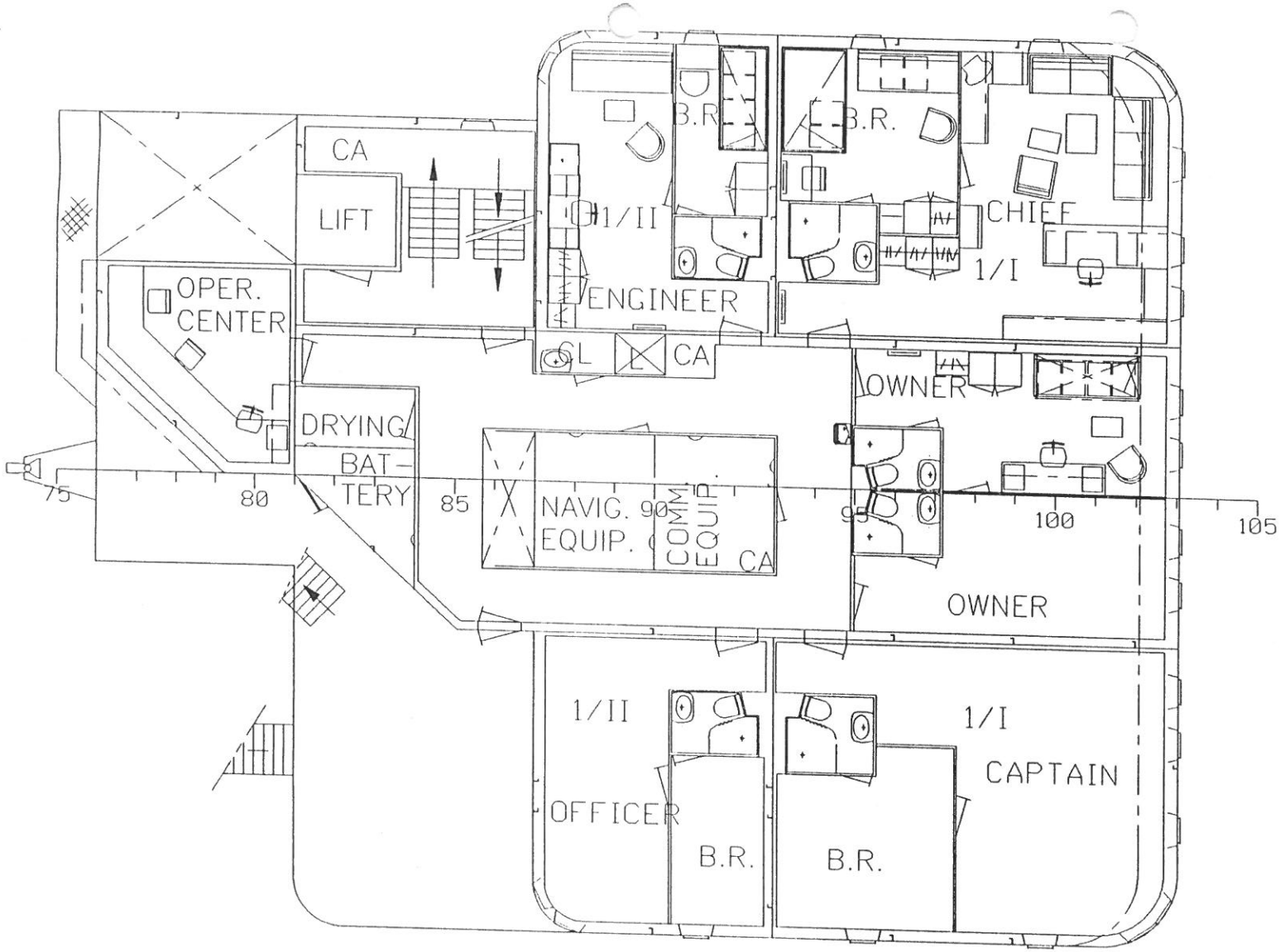
FINNYARDS

FINNYARDS LTD
P.O. Box 139
SF-26101 RAUMA, FINLAND
Tel. +358 38 83611
Fax +358 38 836 2366
Telex 65112 fyard sf

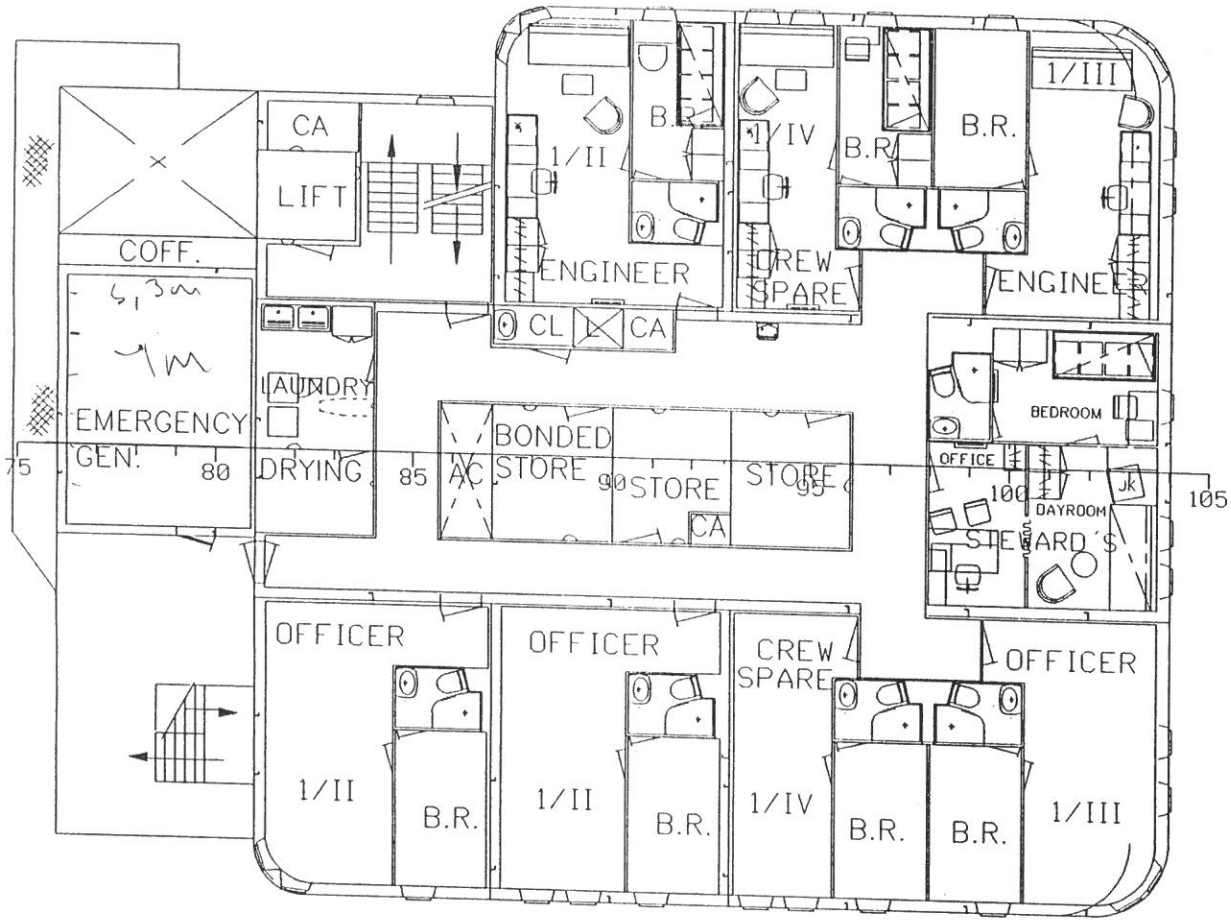




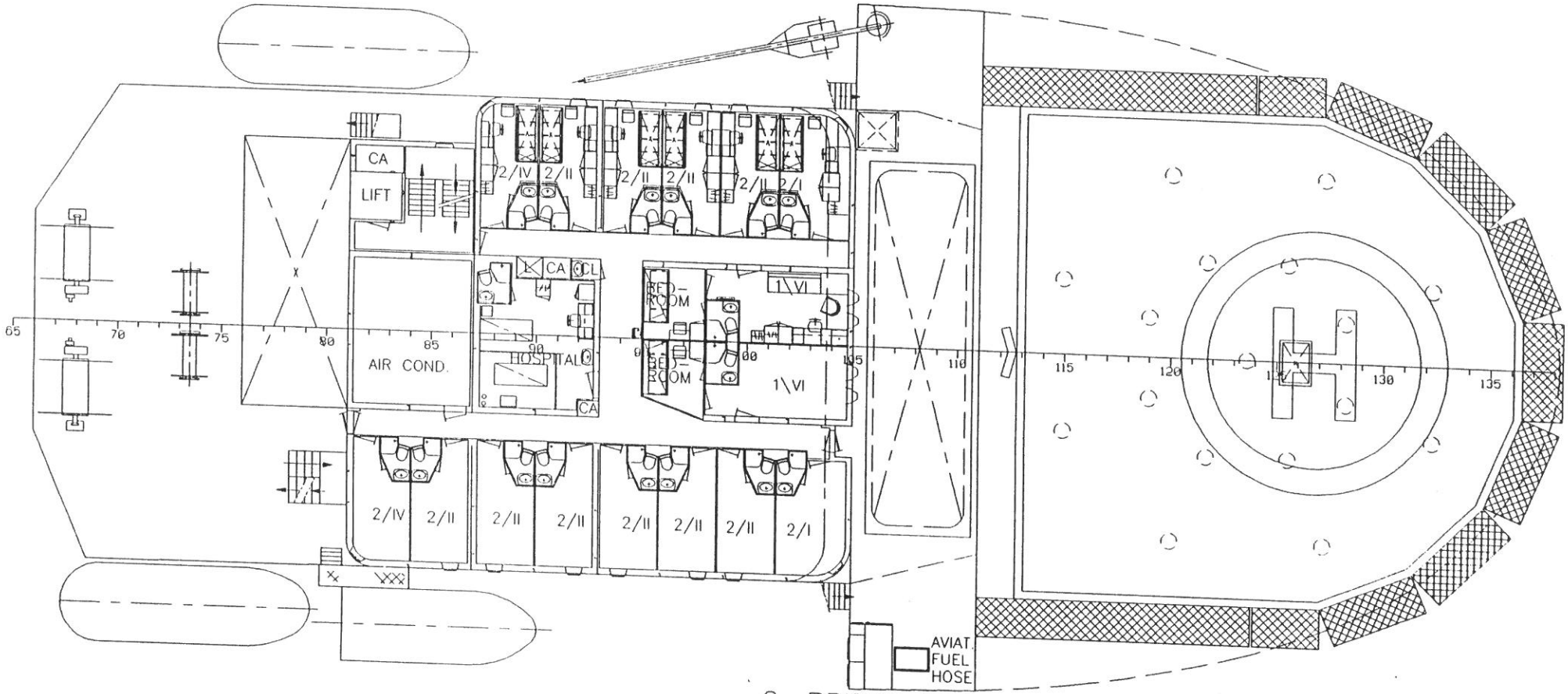
5. BRIDGE DECK 26300



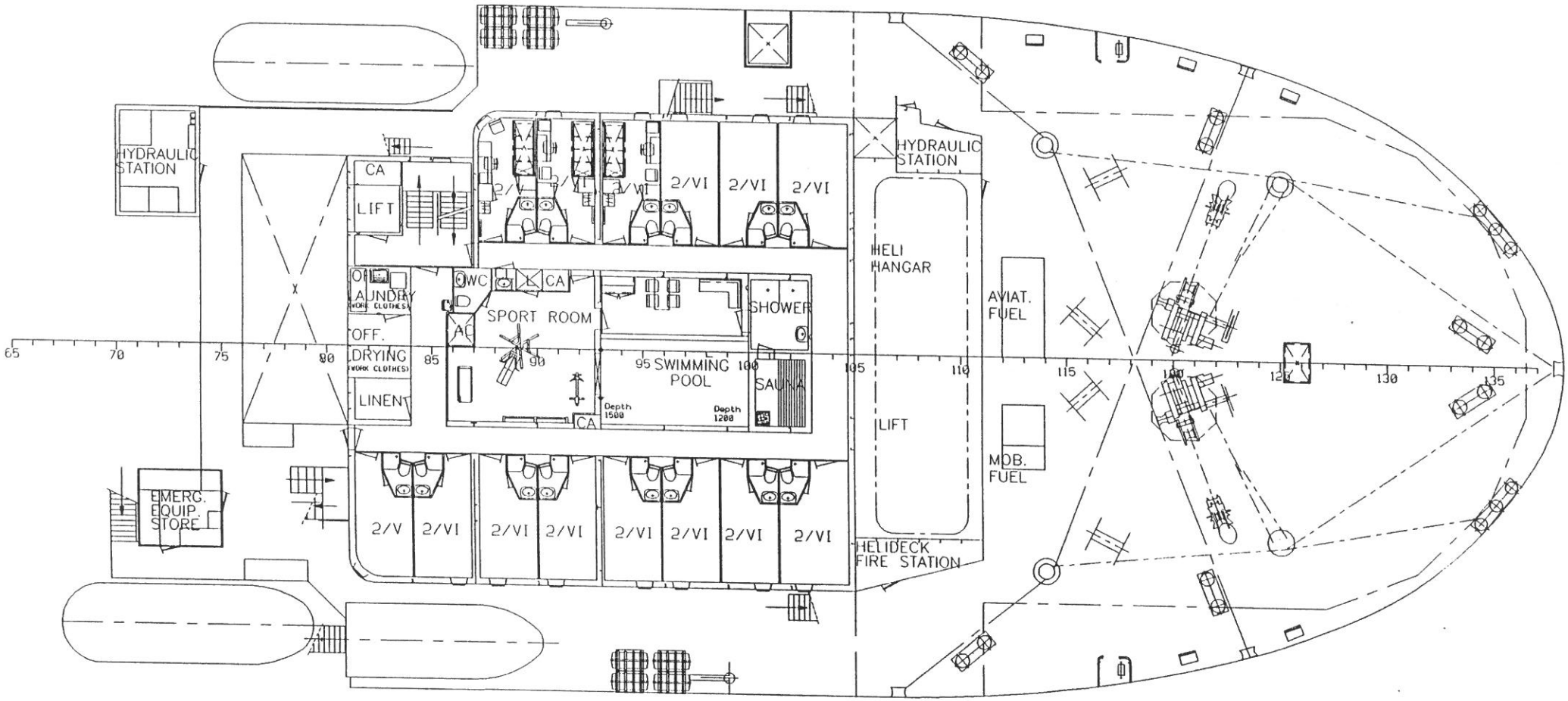
4. BRIDGE DECK 23600



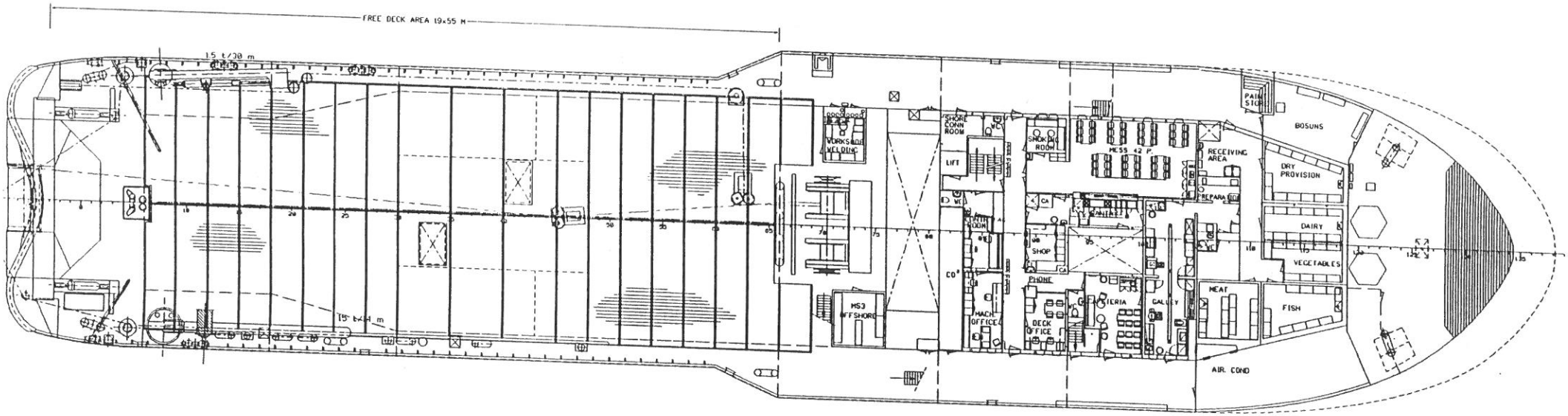
3. BRIDGE DECK 20900



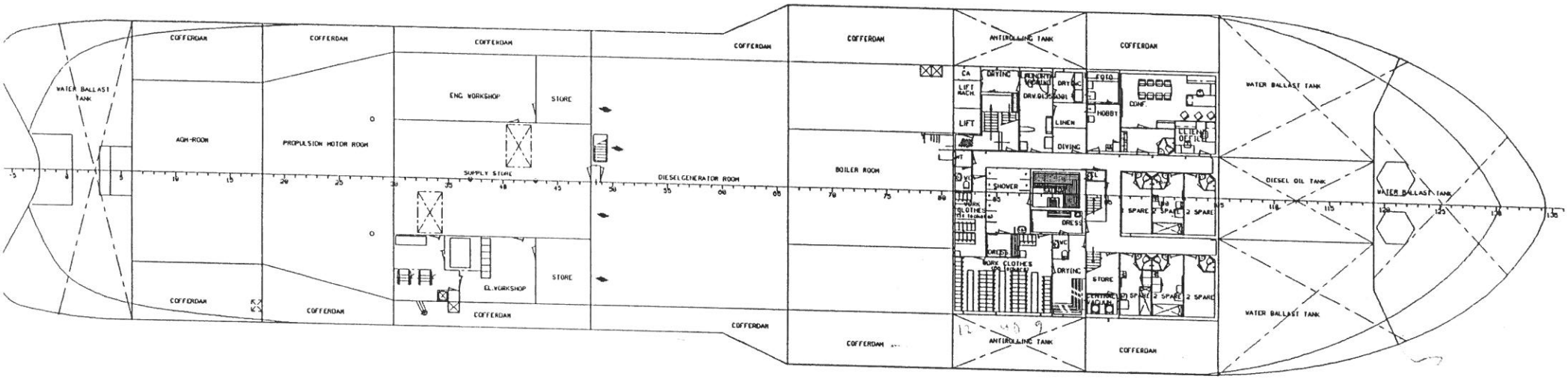
2. BRIDGE DECK 18200



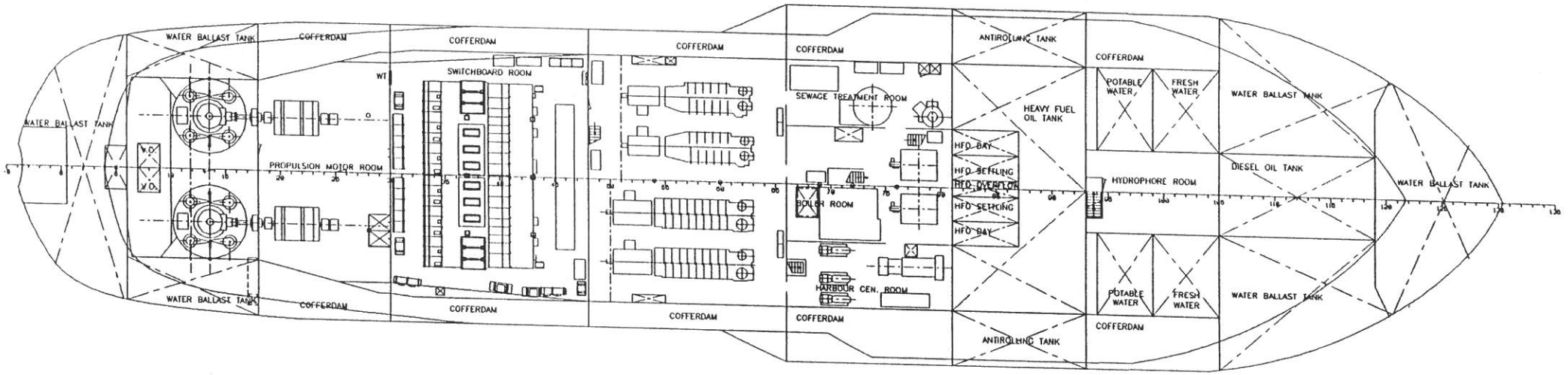
1. BRIDGE DECK 15500



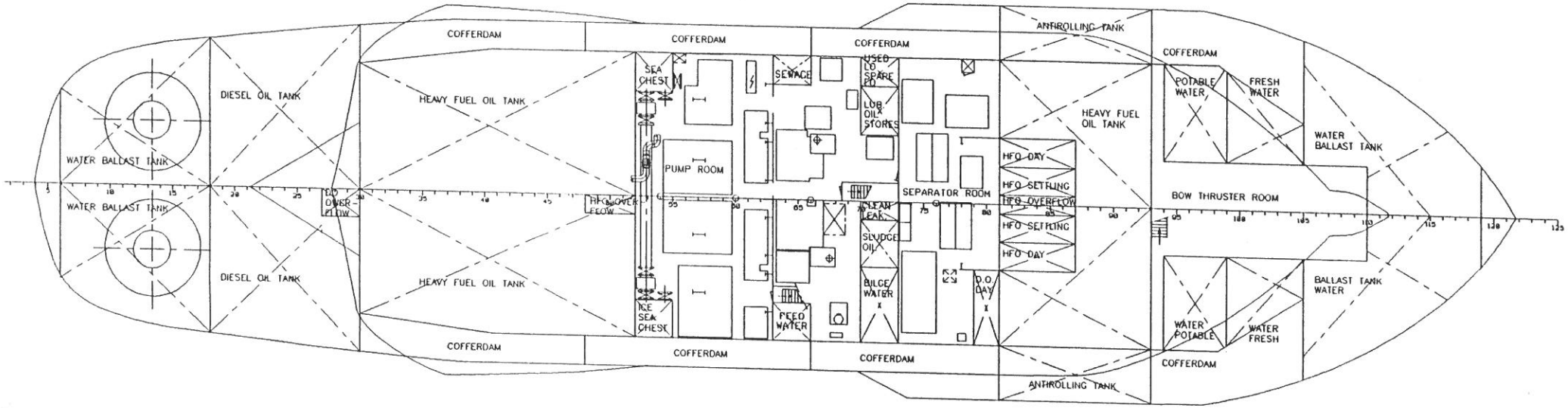
UPPER DECK 12500



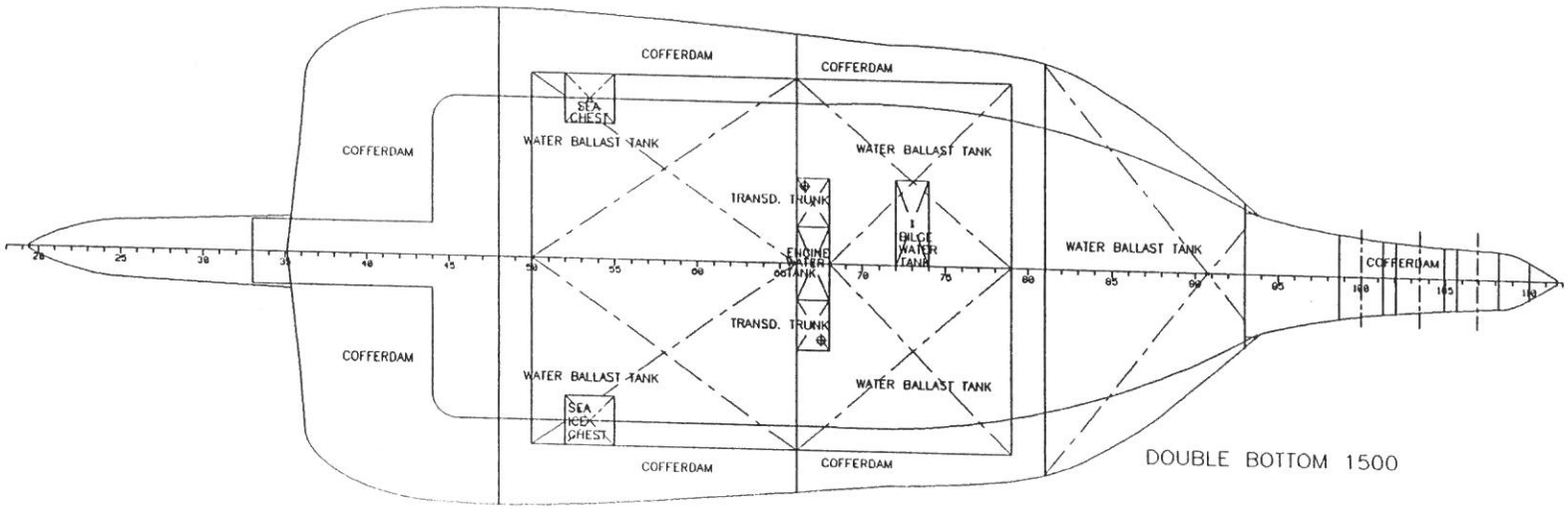
2. DECK 9300



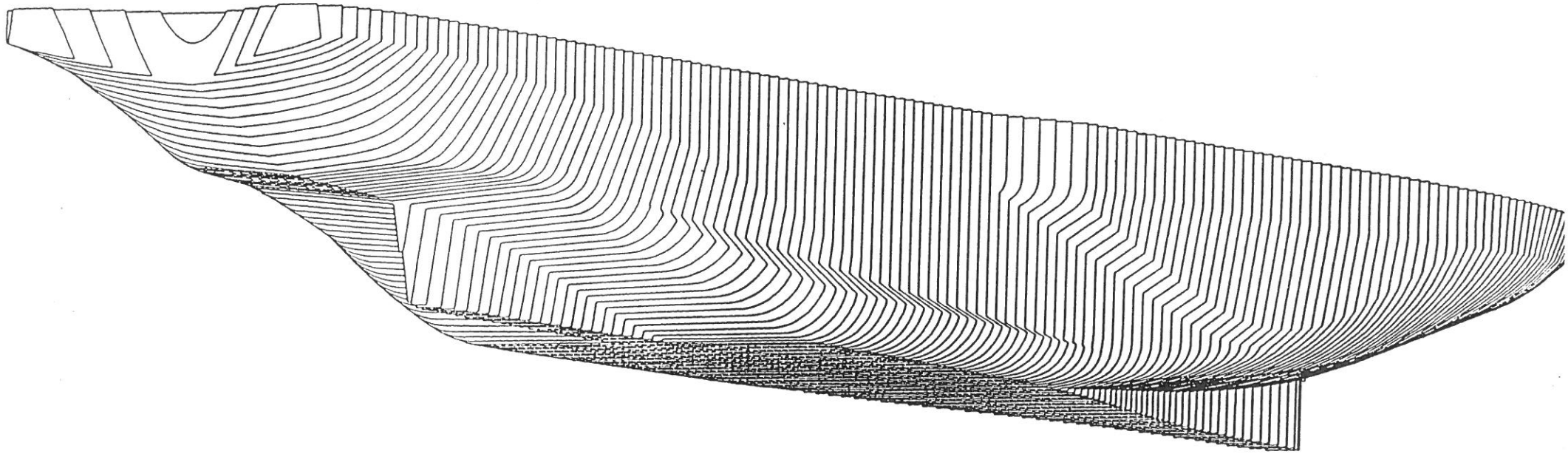
3. DECK 6500

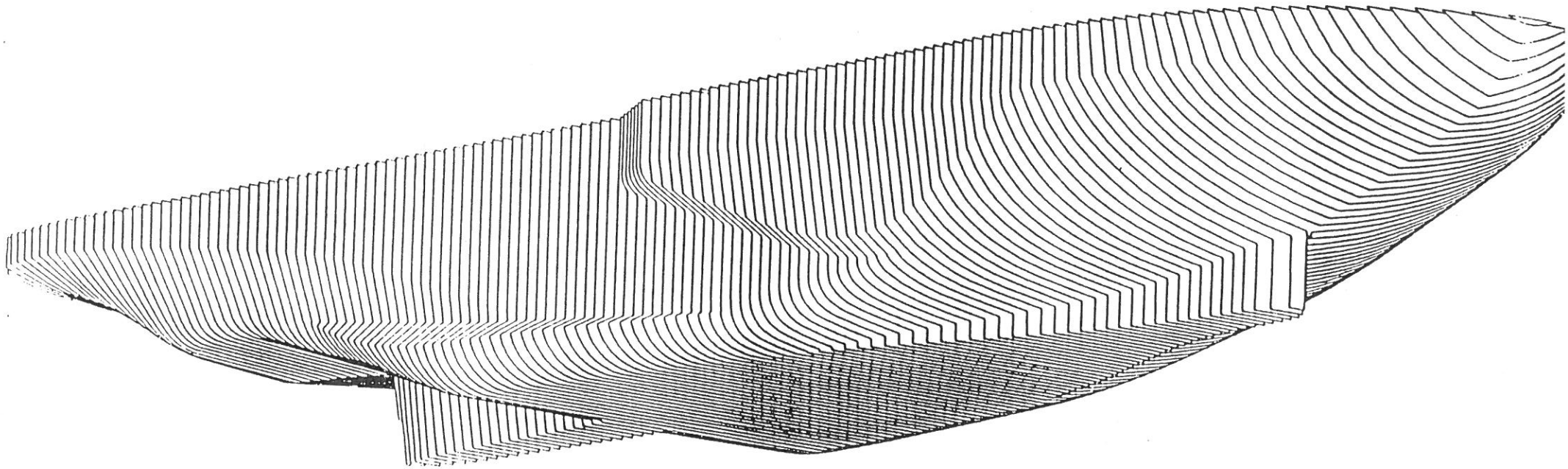


GRATING LEVEL 2700



DOUBLE BOTTOM 1500





DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**SVALBARD**
Owner/Operator:	Royal Norwegian Navy Material Command
Builder:	Langsten AS, Norway
Year of Construction:	2001
Contract price:	575[1)] mNOK [1)]w/o navig. and comm. systems and armament
Ship Type:	Icebreaking Coast Guard Vessel, patrolling (economic zone, fisheries area) around Jan Meyen and Svalbard, winter northern parts of the Barents Sea as an icebreaker, tug and heli platform. Pollution control and SAR operations, research and expedition and support tasks.
Operation Area:	Worldwide, see above
Class Notation:	DNV 1A1, Icebreaker POLAR 10, RPS, F-A, E0,HELDK-SH, DEICE, FiFi 1
Ice Class:	DNV Icebreaker POLAR 10
Stem Angle:	35°
L_{OA}	103,7 m
L_{PP}	89,0 m
L_{WL}	
B_m	19,1 m
B_{WL}	18,6 m
H	8,3 m
T_{design}	6,5 m
$T_{scantling}$	
Displacement	
DWT	
Accommodation:	For 48 persons**,** high pressure and gas-defense
Open Water Speed:	17 kn
Main Engine Type/Power:	DE-Machinery, 4 pcs Bergen Diesel BRG-8; 13 560 kW (4x3390 kW/720 rpm)
Propulsion Type/Power:	2 x pod azimuth thrusters, Azipod 10 000 kW (2x5000 kW)
Propellers, Type, Dia:	FP-propellers
Bollard Pull:	100 t
BP/B_{WL}	5,4 t/m
Prop. Power/Bwl:	538 kW/m
Ice Performance Ahead:	1,0 m / 3 kn level ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	

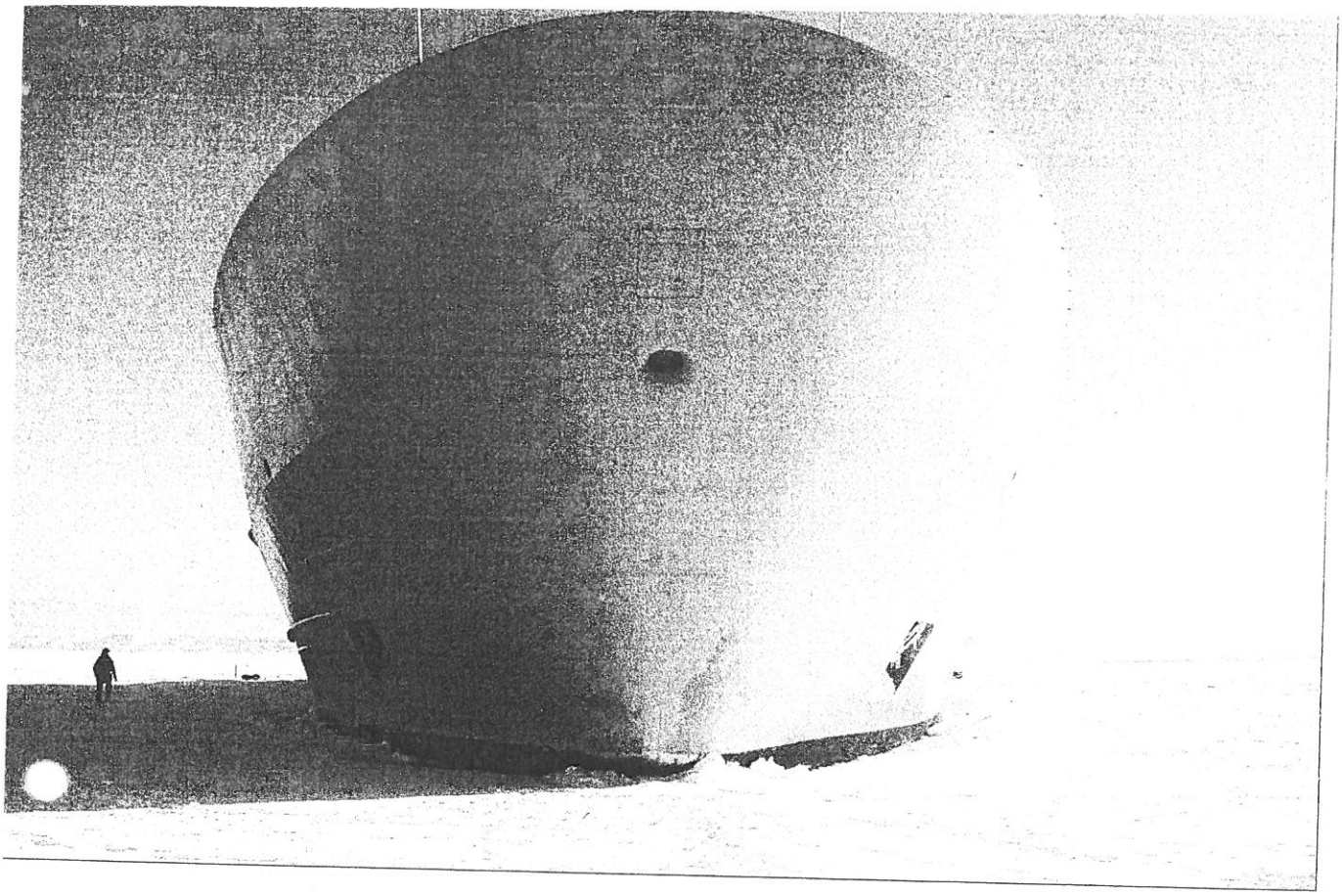
Miscellaneous:
- De-icing capacity 1500 kW, 17 km heating cables
- forward tunnel thruster 2180 kW
- Towing winch 100t, 30 t pull
- Deck crane 12 t/17,5 m
- FiFi 1 system: 2x1200 m^3/h
- Helideck

GA available.

References: Aker Yards Langsten: Yard no 182 Svalbard. Brochure. (GA)

Svalbard: the most powerful Norwegian ice breaker yet? *Significant Small Ships of 2002*.

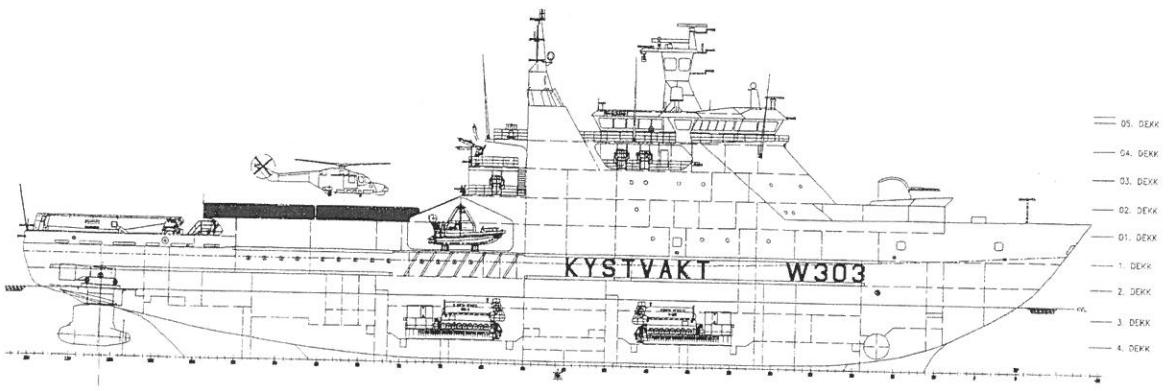
Bakka Jr, Dag: Norwegian coast guard vessel for Arctic conditions. *Scandinavian Shipping Gazette*. January 25, 2002. P. 52-53



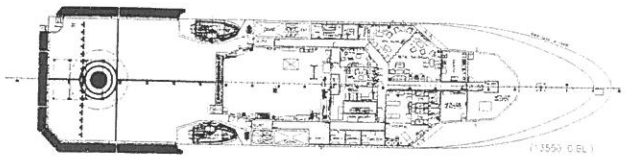
THE VESSEL PRIMARY TASKS

Fishery inspection
Enforcement of sovereignty
Search and rescue service
Environment protection
Support tasks
Research and expedition
Icebreaking

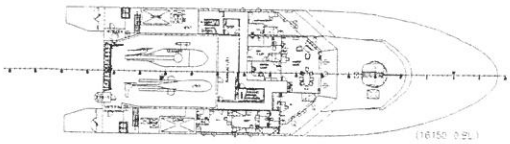
GENERAL ARRANGEMENT



PROFILE

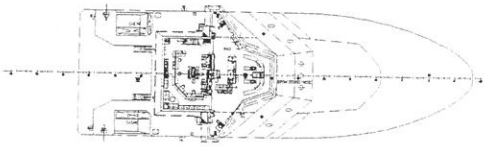


01 Deck

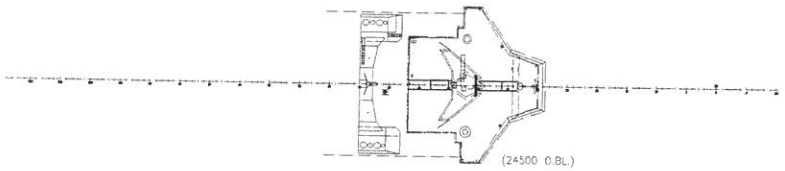


02 Deck

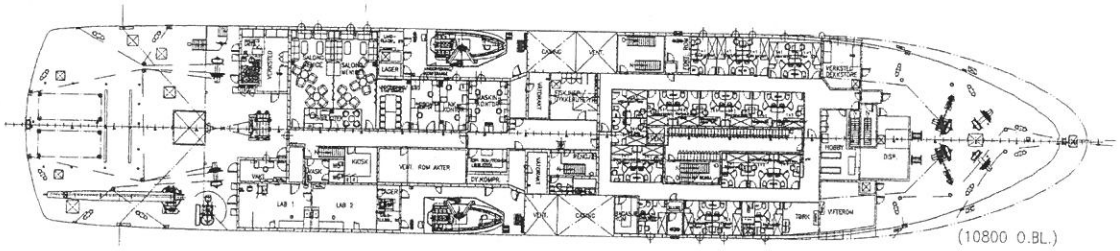
03 Deck



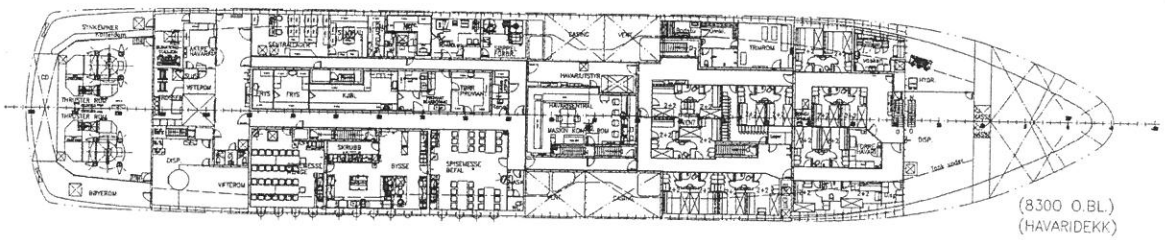
04 Deck



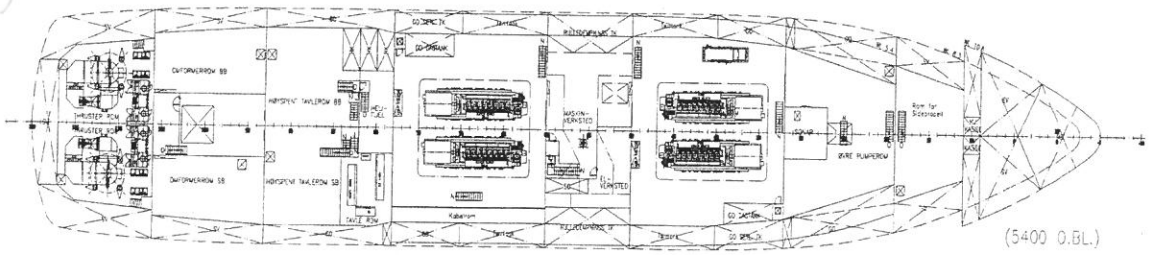
05 Deck



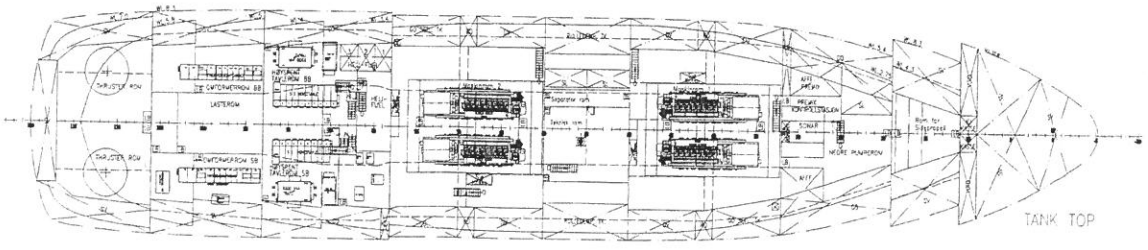
1. Deck



2. Deck



3. Deck



4. Deck

Design: Centi Media, Molde

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Svitzer Sakhalin/Svitzer Korsakov/Svitzer Busse/Svitzer**
AnivaOwner/Operator:	Svitzer
Builder:	Admiralteyskiy Sudostroitelnyy Zavod, St Petersburg
Year of Construction:	**2**007
Contract price:	
Ship Type:	Tug
Operation Area:	Sakhalin II
Class Notation:	Lloyds +100A1, Ice 1A Super, FiFi 1
Ice Class:	IA Super
Stem Angle:	
L_{OA}	35,3 m
L_{PP}	34,5 m
L_{WL}	
B_m	13 m
B_{WL}	
H	
T_{design}	5,7 m
$T_{scantling}$	
Displacement	
DWT	
Accommodation:	Six single
Open Water Speed:	12 kn
Main Engine Type/Power:	2 x Bergen C25:33L9P 2395 kW =4,8 MW
Propulsion Type/Power:	
Propellers, Type, Dia:	2 Aquamaster
Bollard Pull:	>75 t
BP/B_{WL} :	5,76 t/m
Prop. Power/Bwl:	369 kW/m

Ice Performance Ahead:

Ice Performance Astern:

Other Icebreaking Characteristics:

Miscellaneous: -

References:

Russian-built Svitzer tugs to serve Sakhalin II. *Scandinavian Shipping Gazette*. 2008. Available at: http://www.shipgaz.com/old/magazine/issues/2008/02/0208_article3.php

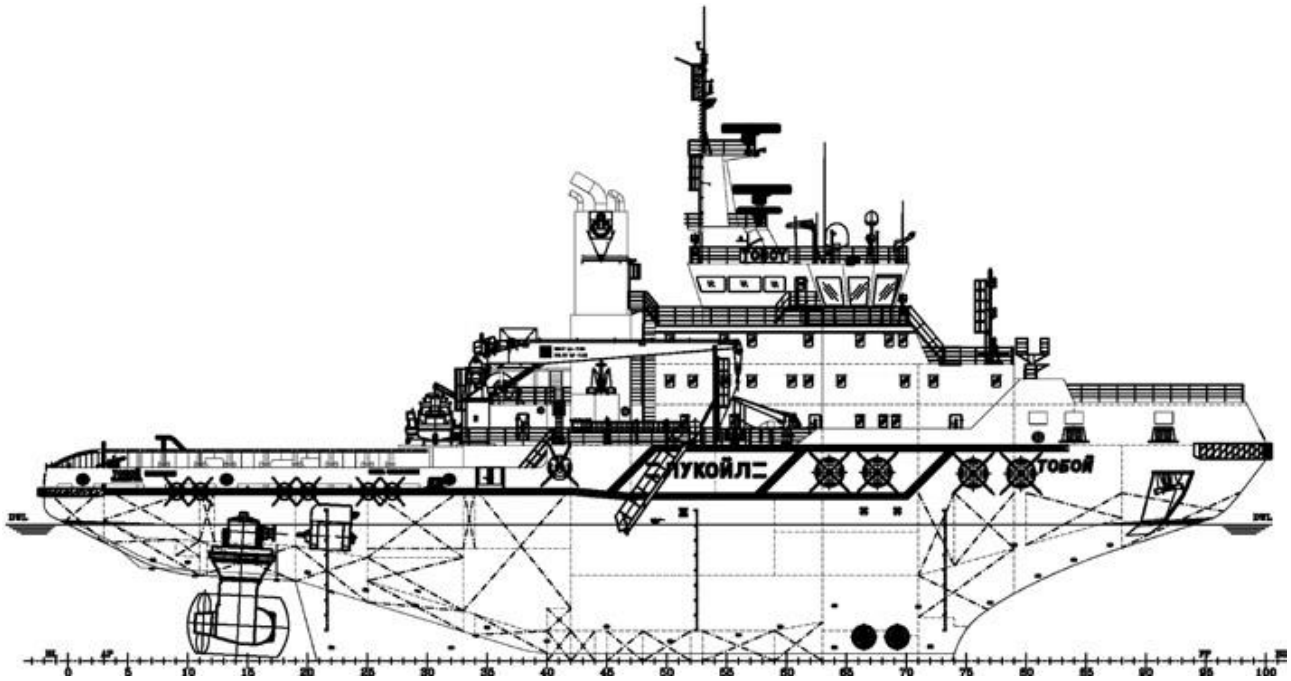
Sakhalin – ice management. *ICE FOCUS Supplement*. Aprill 2009.

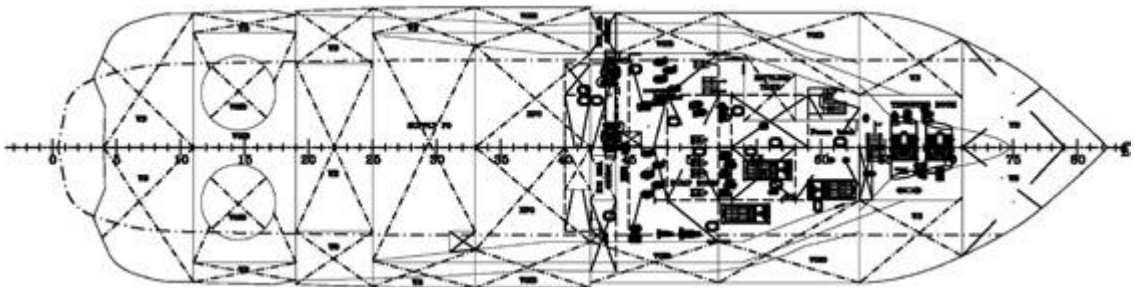
DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**TOBOY**
Owner/Operator:	Lukoil
Builder:	Keppel Singmarine, Singapore
Year of Construction:	2008
Contract price:	
Ship Type:	Multipurpose Icebreaking Supply Vessel. Also oil recovery, firefighting, FW and FO supply and deck cargo capacity
Operation Area:	Worldwide, Pechora Sea Varandey terminal
Class Notation:	RMRS KM*LU7 (1) A1 Supply Vessel
Ice Class:	LU7
Stem Angle:	18^o
L_{OA}	81,6 m
L_{PP}	73,3 m
L_{WL}	
B_m	18,5 m
B_{WL}	18,0 m
H	11,2 m
T_{design}	9,1m
$T_{scantling}$	9,3 m
Displacement	
DWT	2169 t
Accommodation:	For 24 persons
Open Water Speed:	15 kn
Main Engine Type/Power:	DE-Machinery, 3 pcs Wärtsilä 9V32; 12 960 kW (3x4320 kW/720 rpm)
Propulsion Type/Power:	2xZ-drive Azimuth thrusters, Steerprop 10 400 kW (2x5200 kW)
Propellers, Type, Dia:	FP-propellers, dia 4 m
Bollard Pull:	
BP/B_{WL}	
Prop. Power/Bwl:	578 kW/m
Ice Performance Ahead:	1,5 m level ice + 20 cm snow / 3 kn
Ice Performance Astern:	

Other Icebreaking Characteristics:

Miscellaneous: - Oil recovery tank 146 m^3
- 2 forward tunnel thrusters 2x600 kW
- Towing winch
- Deck crane 10 t/17,5 m
- FiFi 1 system: 2x1200 m^3/h





References:

Keppel Singmarine: Toboy brochure. (source for the pictures)

Non-public: GA from ILS OY.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**VARANDEY**
Owner/Operator:	Lukoil
Builder:	Keppel Singmarine, Singapore
Year of Construction:	2008
Contract price:	
Ship Type:	Multipurpose Icebreaker. Also oil recovery, firefighting, rescue, FW and FO supply and deck cargo capacity
Operation Area:	Worldwide, Pechora Sea Varandey terminal
Class Notation:	RMRS KM*LL7 (2) A1 Icebreaker Tug
Ice Class:	LL7
Stem Angle:	18^o
L_{OA}	100,0 m
L_{PP}	88,8 m
L_{WL}	
B_m	21,7 m
B_{WL}	21,0 m
H	13,3 m
T_{design}	10,5 m
$T_{scantling}$	10,6 m
Displacement	
DWT	4463 t
Accommodation:	For 28 persons
Open Water Speed:	15 kn
Main Engine Type/Power:	DE-Machinery, 4 pcs Wärtsilä12V32; 23 000 kW (4x5760 kW/720 rpm)
Propulsion Type/Power:	2xZ-drive Azimuth thrusters, SteerpropSPO 4,5 ARC 16 800 kW (2x8400 kW)
Propellers, Type, Dia:	FP-propellers
Bollard Pull:	**N/A**
BP/B_{WL}	
Prop. Power/Bwl:	800 kW/m
Ice Performance Ahead:	1,7 m level ice + 20 cm snow / 3 kn
Ice Performance Astern:	

Other Icebreaking Characteristics:

Miscellaneous:
- Oil recovery tanks 500 m^3
- 2 forward tunnel thrusters
- Towing winch
- Deck crane 10 t/17,5 m
- FiFi 1 system: 2x1200 m^3/h

References:

Keppel Singmarine: Varandey brochure.
Non-public: GA from ILS Oy.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Vitus Bering, Aleksey Chirikov**
Owner/Operator:	Sovcomflot
Builder:	Arctech Helsinki Shipyard
Year of Construction:	2013
Contract price:	
Ship Type:	Multifunctional icebreaking supply vessel
Operation Area:	Sakhalin 1
Class Notation:	LR +100A1 Icebreaker, Offshore Tug/Supply Ship, Fire-fighting Ship 1, WDL, RD, IWS*, Winterisation H(-35) B(-35), +LMC, UMS, DP (AM), NAV1, OIL RECOVERY, EP, ShipRight ACS(B)
Ice Class:	
Stem Angle:	
L_{OA}	99,9 m
L_{PP}	
L_{WL}	93,9 m
B_m	21,7 m
B_{WL}	
H	
T_{design}	7,6 m
$T_{scantling}$	
Displacement	
DWT	3950 t
Accomodation:	22 crew, 28 special persons, 195 evacuees
Open Water Speed:	15 kn
Main Engine Type/Power:	18 MW
Propulsion Type/Power:	13 MW
Propellers, Type, Dia:	Azimuthing
Bollard Pull:	>128 t
BP/B_{WL}:	5,9 t/m
Prop. Power/Bwl:	599 kW/m
Ice Performance Ahead:	3 kn in 1,5 m level ice, operate independently in 1,7 m level ice
Ice Performance Astern:	

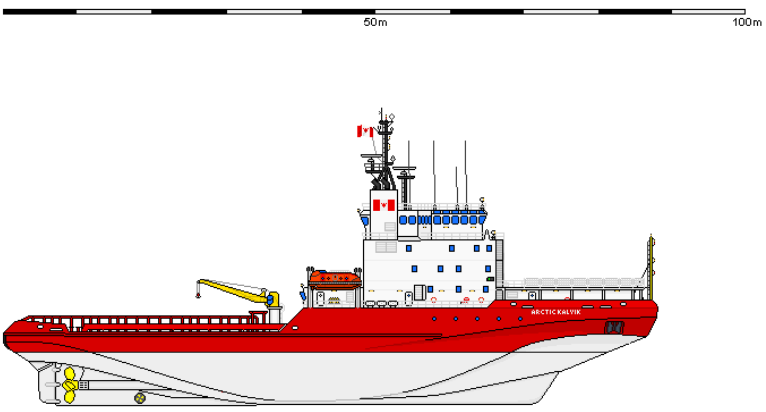
Other Icebreaking Characteristics: Penetrate consolidated 20 m ice ridges

Miscellaneous: -

References: Arctech: Multifunctional icebreaking supply vessels Vitus Bering and Aleksey Chirikov. Brochure. Available at: http://arctech.fi/wp-content/uploads/NB506-507_EN_2013_www.pdf

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Vladimir Ignatyuk (formerly Arctic Kalvik)**
Owner/Operator:	Murmansk Shipping Co.
Builder:	Burrard Yarrows Co. Canada
Year of Construction:	1983
Contract price:	
Ship Type:	Multi icebreaker/ Icebreaking AHTS
Operation Area:	Barents Sea
Class Notation:	Lloyd's Register of Shipping + 100 A1 Icebreaker Tug + LMC
Ice Class:	Icebreaker 7, IA Super
Stem Angle:	25°
L_{OA}	88
L_{PP}	75
L_{WL}	
B_m	17,82
B_{WL}	
H	10 m
T_{design}	8,3 m
$T_{scantling}$	
Displacement	7077 **t**
DWT	1933 t
Accomodation:	24 crew + 10
Open Water Speed:	15,5 kn
Main Engine Type/Power:	4 8TM410 Stork Werkspoor Diesel, 4175 kW each = 16700 kW
Propulsion Type/Power:	Twin open screws/ single rudder = 17300 kW
Propellers, Type, Dia:	2 CPP 4 blades, Bow thruster: CPP 18 t, Stern thruster: CPP 5 t
Bollard Pull:	220 t
BP/Bm (B_{WL}) :	12,3 t/m
Prop. Power/Bm(Bwl):	970 kW/m
Ice Performance Ahead:	3 kn in 1,2 m ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous: -	



Canada, IB Arctic Kalvik (1982-2003)
(Lazer_one)

www.shipbucket.com

References: Wikipedia: Vladimir Ignatyuk. Available at: http://en.wikipedia.org/wiki/Vladimir_Ignatyuk_(icebreaker)

Murmansk Shipping Company: Icebreakers. Available at: http://msco.ru/en/fleet/ice-breaker

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Vladislav Strizhov**
Owner/Operator:	CJSC Sevmorneftegas
Builder:	Aker Yards Soviknes
Year of Construction:	2006
Contract price:	
Ship Type:	Multipurpose icebreaking supply vessel
Operation Area:	Prirazlomnoye, Barents Sea
Class Notation:	DNV and Russian Maritime Register of Shipping: 1A1 ICE-15 Icebreaker Tug Supply Vessle Standby Vessel(S) Fire Fighter I OILREC SF DEICE E0 DYNPOS-AUTS NAUT-OC CLEAN DAT(-40C) DK(+) HL(2.0)
Ice Class:	
Stem Angle:	
L_{OA}	99,3 m
L_{PP}	84,39 m
L_{WL}	
B_m	19 m
B_{WL}	
H	10,5 m
T_{design}	
$T_{scantling}$	8 m
Displacement	
DWT	2500 t
Accommodation:	21 single cabins, 5 four person cabins
Open Water Speed:	15 kn
Main Engine Type/Power:	**2** x Wärtsilä 12V32 6000 kW, 2 x 8L32 4000 kW; total 20MW
Propulsion Type/Power:	2 x Azipod V16 7500 kW, total 15 MW
Propellers, Type, Dia:	Azipod
Bollard Pull:	170 t
BP/B_{WL}:	8,95 t/m
Prop. Power/Bwl:	789 kW/m
Ice Performance Ahead:	10 kn in 80 cm ice, 2 kn in 1,5 m ice
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous: -	

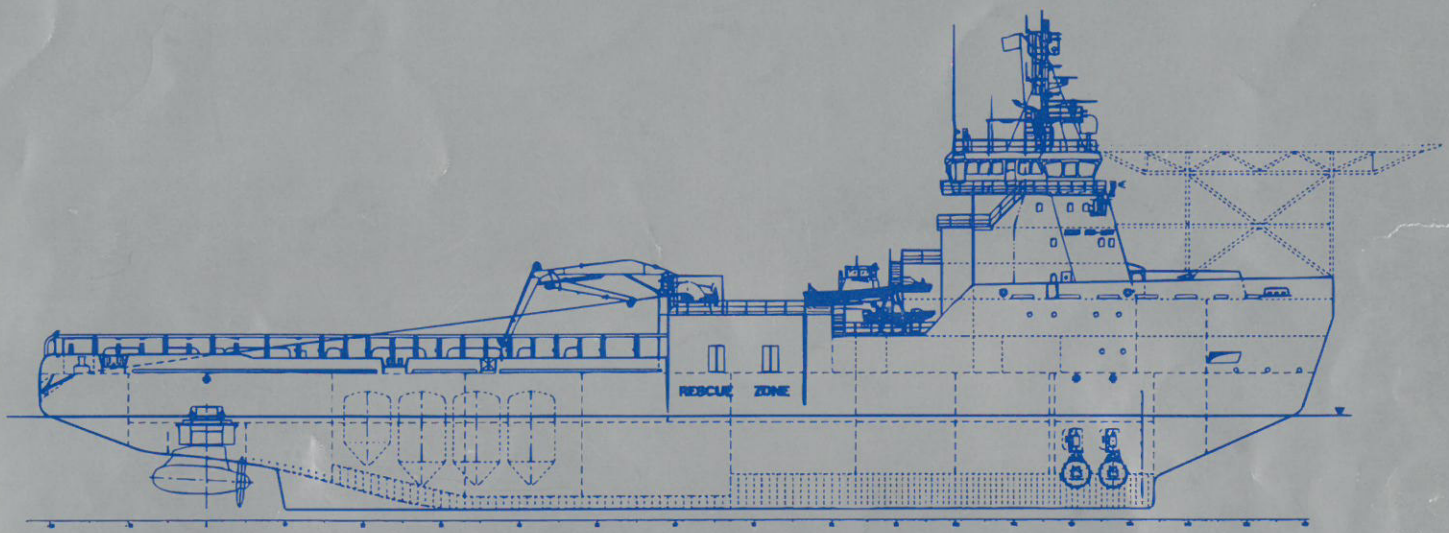
References:

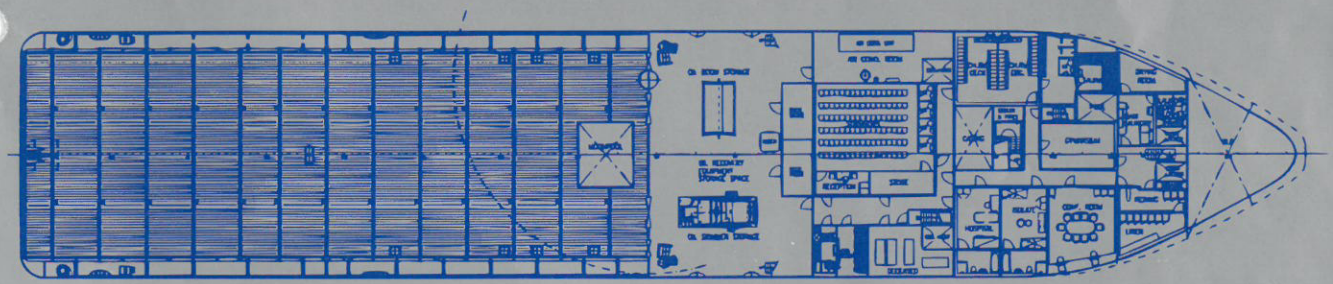
Foxwell, David: Krylov expertise gives Moss designs a Russian flavor. *Offshore journal*. 2nd quarter 2004. P. 21.

Baltiysky Zavod: Multipurpose icebreaking supply vessel MOSS 828-MISV. Brochure.

Baltiysky ZAVOD
JOINT STOCK COMPANY

BALTIYSKY ZAVOD JSC
16, Kosaya Liniya, St.Petersburg
199106, Russia
phone (812) 324-92-54
fax (812) 327-71-84
e-mail: marketing@bz.ru
www.bz.ru





MULTIPURPOSE ICEBREAKING SUPPLY VESSEL MOSS 828-MISV

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Arctic Offshore Patrol Ship (AOPS)**
Owner/Operator:	Royal Canadian Navy
Builder:	Irving Shipbuilding
Year of Construction:	2018
Contract price:	288 million dollars
Ship Type:	Multiseason patrol ship
Operation Area:	Canadian Arctic
Class Notation:	
Ice Class:	
Stem Angle:	38°
L_{OA}	98 m
L_{PP}	
L_{WL}	
B_m	19 m
B_{WL}	
H	
T_{design}	5,75 m
$T_{scantling}$	
Displacement	5874 t
DWT	
Accommodation:	45 normal + 20 additional + 20 embarked force
Open Water Speed:	
Main Engine Type/Power:	
Propulsion Type/Power:	2 x 4500 kW
Propellers, Type, Dia:	**2**
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	
Ice Performance Astern:	
Other Icebreaking Characteristics:	

Miscellaneous: GA/Linedrawing available

References: Canadian American Strategic Review: Comparing Arctic Ship Procurement – or a tale of two icebreakers: Canada's AOPS and Russian Arctic Rescue and Salvage ship purchase. 2013. Available at: http://www.casr.ca/as-arctic-sar-ships.htm

Non-public: GA/Linedrawing available.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME: Baltika

Owner/Operator:	Rosmorrechflot/ Russian Marine Emergency Rescue Service
Builder:	Arctech Helsinki Shipyard
Year of Construction:	2014
Contract price:	76 million euro
Ship Type:	Oblique icebreaker
Operation Area:	Harbours
Class Notation:	KM * Icebreaker6, [1], AUT1-ICS, OMBO, FF3WS, EPP, DYNPOS-1, ECO-S, Oil recovery ship (>60C), Salvage ship, Tug, HELIDECK
Ice Class:	Icebreaker 6

Stem Angle	N/A
L_{OA}	76,4 m
L_{PP}	N/A
L_{WL}	72,1 m
B_m	20,5 m
B_{WL}	N/A
H	N/A
T_{design}	**6,3** m
$T_{scantling}$	N/A
Displacement	N/A
DWT	1150 **t**

Accomodation:	24 crew, 36 total
Open Water Speed:	14 kn
Main Engine Type/Power:	9,0 MW (3 x 3000 kW Rolls Royce)
Propulsion Type/Power:	7,5 MW (3 x 2500 kW)
Propellers, Type, Dia:	Three azimuth thrusters

Bollard Pull:	N/A
BP/B_{WL} :	N/A
Prop. Power/(Bwl) B :	366 kW/m

Ice Performance Ahead:	3 kn in 1.0 m level ice
Ice Performance Astern:	3 kn in 1.0 m level ice

Other Icebreaking Characteristics: 50 meter channel in 60 cm ice, sideways operation
Miscellaneous: -

References: Arctech: Icebreaking multipurpose emergency and rescue vessel. Brochure.

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**CCGS John G. Diefenbaker**
Owner/Operator:	Government of Canada/Canadian Coast Guard
Builder:	Seaspan Marine Corporation
Year of Construction:	2020s
Contract price:	1,3 billion
Ship Type:	Canadian Coast Guard Icebreaker
Operation Area:	
Class Notation:	
Ice Class:	PC2
Stem Angle:	
L_{OA}	149 m
L_{PP}	
L_{WL}	
B_m	28 m
B_{WL}	
H	13,5 m
T_{design}	10,5 m
$T_{scantling}$	
Displacement	23700 t
DWT	
Accomodation:	60 core crew, 40 program personnel
Open Water Speed:	18 kn max
Main Engine Type/Power:	5 diesel engines, 42 MW
Propulsion Type/Power:	Diesel-electris; three shafts 3 x 12 MW
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	3 kn in 2,5 m ice + 30 cm snow
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous: -	

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Kemin Karhu**
Owner/Operator:	Arctia Karhu
Builder:	Uudenkaupungin Työvene
Year of Construction:	2014
Contract price:	10 million euro
Ship Type:	Escort tug harbor icebreaker
Operation Area:	Bay of Bothnia
Class Notation:	Bureau Veritas I +HULL +MACH Tug, Escort Tug Unrestricted Navigation ICE 1ASuper, +AUT-UMS
Ice Class:	1A Super
Stem Angle:	30°
L_{OA}	40 m
L_{PP}	
L_{WL}	37,8 m
B_m	12,8 m
B_{WL}	
H	7,75 m
T_{design}	4,7 m
$T_{scantling}$	5,0 m
Displacement	
DWT	200 t
Accomodation:	8 crew
Open Water Speed:	Max 12 kn
Main Engine Type/Power:	2 x Wärtsilä 9L20, total 3600 kW
Propulsion Type/Power:	Two azimuth propulsion units Rolls Royce US 305 CP
Propellers, Type, Dia:	2 FP
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	3 kn in 60 cm packed channel, 0,7 m level ice at 3 kn
Ice Performance Astern:	6 kn in 0,3 m level ice

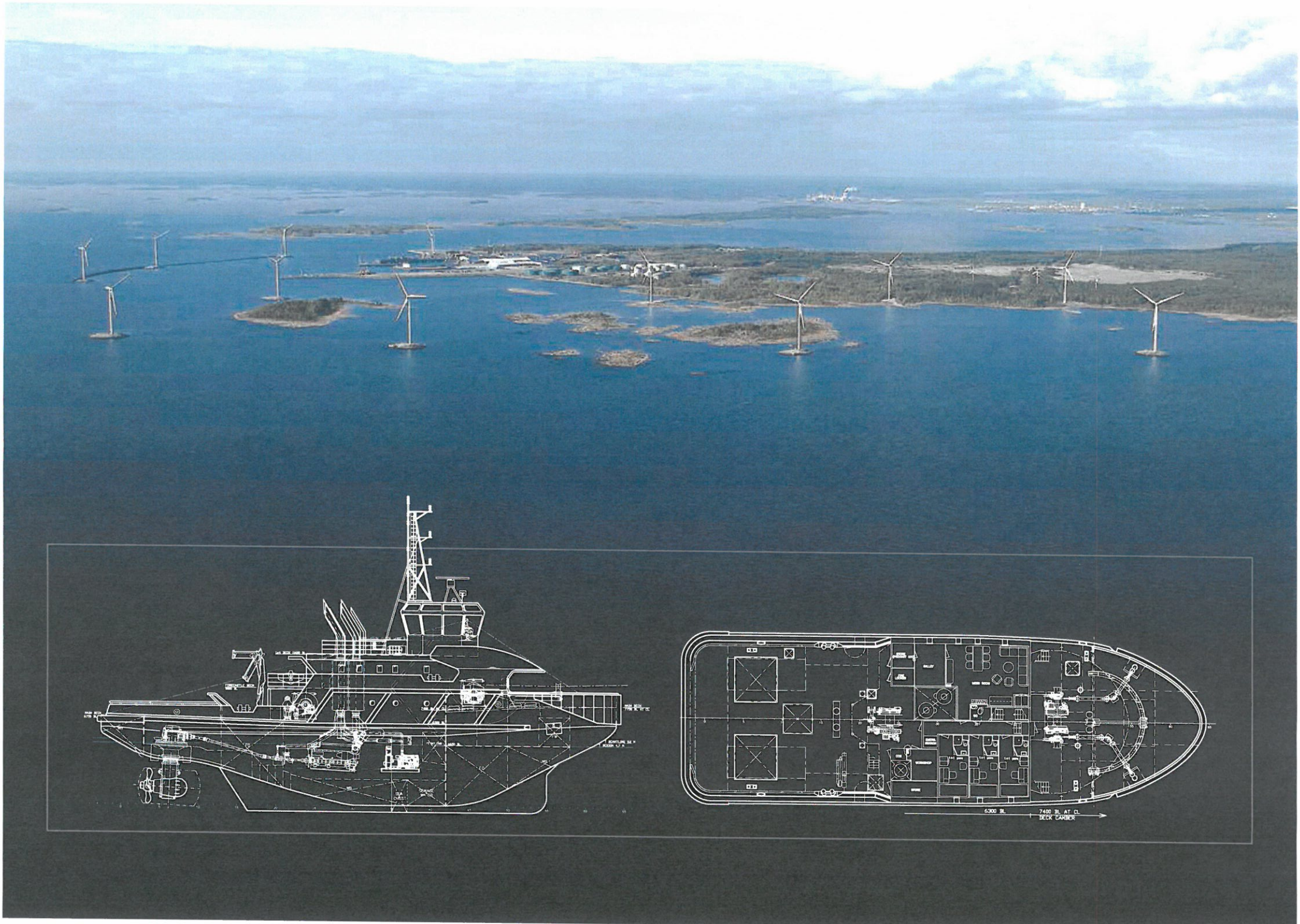
Other Icebreaking Characteristics: 180 degrees in 0,3 m level ice in 3 minutes

Miscellaneous: -

References:

Arctia Karhu brochure.

Non-public: GA by ILS OY.


6300 BL
7400 BL AT CL
DECK CAMBER

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Kronprins Haakon**
Owner/Operator:	Norwegian Institute of Marine Research
Builder:	Fincantieri Italy, VARD Norway
Year of Construction:	2016
Contract price:	175 mil euro
Ship Type:	Polar research vessel/icebreaker
Operation Area:	The Arctic
Class Notation:	
Ice Class:	Polar 10
Stem Angle:	
L_{OA}	>100 m
L_{PP}	
L_{WL}	
B_m	21 m
B_{WL}	
H	
T_{design}	
$T_{scantling}$	
Displacement	
DWT	
Accomodation:	55 persons in 38 cabins
Open Water Speed:	
Main Engine Type/Power:	
Propulsion Type/Power:	
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous:	
References: MarineLink.com: Fincantieri to Build new Norwegian polar institute ship. Available at: http://www.marinelink.com/news/fincantieri-norwegian361540.aspx	

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**LK-60 (Arktika?)**
Owner/Operator:	JSC Atomflot
Builder:	Baltiysky Zavod
Year of Construction:	2017
Contract price:	37 billion RUB (1,2 billion US dollars)
Ship Type:	Nuclear icebreaker
Operation Area:	The Arctic and Siberian rivers
Class Notation:	
Ice Class:	9
Stem Angle:	
L_{OA}	173 m
L_{PP}	
L_{WL}	
B_m	34 m
B_{WL}	
H	
T_{design}	8,5 m to 10,8 m
$T_{scantling}$	
Displacement	
DWT	
Accomodation:	
Open Water Speed:	
Main Engine Type/Power:	
Propulsion Type/Power:	
Propellers, Type, Dia: 2	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	Break 3 m thick ice**.**
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous: -	

References: Pettersen, Trude: Three new nuclear icebreakers in the pipeline. *Barents Observer*. 2012. Available at: http://barentsobserver.com/en/arctic/three-new-nuclear-icebreakers-pipeline-14-11

RT: Russia lays down world's largest icebreaker. 2014. Available at: http://rt.com/news/world-biggest-icebreaker-russia-275/

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Murmansk**
Owner/Operator:	Rosmorport
Builder:	Arctech Helsinki Shipyard
Year of Construction:	2015
Contract price:	
Ship Type:	Icebreaker
Operation Area:	Baltic Sea/Arctic Seas
Class Notation:	KM * Icebreaker6 [2] AUT1-ICS FF2 EPP ECO BWM HELIDECK Special Purpose ship
Ice Class:	Icebreaker 7
Stem Angle:	
L_{OA}	119,8 m
L_{PP}	
L_{WL}	104 m
B_m	27,5 m
B_{WL}	
H	
T_{design}	8,5 m
$T_{scantling}$	
Displacement	
DWT	5430 t
Accomodation:	36 crew + 22 special personnel
Open Water Speed:	17 kn
Main Engine Type/Power:	4 main diesel generator set, 27 MW
Propulsion Type/Power:	2 azimuth thrusters, 18 MW
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	**3,5 kn in 1.5 m level ice**
Ice Performance Astern:	
Other Icebreaking Characteristics:	
Miscellaneous:	

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:

Owner/Operator:	Finnish Transport Agency
Builder:	Arctech Shipyard Helsinki
Year of Construction:	2015
Contract price:	
Ship Type:	Icebreaker
Operation Area:	The Baltic Sea
Class Notation:	
Ice Class:	PC-4
Stem Angle:	23°
L_{OA}	110 m
L_{PP}	
L_{WL}	
B_m	
B_{WL}	24 m
H	
T_{design}	8 m
$T_{scantling}$	
Displacement	
DWT	3000 t

Accommodation:

Open Water Speed:	17 kn
Main Engine Type/Power:	Dual Fuel (LNG/Diesel), total 22 MW
Propulsion Type/Power:	Three unit azimuth propulsion, total 19 MW
Propellers, Type, Dia:	
Bollard Pull:	193 t ahead/187 t astern
BP/B_{WL} :	8,04 t/m
Prop. Power/Bwl:	791 kW/m

Ice Performance Ahead: 4 kn 1,8 m level ice, 6,8 kn in 1,27 m; 9,2 kn in 0,87 m

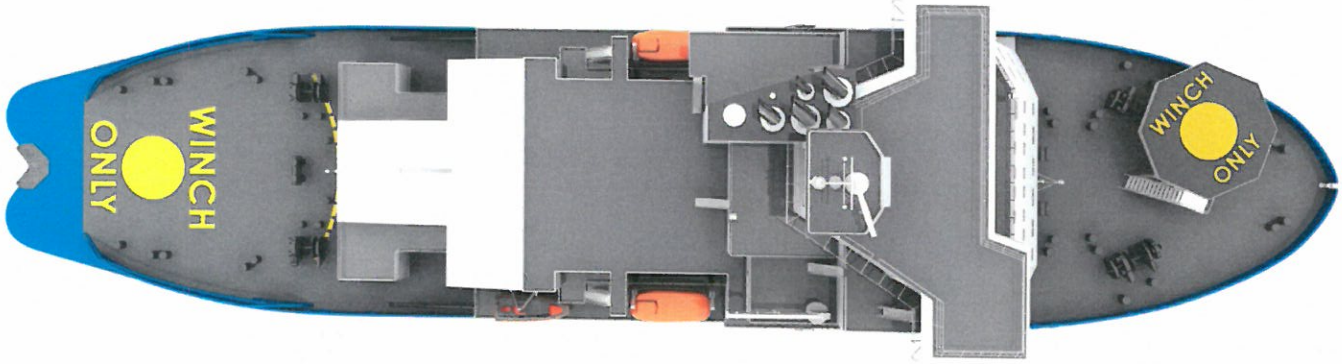
Ice Performance Astern: 5,5 kn in 1,27 m level ice, 8,7 kn in 0,87m

Other Icebreaking Characteristics:

Miscellaneous: GA available

General Arrangement

Aker Arctic



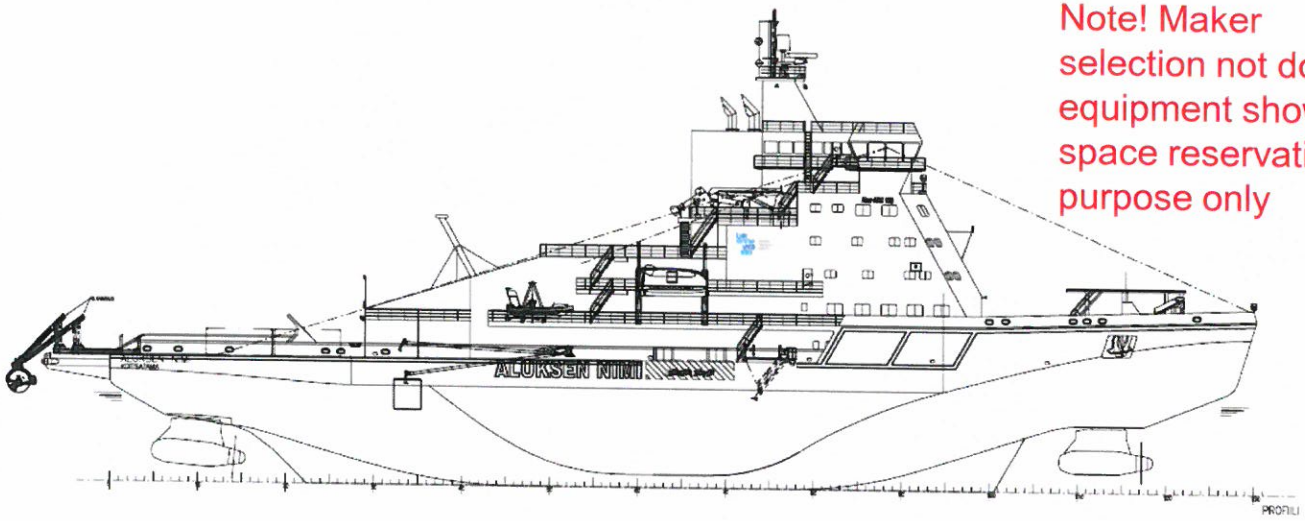
Co-financed by the European Union
Trans-European Transport Network (TEN-T)

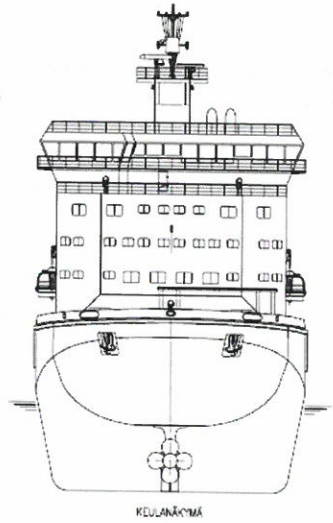
Liik enne vira sto

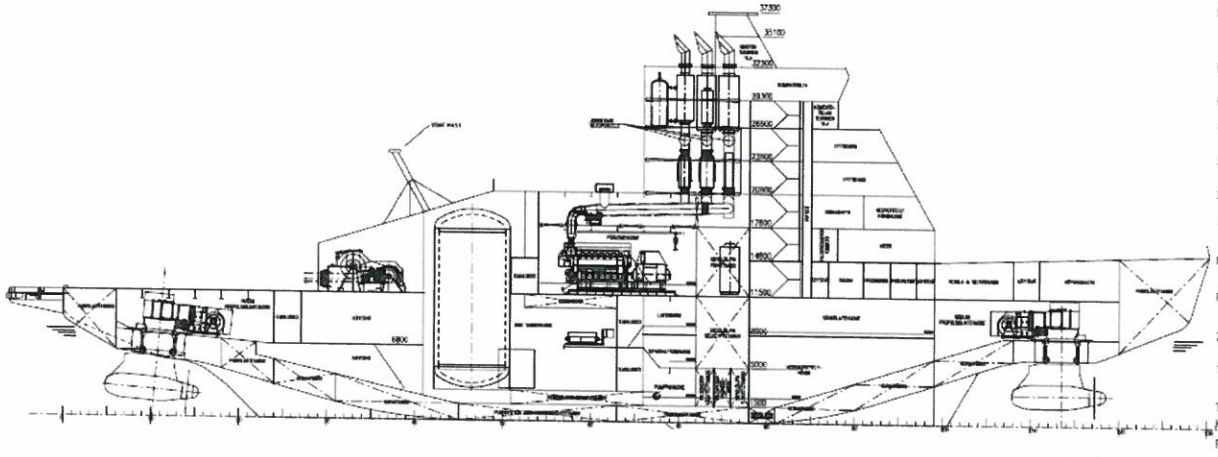
General Arrangement

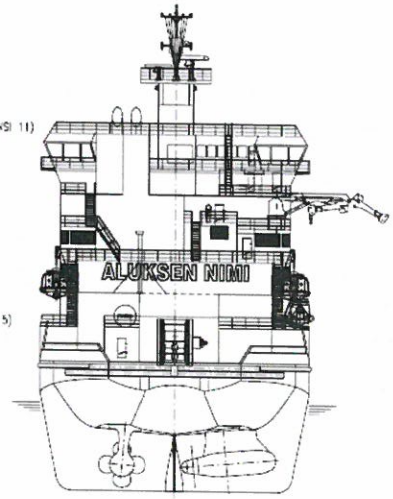
Aker Arctic

Note! Maker selection not done, equipment shown for space reservation purpose only







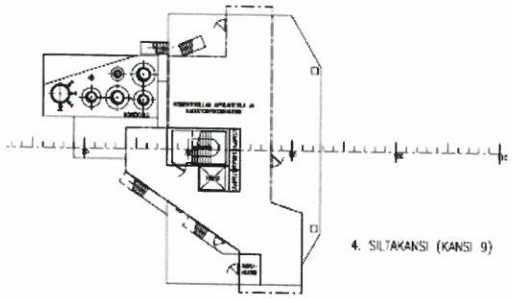


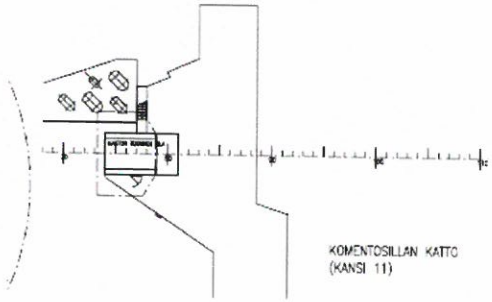
Co-financed by the European Union
Trans-European Transport Network (TEN-T)

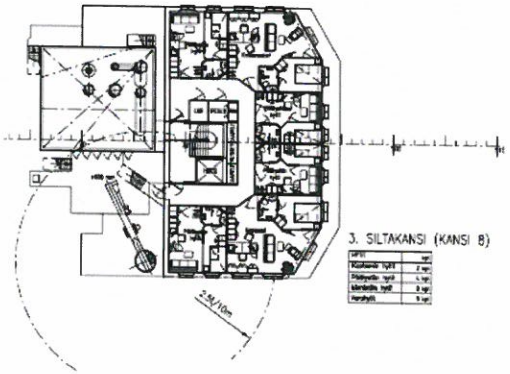
Liikennevirasto

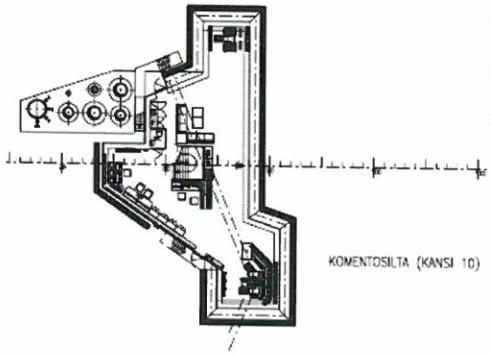
General Arrangement

Aker Arctic







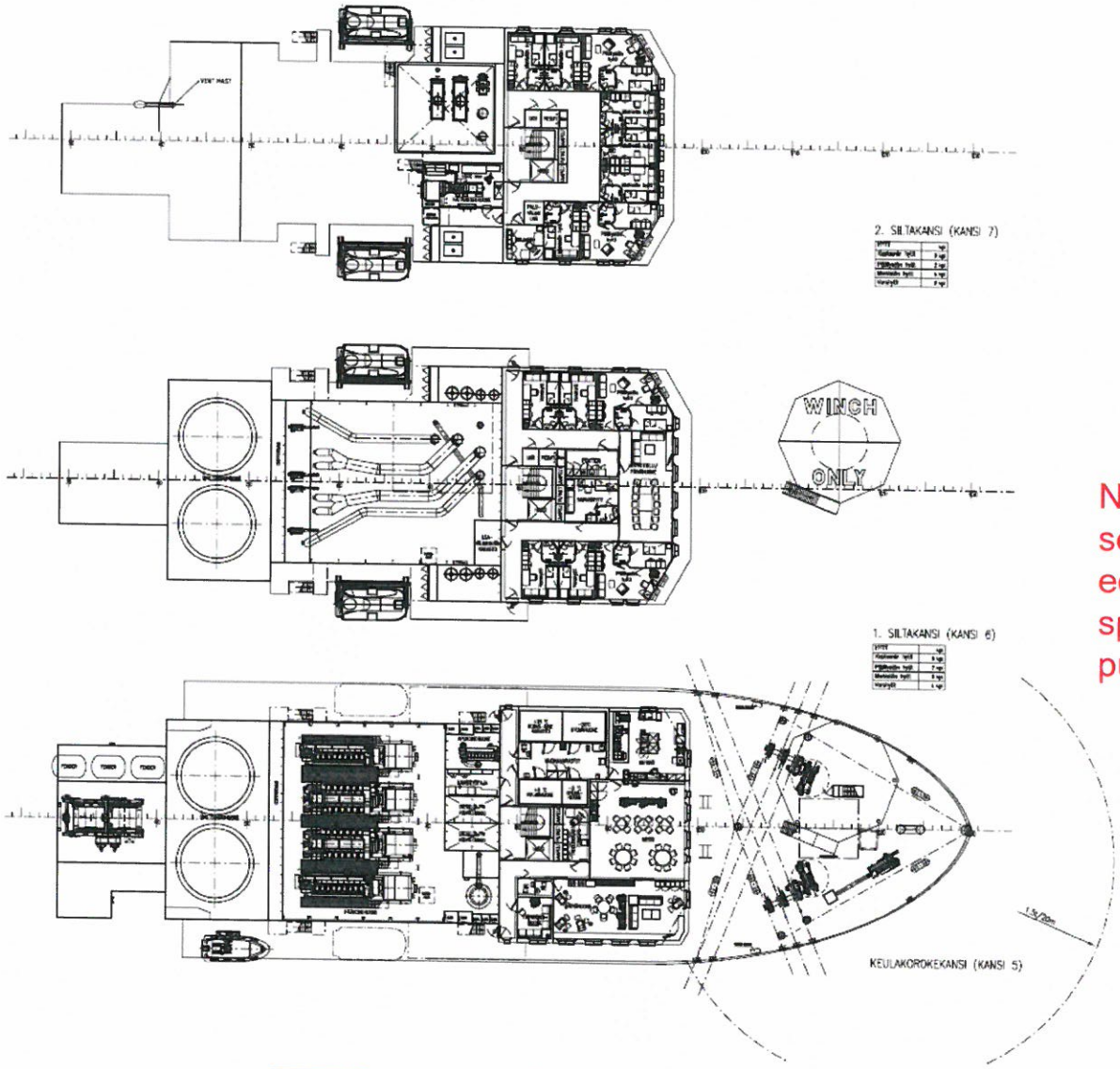


Note! Maker selection not done, equipment shown for space reservation purpose only

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

General Arrangement

Aker Arctic

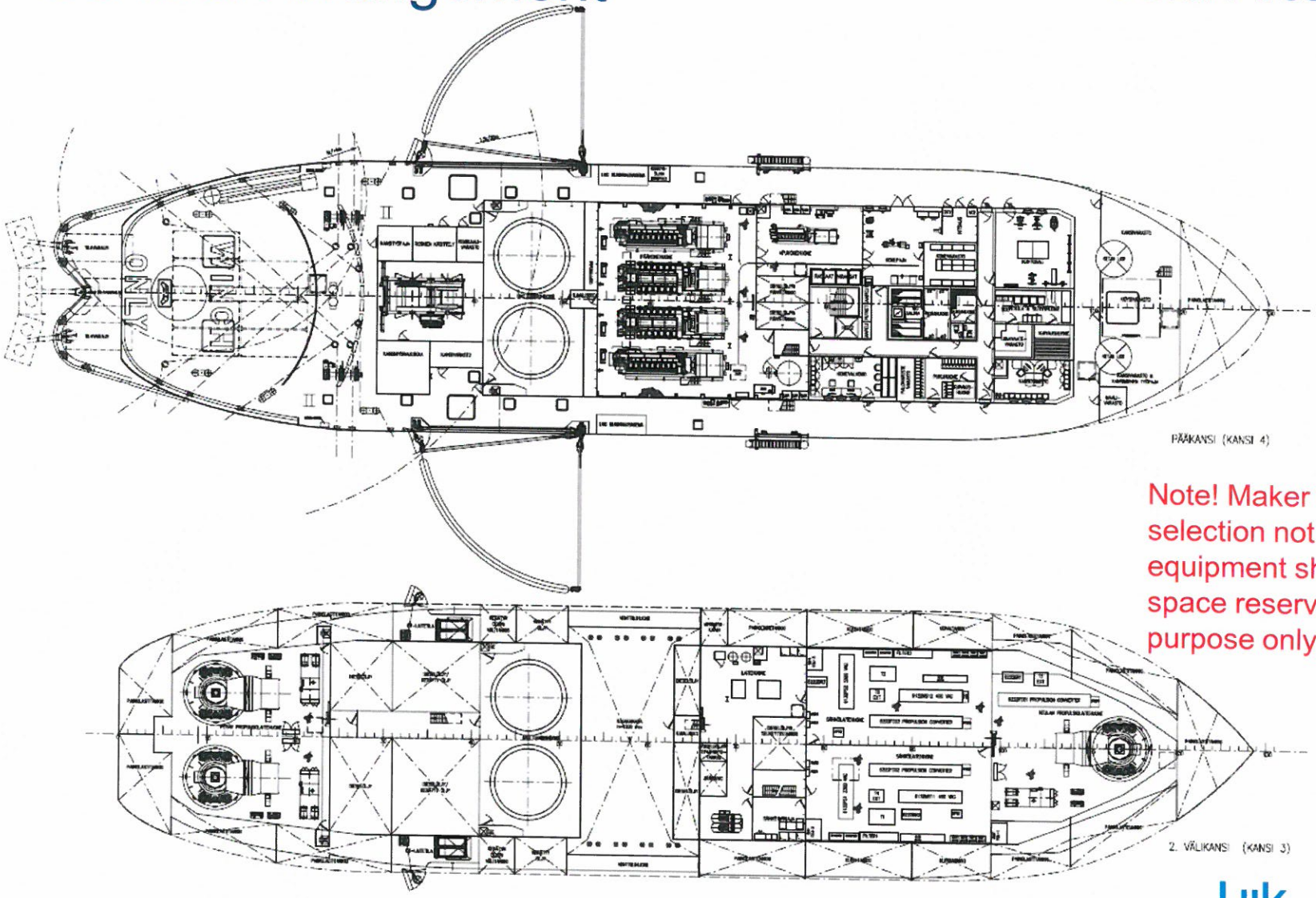


Note! Maker selection not done, equipment shown for space reservation purpose only

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

General Arrangement

Aker Arctic



Note! Maker selection not done, equipment shown for space reservation purpose only

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:

Owner/Operator: Russia's State Maritime Rescue Coordination Centre

Builder: Nordic Yards GmbH Germany

Year of Construction: 2015

Contract price: 150 million euros for two vessels

Ship Type: Rescue Icebreaker

Operation Area: Russian Arctic

Class Notation:

Ice Class: Icebreaker 6

Stem Angle:

L_{OA} 86 m

L_{PP}

L_{WL}

B_m 19 m

B_{WL}

H

T_{design}

$T_{scantling}$

Displacement

DWT

Accomodation:

Open Water Speed:

Main Engine Type/Power:

Propulsion Type/Power: 2 x 3,5 MW Azipod ICE1400

Propellers, Type, Dia:

Bollard Pull:

BP/B_{WL}

Prop. Power/Bwl:

Ice Performance Ahead:

Ice Performance Astern:

Other Icebreaking Characteristics:

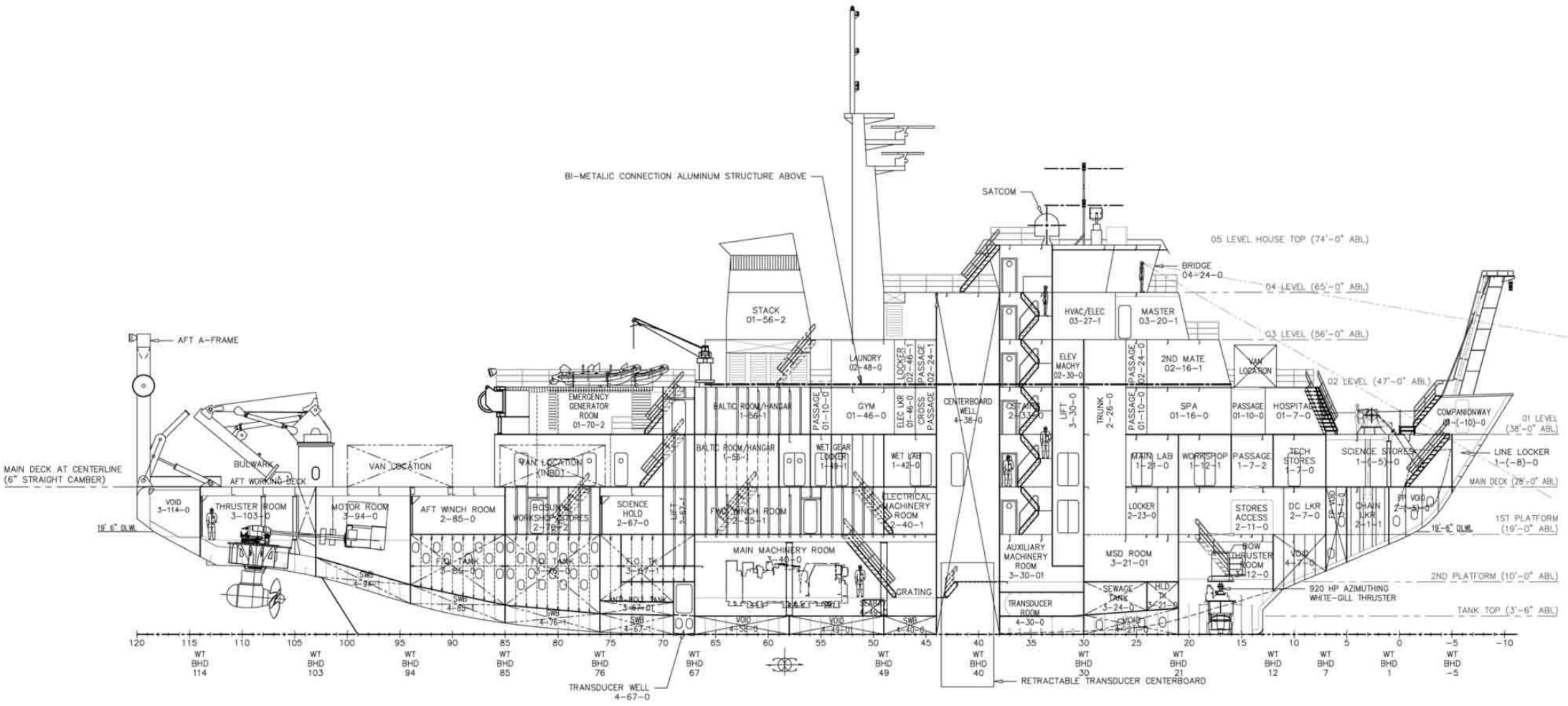
Miscellaneous: -

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**Sikuliaq**
Owner/Operator:	National Science Foundation/University of Alaska Fairbanks School of Fisheries and Ocean Sciences
Builder:	**Marinette Marine Corporation, Wisconsin**
Year of Construction:	**2014**
Contract price:	**200 US million dollars**
Ship Type:	Research vessel
Operation Area:	Alaska region
Class Notation:	
Ice Class:	
Stem Angle:	
L_{OA}	80 m
L_{PP}	
L_{WL}	72 m
B_m	16 m
B_{WL}	
H	9 m
T_{design}	5,715 m
$T_{scantling}$	
Displacement	3724 t
DWT	
Accommodation:	24 science berths, 20+2 crew berths
Open Water Speed:	14,2 kn
Main Engine Type/Power:	4 diesel engines, 4290 kW
Propulsion Type/Power:	Two Wärtsilä Icepod 2500 azimuth thrusters
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/Bwl:	
Ice Performance Ahead:	2 knots in 0,76 m ice
Ice Performance Astern:	

Other Icebreaking Characteristics:
Miscellaneous: General arrangement available

References: Alaska Region Research Vessel (AARV) Contract Specifications. 2009



INBOARD PROFILE

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**LK-25**
Owner/Operator:	FSUE Rosmorport
Builder:	OOO Baltic Shipyard
Year of Construction:	2015
Contract price:	7,25 billion RUB
Ship Type:	DAS Icebreaker
Operation Area:	
Class Notation:	KM Icebreaker 8 [2] AUT1-ICS OMBO FF"WS DYN-POS-2 EPP ANTI-ICE ECO-S HELIDECK-H WINTERIZATION (-40) Special purpose ship
Ice Class:	Icebreaker 8
Stem Angle:	
L_{OA}	142 m
L_{PP}	
L_{WL}	
B_m	29 m
B_{WL}	
H	16,2 m
T_{design}	9,5 m
$T_{scantling}$	
Displacement	22130 **t**
DWT	
Accomodation:	38 crew, 90 specialized personnel
Open Water Speed:	
Main Engine Type/Power:	
Propulsion Type/Power:	2 x Azipod 7,5 MW + one FP 10 MW = 25 MW
Propellers, Type, Dia:	
Bollard Pull:	
BP/B_{WL} :	
Prop. Power/B(~~Bwl~~):	862 kW/m
Ice Performance Ahead:	2 kn in 2 m ice+20 cm snow
Ice Performance Astern:	2 kn in 2 m ice+20 cm snow

Other Icebreaking Characteristics:

Miscellaneous: -

References: Arctic Passion News: First Aker Arctic multi-screw DAS hybrid propulsion application. March 2013. P. 12

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:	**"Aurora Slim"**
Owner/Operator:	
Builder:	
Year of Construction:	**Concept**
Contract price:	500 million euro estimate
Ship Type:	DAS Polar research icebreaker with core drilling capability
Operation Area:	
Class Notation:	
Ice Class:	Polar class 1
Stem Angle:	
L_{OA}	163,3 m
L_{PP}	
L_{WL}	152,4 m
B_m	37,4 m
B_{WL}	**37,4 m**
H	**16,15 m**
T_{design}	**11 m**
$T_{scantling}$	
Displacement	**42000 t**
DWT	**9100 t**

Accomodation:

Open Water Speed:
Main Engine Type/Power: **58,5 MW**
Propulsion Type/Power: 3 x 15 MW Azipods
Propellers, Type, Dia:

Bollard Pull: t
BP/B_{WL} : t/m
Prop. Power/Bwl:

Ice Performance Ahead:

Ice Performance Astern:

Other Icebreaking Characteristics:

Miscellaneous: -

DATA SHEET OF ICEBREAKERS SUITABLE/OF INTEREST FOR BALTIC USE WINMOS P-899, 17.2.2014/HE

SHIP NAME:

Owner/Operator: Chinese State Oceanic Administration, The Chinese Arctic and Antarctic Administration, Polar Research Institute of China

Builder:

Year of Construction: **Concept**

Contract price:

Ship Type: Icebreaking research vessel

Operation Area:

Class Notation:

Ice Class: PC3

Stem Angle:

L_{OA} 122,5 m

L_{PP}

L_{WL} 117 m

B_m 22,3 m

B_{WL}

H 11,8 m

T_{design} 8,0 m

$T_{scantling}$

Displacement

DWT

Accomodation: 90 persons

Open Water Speed: 15 kn

Main Engine Type/Power:

Propulsion Type/Power: Twin azimuthing propeller drives, 2 x 7,5 MW

Propellers, Type, Dia:

Bollard Pull:

BP/B_{WL} :

Prop. Power/Bwl:

Ice Performance Ahead: **2-3 kn in 1,5 m ice**

Ice Performance Astern:

Other Icebreaking Characteristics:

Miscellaneous: -