Two Shallow Draft Ice Breaking Supply Vessels for Caspian Sea Operations

A requirement to support year round operation of drilling platforms in the Northern Caspian Sea has produced two interesting vessels whose design is tailored to some very special needs.
Arcticaborg and Antarcticaborg were ordered from Kvaerner Masa-Yards Helsinki New Shipyard in December 1997 as Yard nos. 496 and 497. Since their delivery in November 1998 they are operated by Wagenborg Kazakhstan B.V., a company in the Dutch Wagenborg ship owning Group.

Arcticaborg (photo: Flying Focus).

These shallow draught ice breaking supply vessels serve drilling platforms operated by Agip KCO, who has taken them on long term charter.
These are unusual ships 65.1 m long and 16.4 m beam but with a loaded draught of a mere 2.9 m. They are the first full developments of the double acting ice breaker principle developed by Kvaerner Masa-Yards and perfected at the company's Arctic Technology Centre. The bow is designed for good sea keeping and open water characteristics and in light ice conditions or open water, the vessels will proceed conventionally bow first. In heavy ice conditions the ships go stern first. In this configuration they can break about 1 m thick level ice and they can also penetrate ice ridges which in this operating area are far greater than the draught of the vessels and in some cases may reach the sea bottom. An interesting feature is propulsion by two 1620 kW electric azimuthing Azipod units.
These two sister vessels carry dry cargo, fresh water, fuel oil, oil mud, cement and baryte, they also remove sewage and waste water from the rigs.
Fire fighting, rescue and pollution control capabilities have been included and there is towing and anchor handling equipment. The towing arrangements also allow them to function as assistance ice breakers if required.
Twelve cabins for crew and a total of twenty berths are provided in the forward superstructure, all of which are above main deck level to distance people from noise generated by ice breaking.
Arcticaborg and Antarcticaborg are built to Bureau Veritas rules for supply vessels with Ice Class 1A Super. After delivery their class was transferred to the Russian Maritime Register of Shipping.
Overall these vessels have had to take account both of the operating conditions in the North Caspian Sea and the physical limitations of access through the Volga-Don and Volga-Balt waterway systems. These allow vessels of up to 190 m but a beam of only 16.7 m, a maximum air draft of 12.4 m and a maximum water draft of 4 m.

The Caspian itself is noted for shallow waters often less than 5 m deep, ice formations typically up to 90 cm thick, challenging sea conditions and drifting ice can be encountered.

Engine room (photo: Gero Mylius, Indav Ltd, Finland).

There are high variations in water level and to cap it all the area is considered to be environmentally sensitive.

These vessels are each propelled by a pair of Wärtsilä NSD 6L26 engines rated at 1950 kW. These are coupled to Von Kaick generators supplying power at 690 V. Valmet powered harbour and emergency gensets are fitted of 135 kW and 130 kW respectively.

Power for propulsion is supplied through a cyclo converter system to two ABB Azipod thruster units. These have pulling propellers and synchronous electric motors in the pods. The propeller shaft axis is inclined to the horizontal to give the best propeller inflow conditions. These two steerable units are each rated at 1620 kW and are assisted by a 150 kW bow thruster.

The specification calls for the supply boats to break 60 cm of ice going ahead and 1 m plus pressure ridges astern. The bollard pull is around 32 tonnes.

The working deck is wood planked and has an area of 350 m², 580 tonnes of cargo can be carried.

Arcticaborg and sister are fully equipped for fire fighting since these vessels may be the only supply boats able to operate in the area during winter. A Kvaerner Eureka fire pump rated at 1,500 m³/h and 15 bar is driven from each main engine through a Kumera step up gear. These units supply two monitors.

The towing winch is by Ten Horn and is rated at 100 kN pull with a brake force of 800 kN. The same manufacturer supplied the 5 tonne tugger winches and the 1 m dia stern roller. Towing pins are by Karmøy, hatches from Tebul and the HMB deck crane is rated at 4 tonnes/19,5 m.

The bulk handling system for cement comprises 5 Merewido tanks totalling about 50 m³, Bergen Rørhandel supplied the oil mud system using Allweiler pumps and agitators. Two 5,8 m long waterjet driven Norsage rescue boats are carried under Vestdavit handling gear.

Icebreaking

Kvaerner Masa-Yards have long experience of ice breaker design and construction, including very shallow draught units. The Arctic Technology Centre can test promising hull forms and propulsion layouts and much research time has been used in evaluating the double acting system, especially in conjunction with Azipod units with pulling propellers.

A series of diesel electric shallow draught river icebreakers of the Kapitan Checkin class were built in the late 1970s for operation on Siberian rivers. These used three stern propellers. In 1983 eight vessels of the Kapitan Edvokimov class were built. These had four stern propellers, a cylindrical bow form and an extremely shallow draught.

The ideas used in the latest Caspian supply boats can be traced to the diesel electric river ice breaker Röthelstein built in 1995. This vessel operates on the Danube and has two Azipod thrusters, each of 560 kW. The advantages of bow propellers for icebreakers have long been recognised: they reduce friction and create a flow of water which helps the breaking process. Röthelstein introduced the idea of running bow first under normal conditions but attacking the ice stern first with the Azipods pulling the vessel in severe ice conditions. One advantage is that power required to break a given thickness of ice is greatly reduced when operating in this mode.

The 16.000 dwt tanker Lunni was converted to Azipod drive in 1995 and has also been used in stern first tests in heavy ice. Although the vessel was not primarily designed for this mode it was able to operate in the toughest conditions found in Finnish waters without icebreaker assistance and the power requirement was about 60% of that needed when attacking ice bow first.

Azipod units have proved well able to cope with ice, including breaking thick pressure ridges. So the technical risks of fitting these units to Arcticaborg and Antarcticaborg were not seen as high.

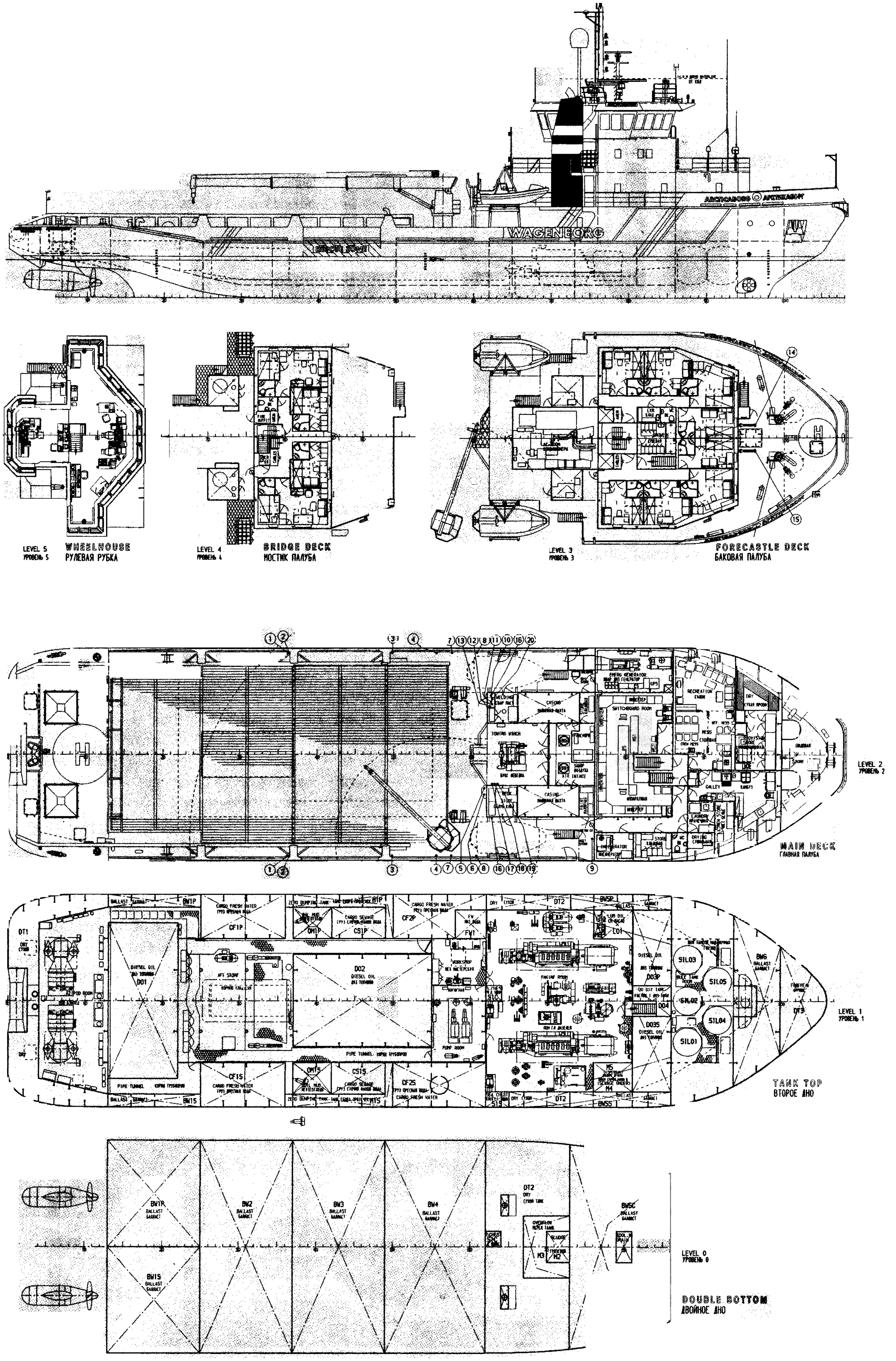
For many decades, experience with the old Sampo with a bow propeller already in 1898 showed that thanks to a reduction in resistance, more power was available in the bow propellers.

Against this background, a pod driven ship was expected to offer very good performance when running astern in ice. Full scale tests in ice on the Nemarc tankers bore this out, and showed a potential to cut ice resistance by as much as 50% when running astern. The astonishing performance of the Lunni in severe ice conditions clearly showed that it was possible, and even desirable from performance point of view, to design a pod drive ship to run astern on a regular basis.

Revolutionary mode of operation

Traditionally, all ships, and particularly con-

Azipod thruster (photo: Gero Mylius, Indav Ltd, Finland)


WAGENBORG
LEVEL 5
УРОВЕНЬ 5
WHEELHOUSE
РУЛЕВАЯ РУБКА
LEVEL 4
УРОВЕНЬ 4
BRIDGE DECK
МОСТИК ПАЛУБА
LEVEL 3
УРОВЕНЬ 3
FORECASTLE DECK
БАКОВАЯ ПАЛУБА
LEVEL 2
УРОВЕНЬ 2
MAIN DECK
ГЛАВНАЯ ПАЛУБА
LEVEL 1
УРОВЕНЬ 1
TANK TOP
ВТОРОЕ ДНО
LEVEL 0
УРОВЕНЬ 0
DOUBLE BOTTOM
ДВОЙНОЕ ДНО

The bridge (photo: Gero Mylius, Indav Ltd, Finland).

ventional Arctic Ships intended for independent operation, are a sum of compromises. When designing a bow, the designer has always to balance the needs of open water and ice operation requirements.

If the focus is on good icebreaking capability, the result will inevitably be poor open water performance and bad seakeeping properties, and vice versa.

The emergence of the pod drives has changed all that. A full rotating pod gives the designer a unique possibility to design the bow of his ship to be good in open water, and the stern to break the ice. The result: a 'double-acting' ship.

The bow design of a double acting (DAT) vessel concept incorporates experience built up with conventional vessels, and is an efficient, ice-strengthened open water bow. This gives an open water performance that is some 10 - 15% better than that of a conventional icebreaking bow.

The stern of the vessel is designed to break the ice. Utilising the full potential of the bow propeller effect, the vessel can attain the required icebreaking capability using only between 40% and 60% of the power required by the best conventional icebreaking hull forms.

In a DAT design, the mode of operation is completely different from normal penetration based on ramming. A DAT vessel enters a ridge field at slow or moderate speed, and lets its pulling propeller chew up the ridge and slowly pull the vessels through.

Less engine power - lower cost

Due to the high icebreaking performance of the DAT concept, costs are much lower than those of conventional designs.

This is mainly due to the need for less engine power. The ice model tests with the Fortum 106.000 tdw tankers showed a need of only 25% of the power which was used for similar performance by the 100.000 tdw test vessel T/T Manhattan when sailing two times through the North West passage to Prudhoe Bay in 1969 and 1970. The flexibility of the machinery also offers a number of benefits. Operating costs will be lower as the efficiency of a DAT vessel in open water is higher than that of a conventional design.

The first icebreaker based in the double acting principle was built in Helsinki in 1995 for service on the Danube in Austria. This tiny icebreaker Röthelstein, with only a 2-meter draught, is operated by a crew of three people and if fitted with twin 560kw Azipod units.

The first two icebreaking supply vessels for the Caspian Sea incorporating the double-acting concept were delivered in 1998 by Kvaerner Masa-Yards Helsinki Shipyard and have now shown successful operation. Named Arcticaborg and Antarcticaborg, these two vessels, operated by the Royal Wagenborg Group of the Netherlands, work for Agip KCO and feature twin propeller units totalling only 3 MW. This gives the master the capability of navigating in ice of up to one meter in thickness in continuos mode, and of reaching a platform stern first through bottom-fast ice formations around a drilling platform, a performance never experienced before in the maritime history.,

Technical data:

Length between perpendiculars	57.68 m
Length over all	65.1 m
Breadth over all	16.6 m
Breadth moulded	16.4 m
Depth moulded	4.4 m
Draught Max (summer)	2.9 m
Gross tonnage	1453 GT
Displacement at max draught	2093 t
Deadweight	650 t
Service speed	13 kn
Service speed in 60 cm ice	3 kn
Bollard pull	32 t

Accommodation:

Crew 11 persons

Loading Capacity:

Fuel cargo tanks	363 m^3
Liquid Mud tanks	48 m^3
Bulk (cement/baryte)	51 m^3
Fresh water	278 m^3
Cargo sewage	67 m^3
Deck cargo space	350 m^2

Nautical Equipment:

1 x GMDSS radio system
2 x Radar system
1 x COSPAS SARSAT EPIRB
1x wind speed and direction indicator system
1 x gyro-compass system
2 x GPS-receivers
2 x SAT-COM C system
2 x SAT-COM B system
1 x echo sounder system
1 x SONAR

Diesel electric propelling machinery:

2 x Wärtsilä NSD diesel engine, type 6L26, 1950 k
2 x Azipod propeller 1620 kW

Auxiliaries:

Diesel generators, each 100 kVA/ 400 V
Emergency diesel generator, 100 kVA/400 V

Classification:

Bureau Veritas (CP) I 3/3 E Supply Vessel, Fire Fighting 1 deep sea, MACH, Aut-MS, Ice Class 1 A Supe (Finnish-Swedish).
Re-classed Russian Maritime Register of Shipping