Baltika excels in Arctic ice trials

The world's first oblique icebreaker surpassed all expectations when she was tested in ice in March–April 2015. Although Baltika was designed to operate primarily in the Gulf of Finland, she was taken to the Gulf of Ob, where the ice conditions are more challenging than in the Baltic Sea, for ice trials.

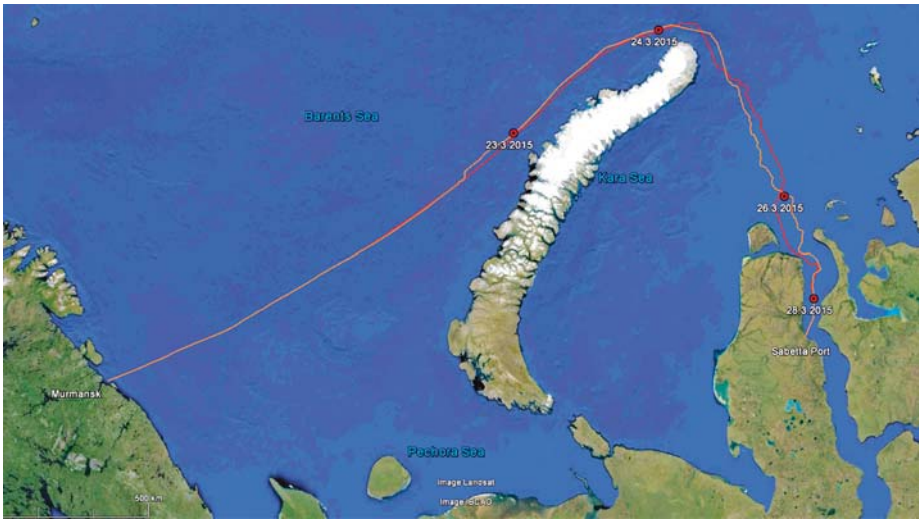
Baltika surpassed all design criteria, even though the ice was stronger than typical sea ice. The oblique mode, which had never been tested before in real life, also worked extremely well and the vessel fulfilled all the design requirements.

Baltika's maiden voyage began at her home port, St. Petersburg, on 6 March 2015. While on her way to Murmansk off the coast of Norway, the vessel encountered rough seas and winds up to 30 m/s. The seakeeping characteristics of the oblique icebreaker were good, and the owner was convinced that *Baltika* is able to take part in rescue operations even in harsh weather.

Ice trials

"We departed for the ice trials from Murmansk on 20 March 2015 and sailed around the northern tip of Novaya Zemlya to the Gulf of Ob and close to the Sabetta terminal area," project manager Mika Hovilainen says. "Our purpose was firstly to demonstrate the vessel's abilities during the worst part of the year, and secondly to perform official ice trials."

The Aker Arctic team consisted of Mika Hovilainen, research engineer Teemu Heinonen, and project engineers Esko Huttunen and Tuomas Romu. In addition, there were representatives from the builders, Arctech Helsinki Shipyard and Yantar Shipyard JSC, as well as from the ship owner.



Ice trials were conducted in the Gulf of Ob during the worst winter conditions. The voyage took three weeks in total.

The testing programme consisted of performance tests in three ice thicknesses in ahead and astern directions as well as in the oblique mode. Various operational tests were also carried out in order to determine the manoeuvrability and operational capability of the vessel.

The thickness and strength of the ice was measured in the areas where tests were carried out using both temperature and salinity profiles as well as beam tests. An automatic measurement system was set up to record ice loads on the ship's hull throughout the three-week voyage, which concluded in Murmansk on 10 April 2015.

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Teemu and Esko are measuring temperature and salinity profiles from core samples in order to determine the flexural strength of the ice.

Temperature was about -10 degrees Celsius.

Mika Hovilainen measuring the ice thickness.

"We tested the vessel in level ice 40 cm, 90 cm and 1.2 metres thick. She surpassed the required performance targets by a great margin in both ahead and astern directions, even though the ice strength properties were double the specified ones," Mr Hovilainen emphasises.

In addition to ice measurements, the Aker Arctic team used a remotely operated quadcopter to record unique video footage of *Baltika*'s journey as well as to look for passages through particularly difficult ice fields. The quadcopter allowed the team to get an overview of the ice conditions ahead of the vessel from an altitude of 500 metres.
The video footage can be found at https://www.youtube.com/user/akerarctic

Oblique mode in real life

The oblique mode, which had never been tested before in real life, also worked extremely well and the vessel fulfilled all the design requirements. By moving sideways, the relatively small oblique icebreaker could create a wide channel in ice.

"We tested the oblique icebreaking first in ice 10 to 15 cm thick in order to learn how the navigation system works and how the vessel behaves," Mr Hovilainen explains. "Navis Engineering Oy has created a special joystick function to use with the Dynamic Positioning (DP) system for this purpose. The oblique angle and speed are entered into the computer and then the DP system takes care of maintaining the heading. While the joystick function worked really well, we also tried navigating manually but it was challenging without any practice.

Thus, a DP system is essential for oblique icebreaking."

In ice 40 cm thick, the vessel was capable of achieving a speed of two knots when the angle of attack – the difference between course and heading – was 85 degrees. In ice 90 cm thick, a small oblique angle of about 15 degrees was still possible.

"The angle can be selected individually; there are no pre-set choices," Mr Hovilainen adds. "With a smaller angle of attack, the channel width is reduced but the vessel speed increases – and vice versa."

Rubble clearing and ice management performance were also tested in the port of Sabetta. *Baltika* demonstrated excellent manoeuvrability and capability in both tasks.

Half the propulsion power

According to Mika Hovilainen, *Baltika*'s voyage to the Gulf of Ob proves the exceptional operational capability of the oblique icebreaker concept in very difficult ice conditions.

"The vessel was able to operate in ice conditions that exceeded the design criteria used as the basis of the vessel concept. *Baltika* carried out the same operations as conventional icebreakers with just half of the propulsion power, as well as performed manoeuvres that are not possible for any other vessel currently in service."

"This is a big step in the direction we want to go: more efficient icebreaking operations that use less fuel and produce reduced emissions, thus taking the environment into consideration. This concept proves that we have succeeded in reaching a new level of icebreaking efficiency," Mr Hovilainen says.

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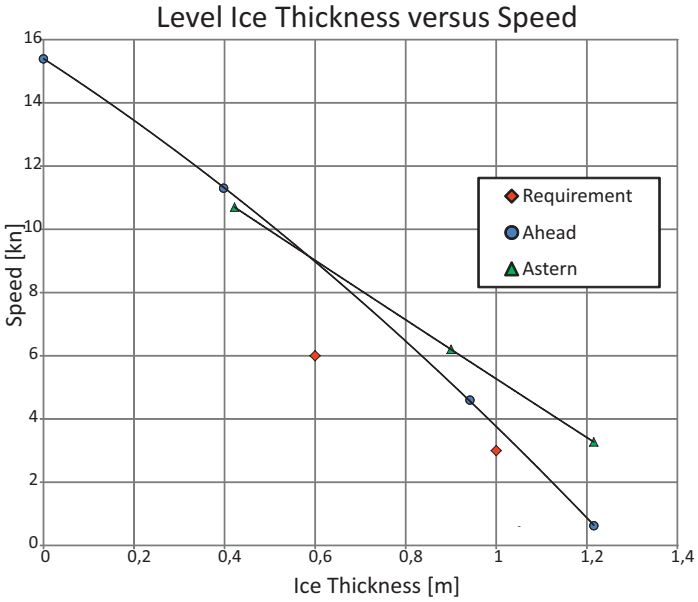
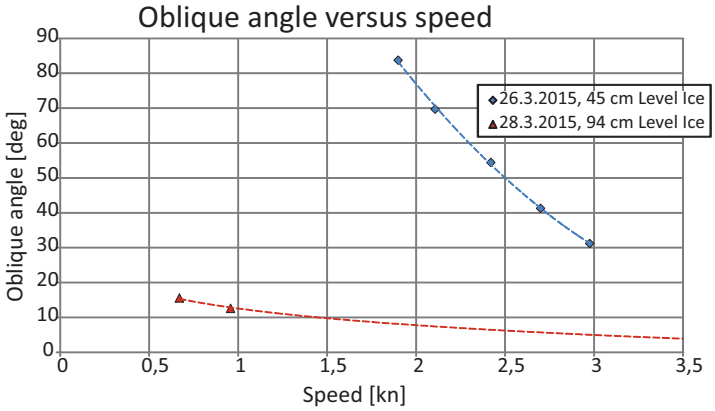


Baltika was tested in level ice 40 cm, 90 cm and 1.2 metres thick. She surpassed the demands in both ahead and astern directions.

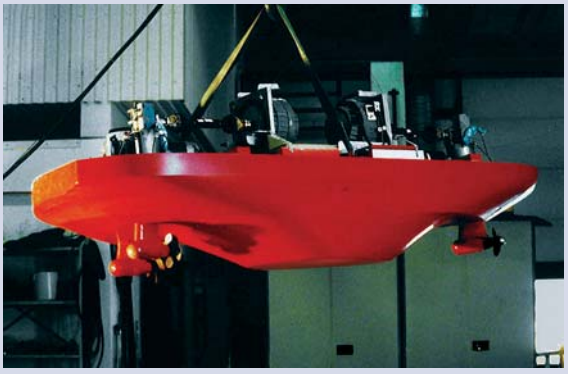


The oblique angle can be chosen individually; there are no pre-set choices. The vessel moves more slowly with a wide angle in order to create a wide channel.

Oblique icebreaker began with an innovation contest

The oblique icebreaker concept was the result of an internal innovation contest in the late 1990s. New oil terminals were planned for the Gulf of Finland, and an analysis was conducted of how the transport situation in the Baltic Sea would develop. The conclusion was that Aframax-sized tankers with a beam of more than 40 metres would be used for transporting oil, escorted by at least two icebreakers due to their large size unless other solutions could be found.

The innovation contest resulted in the first version of the sideways-moving icebreaker.



The first model was constructed in 1997.

By moving sideways, the icebreaker can create a wide channel for big tankers. The first model tests were carried out in 1997 and the invention was patented. The decision to build the Primorsk oil terminal was made in 1999, and later that year the oblique icebreaker's hull was updated and ice model tests continued. Then came the idea to use the ship to help in recovering spilled oil, and the oil spill response patent was received in 2002.

Systematic further development took place jointly with the Finnish Maritime Administration, the Finnish Environment Institute (SYKE), ABB and Aker Arctic, partly funded by Tekes, the Finnish Funding Agency for Innovation.

Decision to construct

In 2003, the newly developed project was introduced to the authorities in Finland and Russia. The vessel received widespread attention due to the exceptional concept, but it was not realised until 2010, when Sovcomflot's CEO Sergey Frank finally made the initiative for a memorandum of cooperation on the further development of the oblique icebreaker vessel.

However, the Russian Ministry of Transport became the contractor of the ship, and in October 2011 Arctech Helsinki Shipyard and Yantar JSC were jointly awarded the contract to build the first oblique icebreaker based on Aker Arctic's design, Aker ARC 100. The new oblique icebreaker was designed as an icebreaker for the Baltic Sea and especially for assisting large vessels in icy harbours.

Yantar JSC manufactured the hull blocks, which were then transported to Helsinki where the vessel was assembled. The world's first oblique icebreaker was ready in May 2014. Prior to delivery, she was tested in extreme conditions including waves three metres high in the Gulf of Finland. The open water testing exceeded expectations.

Last winter, full-scale ice trials were conducted in the Arctic. *Baltika* surpassed all design criteria, even though the ice was stronger than typical sea ice. The oblique mode, which had never been tested before in real life, also worked extremely well and the vessel fulfilled all the design requirements.

Aker ARC 130 A, the new icebreaker design for the Novy Port project, does not have an asymmetric hull form, but otherwise shares a number of features with a heavy-duty oblique icebreaker Aker Arctic is currently developing. The heavy-duty oblique icebreaker, Aker ARC 100 HD, will be updated based on experiences from *Baltika*'s full-scale ice trials as well as from the icebreaker concept for the Novy Port project.

Technical specifications

Built by Arctech Helsinki Shipyard (Helsinki, Finland) in co-operation with Shipyard Yantar JSC (Kaliningrad, Russia)

Based on Aker Arctic's oblique icebreaker design, Aker ARC 100.

Length: 76.4 metres
Beam: 20.5 metres
Draft: 6.3 metres

Diesel-electric power plant consisting of three Wärtsilä 9L26 generating sets with a combined output of 9 MW

Three 2.5 MW Steerprop SP60PULL azimuth thrusters, two in the stern and one in the bow

Dynamic positioning system developed by Navis Engineering

Classification by the Russian Maritime Register of Shipping with ice class Icebreaker6

Built-in oil recovery system

Owner: Federal Agency for Maritime and River Transport of Russia (Rosmorrechflot)

Operator: Russian Marine Emergency Rescue Service (FGI Gosmorspassluzhba).

Aker Arctic has acquired a remotely operated quadcopter that can be used for aerial recording. Unique video footage of the oblique icebreaker Baltika's ice trials in the Arctic can be seen at https://www.youtube.com/user/akerarctic

Project Manager Mika Hovilainen

Mika Hovilainen is the chief designer of *Baltika*. He has been involved in the design since 2010, when the project for Sovcomflot started with Arctech Helsinki Shipyard to build the first oblique icebreaker.

Mika has worked at Aker Arctic since 2006, when he transferred from Helsinki Shipyard. He is an expert in special ship design projects, such as the oblique icebreaker *Baltika,* the *Mangystau* series of shallow-draft icebreaking tugs, the Finnish LNG-fuelled icebreaker, the polar class heavy deck carriers for Yamal, the Sabetta port fleet and the powerful Aker ARC 130 A icebreaker for Novy Port. In addition to working, Mika likes to spend time with his family. He enjoys skiing in winter as well as biking and fishing in summer.