Aker Arctic Technology Inc Newsletter

Arctic Passion News

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Announcements

Heikki Juvani has joined Aker Arctic as a project engineer and will be working on hull modelling and deck outfitting. He has a B.Sc. in machine & production technology, as well as a specialist qualification in product development. Heikki previously worked for the Finnish company Sunborn Marine in Malaysia.

Cayetana Ruiz de Almirón de Andrés has joined Aker Arctic as a project engineer in the Offshore department. She comes from Granada in Spain, where she graduated as a roads, channels and ports engineer. In 2011, she completed her master's degree in integral management of ports and coastal zones at the University of Granada.

Time to expand

Last January, we celebrated ten years as the independent company Aker Arctic. The company has been strongly established on Finnish knowhow in icebreaking and ice technology, and we have been working from our Helsinki and Turku locations. Now the time has come for the company to grow, not only in size but also in terms of broadening our knowhow base.

At the end of May, we were able conclude the acquisition of the Canadian ice expertise company Akac Inc. Akac has been the world's leading consultancy development company in its specialised field: solutions for arctic offshore operations and ice management. Its roots and operational expertise are based mainly on the Canadian Arctic, combined with unique work in early production operations in the Sakhalin area. Secondly, we have always had good client relations with Russian organisations and long-term experience of projects in Russia. We have now made the decision to open our own representative office in Moscow.

Both of these new locations will enable us to provide better services closer to our important clients, and to follow our strong principle of working in close cooperation with our clients. We believe this is the best way to utilise our knowhow in order to improve arctic operations and different types of icebreaking vessels.

Recently, the world economy has been experiencing rapid changes in many areas, not least in the areas of shipbuilding and offshore development. Despite that, the development in the icy seas continues. France is not widely known as one of the big countries in polar shipping, but they also have an icebreaker, and now they intend to build another. It was a good opening when Chantiers Piriou shipyard concluded an agreement to design the new polar logistics vessel for the French national organisations with us. This vessel will be delivering supplies to the French bases in 2018.

In March, the revolutionary oblique icebreaker undertook its first real icebreaking operations in the Arctic, when ice trials were carried out. These tests were followed with a lot of interest, and also with some nervousness regarding how she would actually perform. To everyone's satisfaction – and the engineers' relief – the icebreaker actually did much better than expected. This vessel is unique, and we expect it to open up improved possibilities for many kinds of arctic operations.

You can read more about all of these news stories and others in this issue, and do feel free to contact us with any feedback or for any additional information that may help you in your activities.

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Basic design agreement for French polar logistics vessel

Aker Arctic and Chantiers Piriou have signed a contract for the basic design for a polar logistics vessel, which will be constructed at the shipyard in Concarneau, France. Aker Arctic will also provide technical support to the shipyard during the construction of the vessel in Concarneau, France

The new polar logistics vessel will be jointly owned and operated by the French Southern and Antarctic Lands (Terres australes et antarctiques françaises, TAAF) administration, the French Polar Institute (Institut Polaire Francais Paul-Émile Victor, IPEV) and the French Navy. The new vessel will replace the existing patrol vessel L'Albatros and the polar logistics vessel L'Astrolabe.

Supplies to Antarctica

The new vessel will be 72 metres long overall and have a beam of 16 metres. The vessel, which will act as both a logistics ship and a patrol icebreaker, can accommodate up to 60 persons on board, carry 1,200 tonnes of cargo and accommodate one helicopter. It will also have nominal research features.

The new Polar Logistics Vessel will be built by Chantiers Piriou in Concerneau, France, and delivered in early summer 2017. It will be deployed to the Indian Ocean in autumn 2017 and carry out the first supply mission to the Dumont d'Urville Station in Adélie Land, Antarctica, in winter 2018.

The Polar Logistics Vessel is based on a concept developed by Marine Assistance (France). Aker Arctic assisted the shipyard in performance calculations prior to receiving the order and now the icebreaking capability will be verified by model tests at Aker Arctic's ice model basin in Helsinki, Finland. During basic design, Aker Arctic will be responsible for developing the hull form, open water performance, performance in ice, machinery and winterisation.

Aker Arctic will support the shipyard during the design and construction of the vessel in the special requirements of building an ice-going vessel. Fourteen weeks of on-site engineering support in Concarneau, France, is included in the contract.

National content fulfilled

"A typical requirement in governmental projects is to use local contractors as much as possible," says sales manager Arto Uuskallio from Aker Arctic. "By offering our technical support during design and construction, a vessel can be built at a local shipyard that does not necessarily have previous knowledge of ice-going vessels."

"Based on our experience of various shipbuilding projects, the most important decisions are made in the early phases of the project. Thus, it would be beneficial for the success of the project to have experienced designers involved from the beginning to get the design moving in the right direction right away. Corrections can also be made at a later stage, but they are more laborious and require more time, increasing the total cost. When we start designing a vessel, we look at the basic facts first: What are the requirements, what will the vessel be used for and what performance is expected? Then we look at the size of the vessel and from there we can give a rough estimate of the construction price. If we are approached when the budget is already fixed, there might be disappointing compromises ahead," Mr Uuskallio emphasises.

Port icebreaker ordered for Sabetta

Model tests, including tests in thick brash ice were carried out at Aker Arctic's ice tank. The testing was concluded in July 2015.

Aker Arctic and FSUE Atomflot have signed an agreement with Vyborg Shipyard JSC to construct an Aker ARC 124 port icebreaker to support LNG carriers' operability in the approach channel to the Sabetta harbour and in the terminal of Sabetta.

The harbour icebreaker concept was developed in cooperation with JSC Yamal LNG and FSUE Atomflot in order to meet operational demands. As the vessel is intended to work inside the harbour area, it is a relatively small vessel, able to assist large tankers in turning and berthing.

This is a completely new concept with an exceptional hull form and a propulsion system with four azimuth thrusters: two in the bow and two in the stern. Manoeuvrability and operability are therefore excellent.

"The harbour icebreaker is a totally new concept especially developed for heavy harbour ice conditions with extensive thick brash ice," says chief designer Mika Hovilainen. "Some features are similar to the oblique icebreaker and the new icebreaker for the Finnish government, but in this one operability and harbour ice management capability have been taken one step further."

The brash ice layer is estimated to grow to a thickness of up to four metres in Sabetta harbour. This requires a special kind of vessel to assist tankers in turning and berthing. The harbour icebreaker has been designed to proceed at a speed of two knots in level ice 1.5 m thick and at four knots in 5 m thick brash ice in limited water depth.

"The technical demands have been challenging, but with our persistent development work we have been able to solve them," managing director Reko-Antti Suojanen adds.

Ice model testing was conducted in July. We are now finalising the concept design and have made a basic design agreement with Vyborg Shipyard JSC to begin construction in 2016.

Aker ARC 124 main dimensions

Length	89.5 m
Beam	21.9 m
Draught	6.5 m
Deadweight	750 tonnes
Open water speed	15 knots
Bollard pull	115 tonnes
Propulsion power	12 MW
Ice class	RMRS Icebreaker7

Akac acquisition strengthens offshore knowhow

SEIC oil production in spring 2007.

Aker Arctic acquired the Canada-based company Akac Inc. in June 2015. Akac specialises in tailored solutions for offshore operations in ice conditions and complements Aker Arctic's icebreaker and offshore design expertise.

The founder of Akac Inc., Mr Arno Keinonen, is originally from Finland and began his career at Wärtsilä Ice Model Basin. He founded Akac in 1984, after having been in charge of arctic R&D for Dome Petroleum, the oil company that started the arctic offshore work.
"Our approach from the beginning was to gain a full understanding of an arctic offshore operation, and this has been the foundation of almost everything we have done during the 31 years of our existence," Mr Keinonen says.

Arctic understanding

The inside understanding of arctic offshore operations and their pioneering nature is the most fundamental and unique contribution Akac has systematically brought to its clients, a result of having been so centrally involved in a wide range of operational projects.

Due to its extensive experience and strong analytical support, Akac is able to directly benefit client projects by confidently providing ways to optimally and safely apply an existing ship or combination of ships to any operational project in ice. This is particularly the case for challenging arctic offshore operations.

"Akac was, for instance, in charge of developing and managing the ice risk of the only arctic offshore oil production project in the world that used a floater as part of the oil production and export system. Phase 1 of the Sakhalin-2 project lasted eight years (1999–2007) and used a SALM buoy and FSO off the coast of Sakhalin," Mr Keinonen continues.

Background in operations

Akac complements Aker Arctic's expertise by bringing direct hands-on offshore experience. Some of the key services provided are to develop full risk management for arctic offshore operations, as well as to train people in safety in arctic offshore operations, including ice management and station-keeping.
The newly appointed president, Evan Martin, is confident that the combination of the expertise of Aker Arctic and Akac's practical approach and unique operational expertise in the arctic offshore industry will benefit customers.

"What separates Akac from most others is our strong background in operations. The ability to integrate real-life operational practices into engineering design and planning allows us to best serve our clients, and now together with Aker Arctic," Mr Martin says.

"We look forward to providing our clients with a full range of ice-related engineering services, including conceptual and engineering design, model testing, operational planning, field trials, and operational support and training."

Akac will continue operations in both their Canadian locations under the management of newly appointed company president, Mr Evan Martin. Akac's previous owner and founder, Dr Arno Keinonen, will remain in the company and provide his valuable knowhow through his role as senior advisor.

►

Key projects

Arctic Coring Expedition

ACEX was a venture by the International Ocean Drilling Program to extract core samples from the Lomonosov Ridge. The expedition took place in 2004 in water about 1.2 km deep. The operation used the icebreaker *Vidar Viking* as a drillship, supported by icebreakers *Sovetskiy Soyuz* and *Oden*. This operation was a unique challenge due to the constant motion of the polar ice pack.

Akac had the rare opportunity to be part of performing this ocean floor coring operation – the first of its kind. The successful operation demonstrated that station-keeping in thick moving ice could be successfully performed.

Arctic Coring Expedition in 2004. Icebreakers Vidar Viking, Sovetskiy Soyuz. Photo taken from the Icebreaker Oden.

Stena IceMAX

A recent project has been assisting Stena in establishing the station-keeping limits of the Stena IceMAX.
"Akac's operational experience allowed for the development of ice model testing procedures for DP platforms that better represent the managed ice conditions and operational procedures," Mr Martin says.

The work involved multiple series of model tests, each further refining the scaled environmental conditions and behaviour of the DP system. Akac's role was to assist in model test planning and to analyse the data in a manner that is consistent with how the platform would be operated during actual operations.

Documentation of Unforeseen Events

Akac's operational experience was used to document a large number of events and sequences of events that all have the potential to be unforeseen to new operators in ice conditions. The events, and their possible solutions, will serve to educate clients about potential challenges. It will also allow them to begin to develop operational risk management systems that will permit operations to continue safely despite the potential for unforeseen events.

CSO Constructor – DP in Ice

The *CSO Constructor* was used to construct the subsea infrastructure required for Phase 1 of the Sakhalin-2 project. It was the first ever dynamically positioned vessel to operate in ice. Akac was responsible for selecting the construction vessel, providing ice management support, and training the operators of the *CSO Constructor*, who never had operated in ice before.

Icebreaker Smit Sakhalin cutting ice for CSO Constructor.

Sakhalin-2, Phase 1

Beginning in 1999, Sakhalin Energy contracted Akac to help them to take advantage of the transition periods, from fully operable open water to non-operable ice covered conditions, at each end of the oil production season. Akac's initial involvement was to upgrade the design of the SALM buoy and FSO for ice performance and ice class designation. Once production started, AKAC developed and managed an ice management system that would ensure that the oil production operations could take place safely and efficiently when ice was present.

Akac performed ice management services for Sakhalin Energy for sixteen of the fall shutdown and spring start-up sessions from 1999 to 2007, and was responsible for a ten-person ice management team. A total of 15 different icebreakers were used as ice management vessels in support of this operation. Akac also conducted training programs for the crew of all key production and ice management team members, to familiarise them with ice and ice risk management, station-keeping in ice, and associated planning and operational decision-making.

Photo left: Mike Neville driving the Svitzer Sakhalin terminal tug in Spring 2007.

Photo right: Arno Keinonen and Mike Neville awaiting trasfer to FSO Okha in Sakhalin in Fall 2006.

Cooperation on Arctic project Novy Port

Novy Port terminal, currently under construction at Cape Kamenny in the southern Gulf of Ob, will be used to export oil from the Novoportovskoye oil and gas field. Aker Arctic has been involved in developing the transport solutions for the oil shipments, including icebreakers to secure safe operations.

The oil terminal, owned by Gazprom Neft Novy Port LLC, is located near the settlement of Novy Port, some 400 km south of Sabetta, where Aker Arctic is involved in the harbour project as well as the development of double-acting LNG carriers and the port icebreaker fleet. The area is characterised by shallow waters and harsh winters during which the ice cover can grow up to two metres thick and remain in place for nine months.

Small-scale oil drilling began in Novy Port in 2012 and indicated that the high-quality oil has low sulphur levels. The plan is to increase the production to 5.5 million tonnes per year. Full-scale production should be ready to begin by 2017.

In order to transport the oil to market, a loading terminal, oil tankers and icebreakers need to be constructed. The loading terminal will be a tower solution in the middle of Gulf of Ob, where tankers will attach for loading. Samsung Heavy Industries will construct the six tankers for the oil shipments. We have assisted Samsung Heavy Industries in developing the hull form and have conducted an extensive series of model tests for the tankers.

We have also developed a new powerful icebreaker design, Aker ARC 130 A, to support operations in the Novy Port oil terminal.

"The icebreaker is a new design, which we believe could become a popular new polar-class icebreaker for arctic projects," managing director Reko-Antti Suojanen says. "One of the new features is an azimuthing bow thruster."

"Our extensive know-how in ice technology has been useful in both the tanker development and icebreakers. We were happy to develop the concept together with experts from Gazprom Neft," explains Mr Suojanen.

Two powerful icebreakers

The challenging ice conditions in Novy Port combined with shallow waters need to be managed. Therefore, we have developed a new powerful icebreaker design, Aker ARC 130 A, to support operations in the terminal.

The icebreaker represents a further development of the Aker ARC 130 concept, which was originally developed for the Finnish Transport Agency and is currently under construction at Arctech Helsinki Shipyard. In April 2015, Gazprom Neft Novy Port LLC ordered two vessels based on the new design from Vyborg Shipyard JSC.

Comparable to Taymyr and Vaygach

Project manager Mika Hovilainen highlights that the new icebreakers are comparable to well-known nuclear-powered icebreakers *Taymyr* and *Vaygach* in terms of icebreaking capability, but require about 40% less propulsion power.

"The new icebreakers are capable of breaking level ice two metres thick with 30 cm snow cover both ahead and astern," Mr Hovilainen says.

The tanker traffic will become intense once the oil terminal is completed, resulting in a large amount of brash ice. The consolidated brash ice cover is estimated to grow to a thickness of up to seven metres, in an area where the water depth can be as little as ten metres. The new icebreakers are designed to operate in these challenging conditions. Their manoeuvrability, which is considered an important safety factor when operating in close proximity to oil tankers, is also exceptionally good for such large vessels.

High ice class

The propulsion system consists of three azimuth thrusters: two in the stern and one in the bow of the vessel. This propulsion layout is considered to be particularly suitable for difficult ice conditions such as thick brash ice and ice ridges. Compared to the Baltic escort icebreaker designed for the Finnish Transport Agency, the new vessels are adapted for operation in the arctic, with increased propulsion power and a higher ice class. The hull form has also been optimised to break thick level ice, which is not found in the Baltic Sea.

Nuclear-powered icebreaker Vaygach escorting Pavel Vavilov from the port of Sabetta on April 3, 2015. Aker ARC 130 A is designed to operate in the same region where powerful shallow draft icebreakers are needed.

Low resistance in ice and open water will result in improved fuel economy and reduced environmental footprint.

"Based on the extensive ice and open water model testing, the new icebreaker design will meet all operational requirements," Mr Hovilainen says.

Unlike the Finnish icebreaker, which is the first icebreaker to use liquefied natural gas (LNG) as fuel, the icebreaking vessels operating in the Gulf of Ob will not use LNG because there is no possibility for bunkering natural gas near the Novy Port oil terminal.

The technical design work is currently in its final stages, and construction should begin in autumn 2015. Aker Arctic will support Vyborg Shipyard during the construction of the two vessels, which are planned to be ready for delivery in autumn 2017.

Aker ARC 130 A technical specifications:

Length:	122 m
Beam:	25 m
Design draft:	8 m
Deadweight:	2400 tons
Open water speed:	16 knots
Bollard pull:	200 tons
Propulsion power:	21.5 MW
Ice class:	RMRS Icebreaker8

Model tests for oil tankers

Preparing to test breaking out from the ice channel. Pictured are Mr Riku Kiili from Aker Arctic and Mr Seung Hyun Lee from Samsung Heavy Industries.

Six double-acting oil tankers have been ordered from Samsung Heavy Industries to transport oil year-round from Novy Port to Murmansk and other destinations along the Northern Sea Route.

The hull form was developed in cooperation with Aker Arctic in addition to five weeks of model tests.

Aker Arctic conducted an extensive series of model tests lasting nearly five weeks for the Novy Port tankers in autumn 2014. Two alternative designs were tested in order to choose the more suitable one for the working conditions in the Novy Port area.

"During the first testing period, we carried out all the basic performance tests to compare the designs and to make sure that they fulfilled the requirements set by Gazprom Neft," project manager Riku Kiili says. "All performance requirements were met."

"The next testing period focused more on testing operational performance, such as breaking out from the channel, performance in a narrow channel and ice ridge tests. One key function was to see if the tankers could follow the narrow, curved channel an icebreaker had made. Gazprom Neft wished to have extensive operational testing in addition to testing of the contract performance."

Representatives from Samsung Heavy Industries, Gazprom Neft and CNIIMF followed the tests and were actively involved in testing and evaluating the results.

The tests went well and the customers were pleased with the cooperation work and Aker Arctic's support.

The first of the six tankers being built in Korea will be ready in 2016, and all of them will be delivered by May 2017.

The tankers will be ARC7 ice class vessels and they will be used to transport crude oil from the Novy Port oilfield near Russia's Yamal peninsula to the ice-free Murmansk harbour. The 42,000 DWT icebreaking tankers will be 249 metres long and 34 metres wide.

The tankers are designed to break ice 1.4 metres thick at a speed of 3.5 knots and to withstand temperatures of minus 45 degrees Celsius.

They are double-acting ships with two 11 MW Azipod units in the stern.

In 2007, Samsung Heavy Industries delivered the first double-acting icebreaking oil tanker to Russia's Sovcomflot, followed by two additional tankers. Aker Arctic developed the concept design for these tankers.

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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.

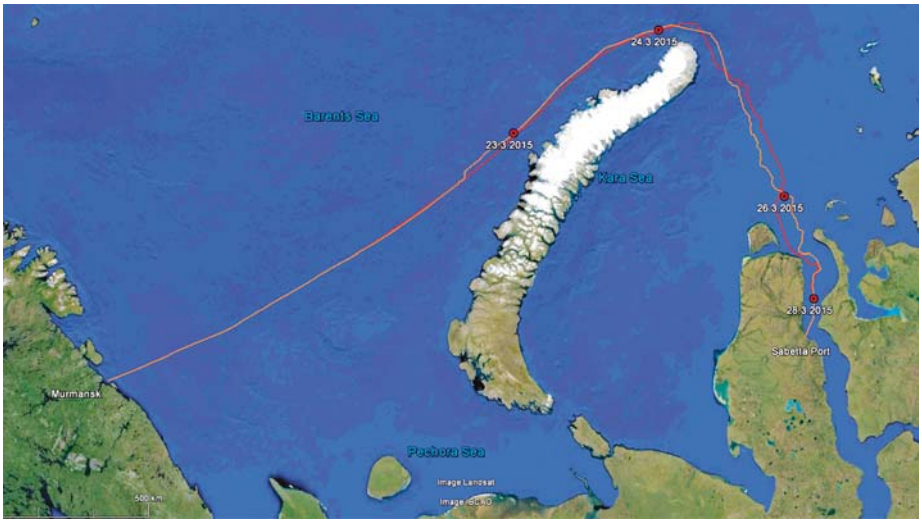
Baltika surpassed all design criteria, even though the ice was stronger than typical sea ice. The oblique mode, which had never been tested before in real life, also worked extremely well and the vessel fulfilled all the design requirements.

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.

The testing programme consisted of performance tests in three ice thicknesses in ahead and astern directions as well as in the oblique mode.

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.

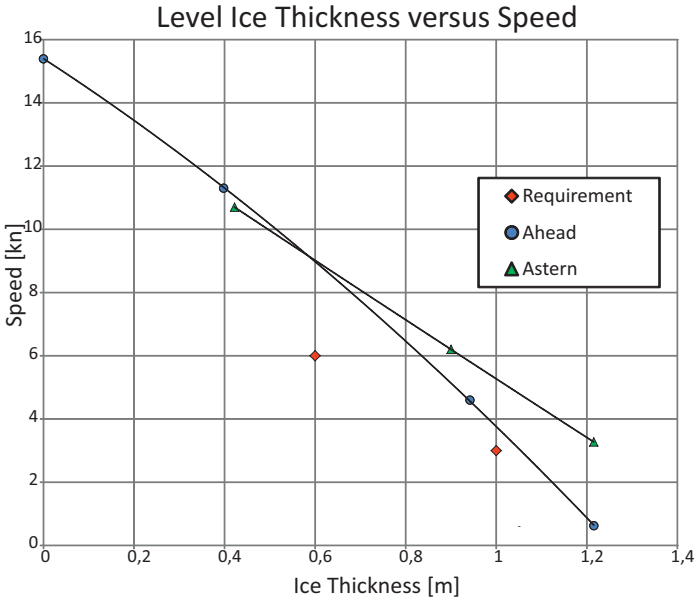
Half the propulsion power

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.

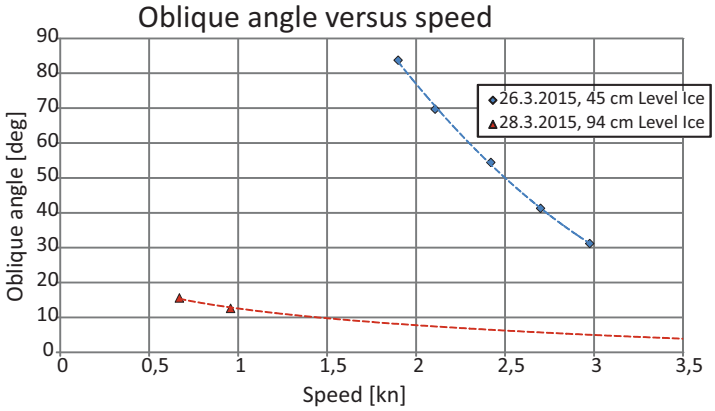
"The vessel was able to operate in ice conditions that exceeded the design criteria used as the basis of the vessel concept. *Baltika* carried out the same operations as conventional icebreakers with just half of the propulsion power, as well as performed manoeuvres that are not possible for any other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

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.



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.

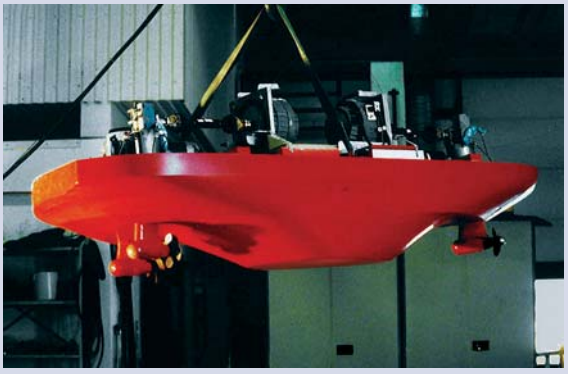


The oblique angle can be chosen individually; there are no pre-set choices. The vessel moves more slowly with a wide angle in order to create a wide channel.

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.

Arctic Aframax for transportation needs

Specially designed hull strengthening improves safety in operations, which is very important in arctic waters.

The hull of the vessel will also be equipped with an Ice Load Monitoring System.

Aker Arctic and Deltamarin have jointly developed a modern Aframax tanker design for arctic use. The combination of Deltamarin's expertise in low-cost, energy-efficient cargo vessels and Aker Arctic's expertise in arctic vessels has turned into a very attractive tanker concept. Apart from being ice-strengthened and equipped with other novel features, she also has a new modern look and will provide reliable, cost-effective tanker operations.

The newly developed arctic Aframax tanker is intended for transporting crude oil and oil products. She is planned to have a deadweight of 118,000 tonnes and will be strengthened to ice class PC5 (approximately equivalent to RMRS category ARC6).

"This means she can work and operate safely in arctic waters," says Project Manager Riku Kiili from Aker Arctic.

The vessel is capable of breaking over one metre of level ice continuously and is intended to operate during the extended summer months on the Northern Sea route and, with assistance, can operate for even longer. During the winter months, she can also operate in other sub-arctic sea areas, such as the Baltic Sea or around Sakhalin.

Bow and hull shape have been optimised with the help of CFD tools to give the best balance of open water performance and icebreaking capabilities.

New features

The vessel is equipped with two CP propellers and shaft lines connected to slow speed diesel engines providing redundancy and safety.

Optionally, the engines can also run on LNG fuel. The possibility of a shaft PTO/PTI system has also been considered.

"Specially designed hull strengthening improves safety in operations, which is very important in arctic waters," Mr Kiili adds.The hull of the vessel will be equipped with an ice load monitoring system. This system measures the ice load on the hull and provides online support to the officers, ensuring safety in operations. The system will also help ship owners in the longer term by analysing the data and creating information for optimal operations.

Winterisation for cold climates has also been emphasised in all aspects of the concept design. All the equipment should work regardless of the outside temperature.

▶

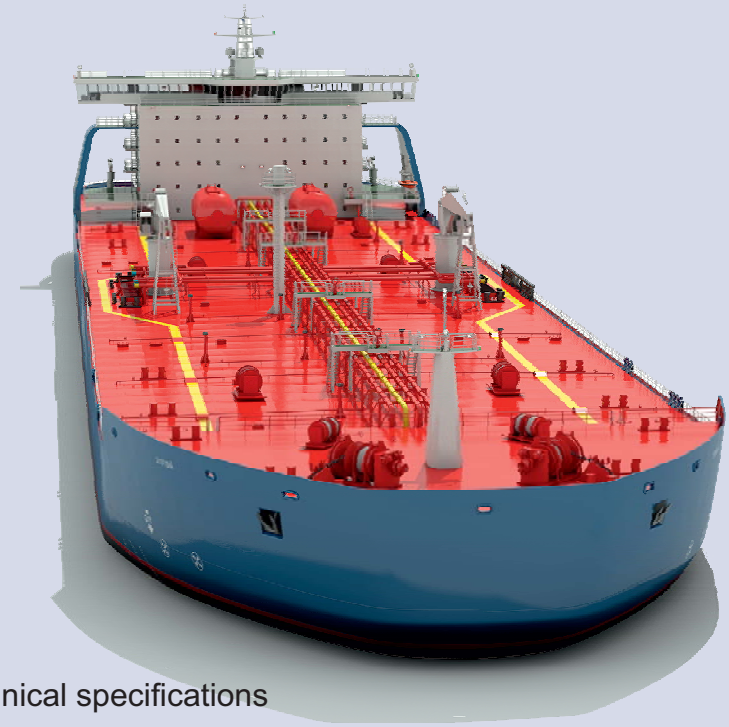
Improved bridge design

Developing an improved command bridge was a particular focus. Project Engineer Antero Jäppinen has been the designer in this area.
"The visibility from the new bridge we have developed is excellent in all directions. We have also prioritised ergonomics, including access and passages to command posts. The layout is one type of the standardised bridge layouts developed by Aker Arctic," Mr Jäppinen says.

Competitive price and fuel-efficient operations

“The main emphasis has been on developing an arctic Aframax tanker which is affordable to build and cost-effective to use in order to offer improved transport economy. This concept development will be fine-tuned according to customers' wishes," Mr Kiili explains.

Arctic Aframax 118,000 DWT Crude Oil Carrier



Technical specifications

Main Dimensions:

Lenght over all:	266.0 m
Breadth	46.0 m
Depth	22.5 m
Draught design	14.8 m

Hull and Performance:

Ice class:	PC5/RMRS Arc6
Level icebreaking capability:	1 metre continuous
Economical open water speed:	13.5 knots

Main Engine Particulars:

2 x low speed MAN 6S60 SMCR, 11 000 kW each

Auxiliary Engines: Abt. 3 x 1 000 kW

Propulsion Particulars:

Two shaft lines, 7.6 m diameter controllable pitch (CP) propellers

Optional:

PTO/PTI	2 x 2250 kW
Transverse tunnel thrusters	2 x 2000 kW
Auxiliary engines	3 x 1800 kW

Cargo and Ballast Pumps:

Deep well type

Meet Riku Kiili

Riku Kiili works with different customer projects and development projects, such as the Arctic Aframax and the Ice-DP system. He began his career at Masa-Yards Arctic Research Centre (MARC) and has been with Aker Arctic from the start.

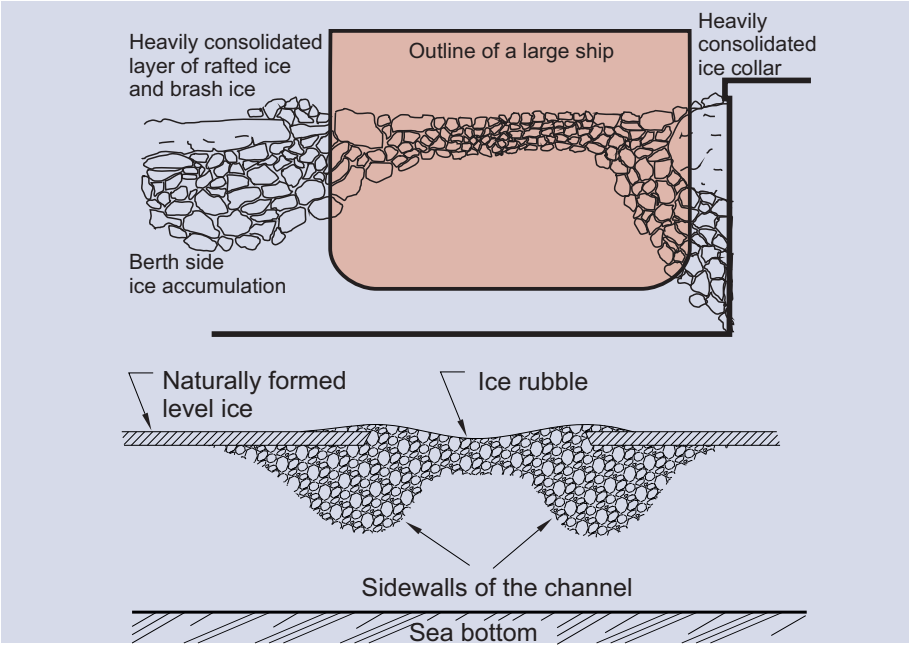
During the past ten years, he has become familiar with all the different areas Aker Arctic is involved in, e.g. model testing at the ice laboratory, ship hull form design and concept development, transportation analyses and innovations, just to mention a few.

Brash ice management in harbour areas

Ice drifting into harbour areas and the formation of brash ice are challenging for winter navigation. Brash ice creates thick sidewalls on the navigation channels. It also accumulates by the pier walls, making it difficult for ships to berth and potentially damaging vessels. Therefore, brash ice needs to be managed.

Every time a vessel breaks ice, the pieces will mix with the cold water and freeze again. This causes the brash ice thickness to grow, and it will become more difficult to navigate over time.

With the formation of brash ice in harbours, the ice consolidates into bigger pieces, which are then pushed against the pier walls when ships approach. An ice collar grows attached to the wall affecting the berthing. This may become a major problem, especially in situations where positioning accuracy is essential for loading and unloading.



"When you break ice, you create more ice," says Cayetana Ruiz de Almirón de Andrés, project engineer at Aker Arctic.

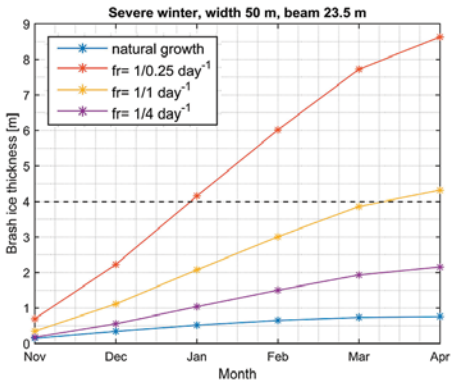
Affecting variables

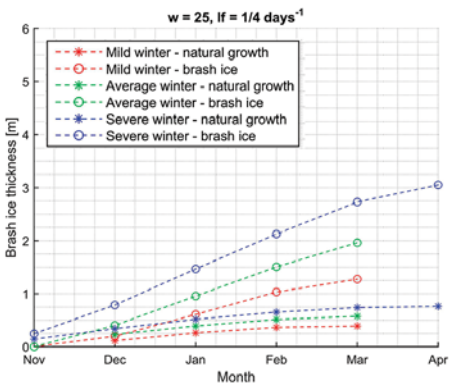
The main variables affecting the brash ice growth are breaking frequency, the air temperature and the ratio between beam of the ship and the width of the navigation channel.

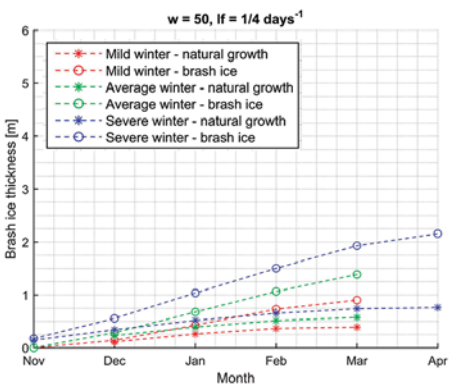
"The more often the ice is broken, the thicker the ice cover will become, because the blocks mix with cold water and freeze again," Ms Ruiz de Almirón de Andrés adds.

A narrow channel will create more brash ice. Conversely, if the channel is wide enough for vessels to move in more freely, the ice grows more slowly. This goes hand in hand with the beam of the ship. If the beam is the same width as the channel, more ice will be created. Air temperature is also a crucial factor. The colder the temperature, the faster the ice thickness will grow as the ice pieces mixed with water will freeze more quickly.

To manage all this, brash ice management methods are needed otherwise the ice formation will keep increasing. There are three main methods: brash ice management systems, ice management vessels or mechanical removal.







The main variables affecting brash ice growth are: breaking frequency, the air temperature, width of the channel and the beam of the ship.

►

Surface current combined with warm water

A brash ice management system (BIMS) consists of a combination of a generated surface current to circulate the thermal energy and warm water (if available) released to the critical zones. The benefits are a reduction in brash ice cohesion and focused melting in specific locations. This system has been used successfully in Finnish harbours for decades.

Flushing the ice

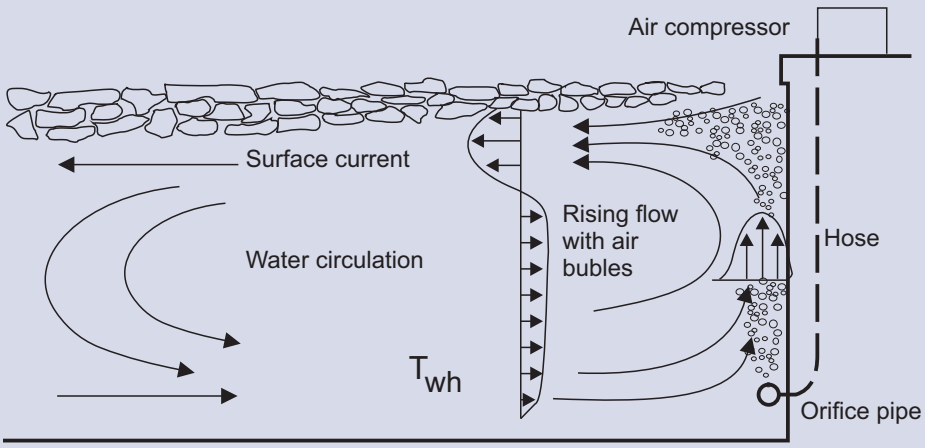
Another possibility is to use ice management vessels to flush the ice away in harbours and lateral transfer in navigation channels. This helps to clean the ice away, but does not prevent the ice from freezing again.

Example of flushing method using ice management vessel to clear the ice.

Mechanical removal

This method of managing ice is a more time-consuming option and therefore not as efficient. In this method, the ice is removed with cranes, scoops or excavators.

During winter, there are added costs for harbour operations due to the presence of brash ice. Mooring takes more time, fuel costs are increased and rudders are exposed to contact with ice.



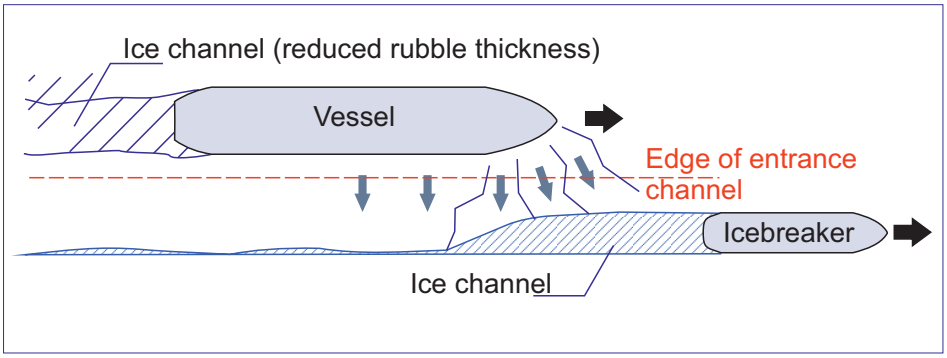
BIMS working principle

Working principles:

- Warm water is released close to the wharf wall
- A pipeline with orifices emits air bubbles, raising the flow up to the surface
- The bubbler system draws part of the thermal energy into the berth area and turns it into a current underneath the brash ice cover
- Additional mechanical removal

System elements:

- Water intake, boiler house and delivery facilities near the berths
- Compressed air facilities and bubbler lines to circulate the warm water for effective melting
- A Port Icebreaker Tug (PIBT) for assistance in berthing and departure (as well as turning in the harbour basin) of cargo vessels
- Excavators and cranes



Possible delays or cancellations are costly, and finally icebreaker assistance adds more costs. "Therefore we at Aker Arctic encourage ship owners to solve the problem and plan for this in advance," Ms Ruiz de Almirón de Andrés says.

Example of lateral transfer using ice management vessel in ice channels.

Meet Cayetana Ruiz de Almirón de Andrés

Cayetana Ruiz de Almirón de Andrés works at Aker Arctic as a project engineer specialising in harbour and terminal designs. She is originally from Granada in southern Spain and has been in Finland since the end of 2013. She completed her master's degree in integral management of ports and coastal zones at the University of Granada in 2011.

Before joining Aker Arctic, she worked at the University's hydraulic laboratory testing breakwaters and studying the morphodynamics of harbour areas. Her biggest passion is backcountry skiing, so she is not afraid of cold winters.

10th Arctic Passion Seminar

The highlight of the day was the ice model demonstration test in our model basin. This year, the Baltic icebreaker Sisu was demonstrated. Sisu is one of the Urho class icebreakers, of which Wärtsilä Helsinki Shipyard built five between 1975 and 1977

This year's Arctic Passion Seminar celebrated ten years of achievements as an independent company. The latest developments in icebreaking, new projects, environmental regulations and updates on new trends were on the agenda.

Aker Arctic Technology Inc was founded ten years ago; however, we have been developing the ice technology business for five decades and some of our employees have been working together as long. Our managing director, Reko-Antti Suojanen, presented key projects from the past ten years while welcoming all guests.

The Finnish Minister of Economic Affairs, Jan Vapaavuori, opened this year's seminar and talked about recent developments in arctic cooperation.

He was followed by Philip Adkins, CEO of ZPMC-Red Box Energy Services, who presented the development project of two polar-class heavy transport vessels designed by Aker Arctic and currently under construction at Guangzhou Shipyard. The transport vessels will be used for transporting liquefaction modules for the LNG plant being constructed at Sabetta for Yamal LNG.

Captain David Burden from the Argentine Navy talked about a new special-purpose ship, which will be used for research and transporting equipment and researchers to Argentina's Antarctic base. Aker Arctic completed the concept design in February this year, and the ship will be constructed in China.

Esko Mustamäki, CEO of Archtech Helsinki Shipyard, then presented joint development projects from design to construction with Aker Arctic, such as the oblique icebreaker *Baltika* and the first LNG-fuelled icebreaker for the Finnish Transport Agency.

Representatives of CNIIMF and the Russian Maritime Register of Shipping (Dr Buyanov, Dr Andryushin, Dr Markozov, Dr Kuteinikov) held an informative lecture on how ice certificates for double-acting ships are assigned . The Ice Navigation Ship Certificate (“ice passport”) is intended to establish safe modes of operation in ice-covered waters proceeding from assurance of hull and propulsion complex strength.

Aker Arctic follows closely how the Polar Code is developing and the impact it will have on ship design and construction. Chief advisers Jorma Kämäräinen and Dr Anita Mäkinen from the Finnish Transport Safety Agency explained the safety and environmental regulations of the Polar Code.

Novy Port oil terminal, currently under construction at Cape Kamenny in the southern Gulf of Ob, will be used to export oil from the Novoportovskoye oil and gas field. Artjom Tsobanjan, head of the Crude Oil Department at Gazprom Neft Trading, presented the main factors of the port project.

The afternoon was packed with information about the latest developments in icebreaking vessels for the Gulf of OB (Sami Saarinen, project manager from Aker Arctic Technology), finite element analysis as a tool to optimise the propellers of ice-going vessels (Ville Valtonen, project engineer from Aker Arctic Technology) and a presentation on multipurpose icebreaker operations in the Arctic (Jukka Salminen, chartering manager from Arctia Offshore).

The day was concluded by Mikhail Grigoryev, director of GECON, who gave an update on the assessment of a contribution of development of the oil and gas fields in the Russian Arctic in the development of the maritime transport system till 2030.

The presentations are available on our website at http://akerarctic.fi/en/arctic-passion

New offices in Russia and Canada

We have recently opened a representative office in Moscow. After the acquisition of Akac Inc., we now also have two offices in Canada. Contact details below:

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Module carrier at OTC Houston

The Aker Arctic team presented the polar class module carrier at the Offshore Technology Conference in Houston last May. The vessel will be used for transporting large modules for the LNG plant being constructed at Sabetta for Yamal LNG.

The owner, ZPMC-Red Box Energy Services, constructed a unique miniature model made of LEGO blocks.

Baltika's successful ice trials

Our theme for this year's Moscow international oil and gas (MIOGE) event was *Baltika*'s successful trials in arctic ice. She is the first icebreaker that can break ice by moving sideways. Originally designed for Baltic Sea ice, she exceeded all expectations during her ice trials in the Gulf of Ob last winter.

Arctic module carrier launched

The Aker Arctic-designed polar class heavy deck carrier was launched at Guangzhou Shipyard in China in September.
The first carrier is expected to be delivered in January 2016 and the second one a month later. The development work was carried out in close cooperation with ZPMC-Red Box Energy Services.

POAC Trondheim

At the International Conference on Port and Ocean Engineering under Arctic Conditions (POAC) in Trondheim, we gave two presentations this year. Anders Mård, naval architect and project engineer, presented the paper "Experimental study of the icebreaking process of an icebreaking trimaran". Research engineer Riikka Matala gave a presentation on "Arctic drillship design for severe ice conditions".

Summer trip to Turku

After the summer vacations, relaxing family time and adventures in foreign countries, it is time to celebrate the return to work and enjoy quality time with colleagues.

This year, our teambuilding trip went to Turku, the former capital of Finland.

Our ice simulator is installed on two ship bridges at Aboa Mare in Turku. We had the chance to see how it works.

Sauna is a Finnish tradition used for relaxation and bonding. We tried a smoke sauna, which is an ancient type of sauna heated up in a special way.

Turku is located on the coast of South-west Finland and features a beautiful archipelago. The Finnish Maritime Academy Aboa Mare trains seafarers here and has installed our ice simulator on two of their ship bridges, so we decided to visit them and see how the simulators work.

Our next stop was the Meyer Turku shipyard. A year ago, the Finnish state and German shipbuilder Meyer Werft acquired the entire share capital of STX Finland. Since then, the shipyard has received many shipbuilding orders, e.g. several cruise ships for TUI Cruises and Carnival Corporation, and recently an LNG-powered fast ferry for Tallink. The two cruise ships for Carnival Corporation will be the first cruise ships powered at sea by LNG. The order book now contains a high workload until 2020.

We also visited Turku Repair Yard, which has one of the largest dry docks in Northern Europe. Close to one hundred ships visit the dry dock annually.

In the evening, we enjoyed a smoke sauna and dinner, and we celebrated Ari Sipilä's retirement. The sauna tradition is part of Finnish culture. Sauna is not only used for hygienic purposes, but also for relaxation and bonding. A smoke sauna (*savusauna*) is the ancient type of sauna, which has seen a boom in popularity in recent years. It is a sauna without a chimney where wood is burned in a special stove to heat up stones and smoke fills the room. When the sauna is hot enough, the fire is allowed to die and the smoke is ventilated out. The stones will keep the heat for hours.

"We had a wonderful day with good weather and interesting visits," says management assistant Jana Vamberova.

Meet us here!

We will participate in the following events:

Neva 2015, St. Petersburg
22 - 25 September 2015
Pavillion 1, Hall F, stand 1027/6

Marintec China 2015, Shanghai
1 - 4 December 2015

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