Arctic Passion News

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Jyrki Saari joined Aker Arctic in March 2016 as a software developer to work on the Ice Simulator project. Before coming to Aker Arctic, he has worked in the mobile phone industry as well as with remote management and monitoring systems and logistical systems.

Alexey Dudal joined Aker Arctic as a Structural Naval Architect to work in ship design and engineering. Alexey graduated from the State Marine Technical University of Saint Petersburg, Russia in 2007 and holds an M. Sc. Degree in Shipbuilding and Ocean Technologies. In his previous work, Alexey was involved in projects related to the design of offshore units and ice-going vessels for the Arctic. This included the assessment of ice loads and design of the appropriate ice reinforcement. His main activities at Aker Arctic are related to the design of the hull structure of ice-going vessels and icebreakers.

Front cover:
MSV Nordica, a Finnish multipurpose icebreaker ploughing through the Northwest Passage in November 2015. Two Aker Arctic experts were on board the vessel for the journey.

Dear Reader,

The market situation in the shipping and especially in the shipbuilding industry has always been volatile. Newbuilding orders have gone up and down and different vessel types have reflected shipping industry needs in different ways. The cargo vessel market is currently at one of its lowest points, with order intakes at a record low. However, at the same time cruise vessels have been ordered in big numbers, and other passenger vessels also show signs of increased activity. Also, it seems that other special vessel types such as icebreakers and special ice capable fleets need to be rebuilt.

This summer has been remarkable in many ways, but one specific issue is to be noted that is of interest to people working with arctic and ice issues. NOAA announced that average global temperatures reached an all-time record high in the previous July. Also, variations in weather conditions have increased, and the temperature increase in the arctic region has been at least twice as high as global averages. This naturally has a significant effect on the ice cover and may be one reason for increased interest in arctic tourism. Is this the last time we will be able to see the polar ice cap? Scientists, marine operators and engineers like us have been familiar with arctic ice and extreme cold temperatures for a long time and can confirm the significant changes in ice conditions.

Unpredictably increases, and what used to be normal is something else today, with conditions becoming increasingly varied. Creating the design basis for technical engineering and solid practices for safe operations are becoming even more challenging. Therefore, familiarity with and knowhow of this experience-based technology is even more valued today.

We have always emphasised reliability and safety, as is demonstrated by the ships in operation. A careful, professional approach has to be taken in regards to the increased shipping activity in the polar regions, whether we are talking about a cruise vessel with large numbers of passengers or a vessel transporting cargo or performing special operations. We have written in this magazine about the polar cruises, and we have also detailed the US icebreaker challenges and have given an overview of other activities occurring in the arctic and cold climate projects, where we are working together with our clients to deliver safe, reliable vessels and operations for you.

Reko-Antti Suojanen
Managing Director

Kauno Sarkkinen in Memoriam

Our dear colleague and friend Kauno Sarkkinen has passed away.

Kauno began his work at Masa-Yards Arctic Research Centre (MARC) in 1990, where he took care of the centre as well as prepared and performed ice model tests. He also took part in ice expeditions and full-scale tests. In 2001 he transferred to the Helsinki Shipyard, but when Aker Arctic was founded in 2005, Kauno's old colleagues persuaded him to join them in Vuosaari, where the new third generation ice model testing facility was being set up.

In addition to preparing and participating in ice model testing, Kauno's responsibilities included taking care of the entire building. He knew all the equipment and machinery by heart, and whenever there was a technical issue, Kauno always came up with a solution. His multi-talented personality will be greatly missed.

Topi Leiviskä

First LNG icebreaker *Polaris*

Polaris in sea trials in spring 2016 outside Helsinki.

The construction of Finland's new icebreaker has been completed at Arctech Helsinki Shipyard. The vessel, *Polaris*, will be owned and operated by Arctia Ltd., a Finnish state owned company providing icebreaking services. She is the world's first LNG-fuelled icebreaker, which also makes her the most environmentally friendly icebreaker ever built. *Polaris* is based on the Aker ARC 130 concept developed by Aker Arctic in cooperation with ILS and the Finnish Transport Agency.

Polaris is an exceptional icebreaker, as she can exceed the performance of even the highly regarded Finnish icebreakers *Urho* and *Sisu* built in the 1970s, which have been widely recognised as the most capable icebreakers in northern Baltic conditions. The main purpose of *Polaris* is icebreaking and assisting other vessels in difficult ice conditions in the northern Gulf of Bothnia, where ice ridges can grow to over ten metres thick due to strong winds. It is common that ridge formations are deeper than the draft of the icebreakers.

Towing needs will increase

During the design phase, two propulsion concepts were compared: a more traditional twin-azimuth concept and a triple-azimuth concept with two propulsion units in the stern and one in the bow. The triple-azimuth concept was chosen as it turned out to be only slightly more expensive, but significantly improved the icebreaking performance and lowered operational costs.

"The Energy Efficiency Design Index (EEDI) is expected to change commercial vessels sailing on the Baltic Sea in terms of size and engine power," project manager Mika Hovilainen says. "Most likely, vessels will become longer and slimmer and be equipped with smaller engines. In difficult ice conditions, these vessels will need more assistance and towing needs will increase in the future."

In the most challenging ice conditions such as heavy ridges, contact towing is usually needed. The benefit of the chosen concept with a bow propulsion unit is that *Polaris* will have exceptional steering capability and performance in ridge fields, even when she is attached to the vessel she is towing.

She is also able to perform oil spill response operations, emergency towing and rescue operations on the open sea all year round.

Fifty years of service

Her planned service life is fifty years– twice that of typical commercial vessels – and this long service life has been taken into account in the design. By way of comparison, her predecessors *Urho* and *Sisu* are now forty years of age.

The ice belt is made of compound steel with a stainless steel outer lining. It requires less service and saves fuel due to reduced corrosion when compared to normal steel coated with abrasion-resistant paint. All the basic work in manufacturing the hull has been done with the long service life in mind and everything is made in accordance with the highest quality standards. Spaces for machinery and equipment are additionally planned so that it will be easy to upgrade and make changes when it becomes necessary.

Polaris is equipped with Wärtsilä 34DF series dual fuel engines. They are equivalent of typical diesel engines, but can also use LNG as fuel with significantly reduced emissions as a result.

"The two 400 m³ LNG tanks carry enough fuel for ten days independent operations in demanding ice conditions. Apart from LNG, low-sulphur marine diesel can also be used to continue the autonomy time," Hovilainen adds.

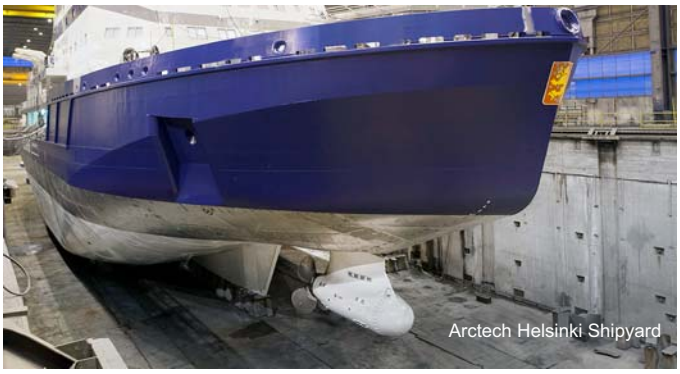
►

The ice belt is made of compound steel covered with a stainless steel layer to reduce ice resistance and maintenance costs.

Arctech Helsinki Shipyard

Arctech Helsinki Shipyard

The main engines are installed on the main deck level. The vertical LNG tanks in the background can hold enough gas fuel for 10 days of independent operation.



Arctech Helsinki Shipyard

Polaris has three Azipod propulsion units, one of which is in the bow of the icebreaker

Mika Hovilainen is convinced that the new vessel will shine.

"*Polaris* is the world's most environmentally friendly icebreaker, she can use LNG and she has enough power and manoeuvrability for all her tasks. Her special hull form and propulsion arrangement will minimise ice resistance and maximise the icebreaking capacity of the vessel. I believe she will become the best and most efficient icebreaker in the Finnish fleet!"

"Extensive full-scale testing has been done during sea trials," states Jarkko Toivola, Head of Winter Navigation Unit at the Finnish Transport Agency. "Course stability of *Polaris* going ahead and especially going astern is better than in previous icebreakers with azimuth propulsion units, but still manoeuvrability is exceptional. Open water speed and bollard pull in both directions exceed specified requirements. Also response of the power plant is quick regardless of used fuel type; LNG or MDO."

Main tasks and features:

- Icebreaking and escort operations in all prevailing ice conditions in the Baltic Sea
- Oil spill response with Lamor's built-in mechanical recovery system and 1 200 m³ tanks for recovered oil
- High bollard pull and emergency towing capability also in heavy seas
- "No compromise" approach to icebreaking operations; performance superior to all existing Finnish icebreakers

Aker Arctic's design responsibilities:

- Concept design including technical documentation for shipbuilding contract
- Hull form and propulsion system development
- Model tests in open water and ice
- Initial design of hull structure and machinery
- In co-operation with ILS Oy and The Finnish Transport Agency
- Technical support in procurement process

General characteristics

Tonnage: 3,000 DWT
Length: 110 m (360 ft)
Beam: 24 m (79 ft)
Draft: 8 m (26 ft) (design)
9 m (30 ft) (max)
Ice class: PC 4 Icebreaker(+)
Installed power: 2 × Wärtsilä 9L34DF (2 × 4,500 kW), 2 × Wärtsilä 12V34DF (2 × 6,000 kW), 1 × Wärtsilä 8L20DF (1,408 kW)
Propulsion: Diesel-electric; three ABB Azipod units, 1 × 6 MW (bow), 2 × 6.5 MW (stern)
Speed: 17 knots (31 km/h; 20 mph) (open water), 4 knots (7.4 km/h; 4.6 mph) in 1.8 m (6 ft) ice
Endurance: 10 days on LNG
20 days on fuel oil
Crew: 16
Builder: Arctech Helsinki Shipyard, 2016

Safe cruising in the Polar areas

In November 2007, the sinking of MV *Explorer* in Antarctic shocked the world. She was ice-strengthened, but misjudgement and operational mistakes combined with a low ice class vessel could not match the prevailing ice conditions. Today, an increasing amount of cruise ships are bringing passengers to explore the Polar waters. Few of these vessels are actually designed to operate in Polar areas and to manage the various challenges that these high latitudes present.

In 2007 the sinking of MV Explorer in Antarctic shocked the world. Luckily, all passengers and crew were saved.

The Arctic and Antarctic differ from each other, primarily because of their different geographical locations. Arctic ice is not as mobile as the ice in Antarctic because the Arctic is almost completely surrounded by land forming a semi-enclosed ocean. Therefore, ice ridges pile up more easily and become thicker than in Antarctic. Antarctica, on the other hand, is a land mass surrounded by an ocean. Ice floes can drift more freely and mix with snow, underwater ice, bergy bits and growlers, forming large underwater rams posing great danger to vessels.

"The Arctic and Antarctic are often referred to with only one word and still we are talking about an area, which is bigger than Europe," says sales and marketing director Arto Uuskallio.

Polar Code and Polar Class are not the same

The newly introduced IMO Polar Code will require additional crew training, enhanced operational practices and vessels to fulfil the criteria, which match the conditions in the intended area of operation. The intention of the Polar Code is to improve safety for the passengers, the crew and also the environment.

"However, complying with the Polar Code is not a guarantee that a vessel can manage all kinds of harsh ice conditions and freezing temperatures," Uuskallio says.

A ship intended for Polar areas needs to have the appropriate ice class. The owners, designers and administrators need to select an appropriate ice class to match the requirements for the ship with its intended voyage or service.

"It is important to understand, that the Polar Class focuses on structural integrity," Uuskallio emphasises. "Moving around is a completely different story. What if the vessel is stuck in ice for two weeks because the Captain made an incorrect interpretation of the ice field? What if the wind packed the ice so thick that the vessel cannot go through? Will the systems still work? What to do with waste and wastewater, which cannot be dumped in these fragile areas? Will somebody come to help?

Area, profile, season

Aker Arctic has been designing high ice class vessels for decades. The starting point is always to decide on the operational area, the operational profile and operational season before beginning to design a vessel.

"It is not sensible to order a vessel first and then hope that the circumstances will be favourable," Uuskallio adds.

Once the operational area has been defined the planning can start. If a vessel is only intended to sail nearby ice areas, but not actually designed to break thicker ice, a low ice class vessel can be chosen, as it will be cheaper to build. It can be PC 6 or 7 and use Aker Arctic's new multi-draft bow, which can manage well in light ice and is economical to use in open water transits.

However, a high ice-class vessel, which can manage independently in thicker ice, is more complicated to design, as the design has to be a balance between the open water performance and good icebreaking characteristics. When operating in Arctic or Antarctic waters, the safety aspect is always crucial. Therefore, a good understanding of the ice loads, effective winterisation to keep the cold out and the operation of the ship's systems is essential when designing the vessel. ▶

Crystal Cruises brings passengers to the Northwest Passage for the first time. An icebreaker accompanies the ship during the entire trip for the safety of the passengers.

Ice class is safety
First of all, from a safety point of view, the right ice class needs to be chosen. Secondly, the right performance in ice and open water has to be selected to keep operating costs down.

"Ice class is a guarantee of safety, not a guarantee of performance," Uuskallio points out.

The choices in performance concern how the vessel will manage operations in ice and open water. Operation in difficult ice conditions is of utmost importance, but also involves higher operation costs. When selecting icebreaking capabilities, it is essential to also include open water performance for cost efficiency in long open water transits.

"Our aim is to always find the optimal solution for our customers' needs, which will combine the icebreaking capabilities with hydrodynamics without at any point compromising safety," says Uuskallio.

Winterisation needs
A third area of consideration is winterisation. This means how well all the machinery and equipment can sustain freezing temperatures and how to keep the accommodation and recreational spaces comfortable.

"Winterisation is not something you can add as a warm jacket when you are feeling cold. It has to be part of the design from the beginning. At the same time, it makes the vessel energy efficient," Uuskallio adds.

Winterisation guarantees that the vessel can function in freezing temperatures. If, for some reason something would happen, the big vessel is usually the safest place to stay. Small lifeboats are cold to sit in and help can be days away.

There are different types of cruise ships and passengers. Expedition-cruises usually take more adventurous passengers, who are prepared to manage also uncomfortable situations. Luxury cruises usually carry passengers who like to dress up nicely and admire the scenery from the restaurant window. Nevertheless, safety should not be a question in either case.

That November night in 2007 was fortunate. The seas around MV *Explorer* were calm and there was enough time for the passengers to board the lifeboats and RIBs in the darkness, while their cruise vessel was taking in more and more water. Help came after only a few hours and all the passengers and crew were saved by another vessel. The next time might not be as lucky, so please contact Aker Arctic before starting to plan your Arctic cruise liner, we would be more than happy to assist you in designing a safe cruise ship.

Aker Arctic has designed strong ice vessels for decades. The starting point is always to decide the operational area, the operational profile and operational season before beginning to design a vessel. The concept drawing is for the International Marine Association's annual conference held in 1989 in Helsinki.

The Double-Acting ship concept Aker Arctic has developed can also be used for cruise vessels. The vessel advances bow first in open water or light ice conditions and stern first in heavy ice conditions. The vessel on the right is Norilskiy Nickel, an Arctic container ship designed by Aker Arctic and built by Aker Finnyards in 2006. She has been operating successfully in the Russian Arctic for ten years and does not require icebreaker assistance even in the hardest ice conditions.

Bow ahead

Stern first

Polar Class	Ice descriptions (based on WMO Sea Ice Nomenclature)
PC 1	Year-round operation in all polar waters
PC 2	Year-round operation in moderate multi-year ice conditions
PC 3	Year-round operation in second-year ice, which may include multi- year ice inclusions.
PC 4	Year-round operation in thick first-year ice which may include old ice inclusions
PC 5	Year-round operation in medium first-year ice which may include old ice inclusions
PC 6	Summer/autumn operation in medium first-year ice which may include old ice inclusions
PC 7	Summer/autumn operation in thin first-year ice which may include old ice inclusions

The Polar Class notation is used throughout the Unified Requirements for Polar Class ships to convey the differences between classes with respect to operational capability and strength. It is the responsibility of the Owner to select an appropriate Polar Class. Source www.iacs.org.uk

A safe Arctic/Antarctic cruise ship

Aker Arctic designed an Antarctic cruise ship in 2008, which was planned to be a safe cruise ship for ice conditions. Most other cruise ships sailing to the Arctic and Antarctic are converted passenger ships and actually not designed for the cold and ice.

The Arctic/Antarctic cruise ship was planned for the actual operational conditions: to bring passengers to the Arctic in summer and to Antarctic in winter.

The PC 5 ice class ship was designed as a luxury modern ice-strengthened expedition cruise vessel for one to three weeks of worldwide itineraries with about 200 passengers.

It has a double-acting stern and can break 1 metre thick ice at a speed of two knots.

The bow is optimised for open water operations but allows breaking 0.5 metre thick ice.

It is also equipped with rib boats for expeditions to take passengers to experience the Polar nature.

The vessel was not constructed due to lack of financing, but the design is available to be used as a basis for new, interested parties.

Since 2008, there have been many inventions and innovations. If the ship would be built today, the optimal hull would be the new multi-draft hull concept, which provides excellent open water performance at design draught and good ice performance when the bow is trimmed down. It would also need to be updated to meet the new Polar Code rules.

“Before beginning the process to acquire an Antarctic cruise vessel, the most important thing is to decide what it will be used for," project manager Maximilian Vocke points out. "What is the operational area and what is the operational profile? Does the vessel need to break ice or will it only stay close to ice areas? What ice class does it need to be and what is the icebreaking capability needed?"

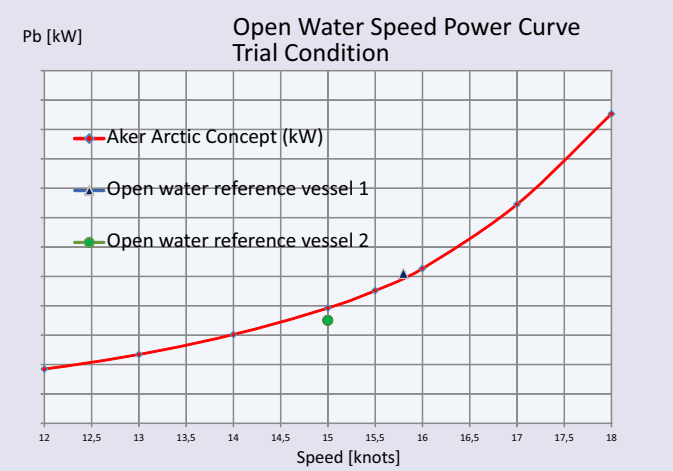
We are now working with high interest on real Polar class cruise vessel projects, which could provide the arctic experience for passengers in a safe way.

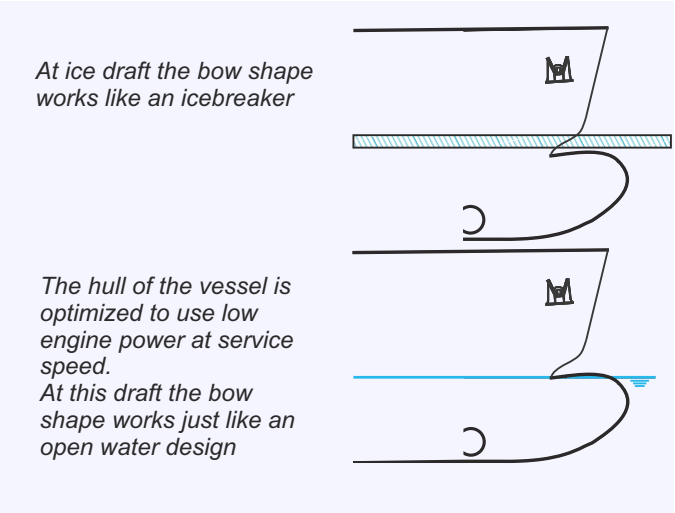
Multi draft bow benefits ice classed cruise vessels

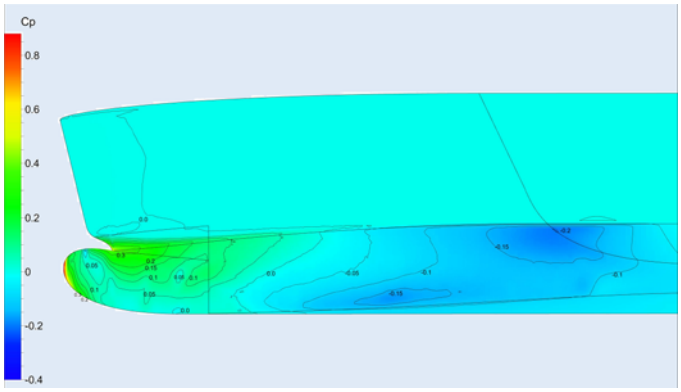
Aker Arctic has developed a new hull concept, which is optimised for both ice and open water. The bow form is a combination of a bulbous bow and an icebreaking bow. At design draught, the vessel uses the bulbous bow, which is optimal for open water. In ice conditions, the bow is trimmed down and then works like an icebreaking bow.

"This invention is optimal for cruise ships as they have a stable draught," says Tom Mattsson, senior specialist in ice performance at Aker Arctic.

"It offers excellent comfort for passengers with its good seakeeping characteristics. Safety is another essential feature as the vessel can manage to get away from even severe ice conditions on its own by using her excellent icebreaking capability."







An extraordinary icebreaker for the United States Coast Guard

The United States Coast Guard (USCG) has launched a Polar Icebreaker Acquisition Program to replace two existing heavy icebreakers built in the 1970s with a new vessel. Aker Arctic is committed to help the USCG to find the best solution to their needs.

Since the 1950s, heavy polar icebreakers have been used to support Operation Deep Freeze, the annual resupply mission to Antarctica, where the icebreakers open a channel through the Ross Sea ice pack and escort tankers and freighters to the world's southernmost harbor at the McMurdo Station. During this month-long voyage that begins and ends in Seattle, the icebreaker will experience extreme temperatures from tropical heat at the equator to the freezing polar climate, strong winds and heavy seas, and finally ice up to eight feet thick. The vessel required for this task has to be an extraordinarily versatile, heavy-duty icebreaker with excellent seakeeping and open water features.

In addition to the resupply mission to Antarctica, the new polar icebreaker will also be used to support science missions in the Arctic and will feature an extensive scientific outfit and laboratories. Due to increasing activity in the Arctic, it will also remain in constant stand-by for demanding search-and-rescue and marine environment protection operations in the ice-covered seas.

"There is neither existing nor planned vessels in the world that fulfill all the demanding mission objectives and requirements set by the USCG," Naval Architect Tuomas Romu at Aker Arctic emphasizes.

"Most icebreakers that work in northern latitudes are not designed for long transits in open water and heavy seas, and most Antarctic vessels are primarily scientific research and supply vessels with lower icebreaking capability. None of them can first manage rough seas with waves up to 45 ft high in tropical heat and then break thick multi-year ice in freezing temperatures."

The optimal vessel

Aker Arctic has already started drafting an icebreaker concept to find out what kind of vessel could meet the objective requirements defined by the United States Coast Guard in the recently published Polar Icebreaker Industry Data Package. "We are looking into a relatively compact vessel which can fulfill all the objectives, but still be affordable to build and economical to use and maintain," says Romu. “A larger vessel would require more powerful engines and bigger fuel tanks. Aiming for a vessel that is not larger than it needs to be to complete its mission successfully keeps the construction and operational costs at bay.”

Based on Aker Arctic's preliminary estimates, the new heavy polar icebreaker would have a displacement of about 20,000 metric tons, making it slightly larger than the existing US-flagged icebreakers. It would feature a highly redundant diesel-electric power plant, which is the current standard worldwide in icebreakers, and a propulsion system with electrically driven fixed-pitch propellers. Possible propulsion alternatives include a conventional triple shaft arrangement as well as azimuth thruster/shaftline hybrids.

"The end result will most likely be a heavy icebreaker that may look somewhat conventional from the outside, but inside has modern technology which has proven to be efficient and reliable over the years," Romu adds. "Icebreaking technology has made a huge leap in the past forty years since the USCGC *Polar Sea* and USCGC *Polar Star* were built."

Since the heavy icebreaker is expected to encounter extremely hard multi-year polar ice, it will be designed to break ice primarily bow-first. The hull form needs to have the right balance between icebreaking and open water operations in order to efficiently fulfill all the operational requirements set by the United States Coast Guard.

"In addition to giving an accurate performance prediction, our in-house model testing facility gives the benefit of evaluating different hull form and propulsion concepts before making any final decisions," says Romu.

The ice strengthening in the hull needs to be sufficient to withstand collision with

Aker Arctic provided extensive conceptual development and design support, including hull form development and propulsion line engineering for the medium icebreaker USCGC Healy.

The highly advanced polar research icebreaker for China is soon ready for construction. Its main tasks will be research operations in the Antarctic. Aker Arctic provided the concept and basic design of the vessel.

Taymyr and Vaygach are the only nuclear-powered icebreakers built outside the Soviet Union or Russia. Aker Arctic employees were involved in the development of these highly capable shallow-draft icebreakers.

Aker Arctic was part of the design team for the new icebreaker for the Canadian Coast Guard, CCGS John G. Diefenbaker. We developed the hull form and performed the model tests for this advanced polar icebreaker.

photo: United States Coast Guard/ Public Affairs Specialist 2nd Class NyxoLyno Cangemi

thick ice floes at high speeds without risking structural damage. For this reason, cold-resistant high-strength steel will be extensively used in the ice belt. On deck, all exposed equipment must be winterized against cold ambient temperatures. The crew should also be protected from sea spray and icing.

Other features include accommodation for a crew of 100-150 as well as 50 additional personnel such as scientists, a helicopter hangar for two helicopters, and large onboard stores. The requirement is that the polar icebreaker has to be able to sail 21,500 nautical miles at a speed of 12 knots in open water. In addition, it has to be able to manage up to three months without refueling or stocking up on supplies.

Tailor made for the best result

While there are many icebreaking vessels and icebreaker designs on the market, they are all designed with specific missions, operating areas and ice conditions in mind. The best end result is always achieved when a vessel is designed for its intended use.

According to Romu, trying to modify an existing design for this project does not make sense. “The result would likely be a compromise where the designer tries to balance between keeping features from the parent vessel in order to save time and making small modifications to adapt the vessel to a new role. Regardless of the end result, most of the classification and production design would have to be re-made, so neither money nor time would be saved at the end.”

"For us, being specialized in designing icebreakers, the time required to design a new icebreaking vessel concept is measured in months, not years. In the total acquisition process, which lasts many years, this is no time at all. The cost of a new concept design is also a fraction of the total investment and the end result is a tailor made vessel that fully meets all requirements and is perfect for its intended use."

"To acquire a new icebreaker is a huge investment both in terms of money and time: it is not worth a compromise," Romu adds.

Time frame for icebreaker

Acquisition processes can take everything from two to ten years. It all depends on the efficiency of the process and the ability to make decisions. The United States Coast Guard has accelerated its timetable for the recapitalization of the icebreaker fleet under President Barack Obama, and aims to begin production activities in 2020. This is two years earlier than what was initially proposed.

►

“This kind of the timetable is clearly achievable, for example The PC 3/Arc7 iceclass arctic module carriers took 28 months from start of concept design to delivery of the first vessel, even though there was no preceding design and the Chinese shipyard had never built icebreaking vessels before," says Romu.

"Working with us makes the process very straightforward as this is our everyday work. We know what needs to be done and in which order," Romu underlines.

Two previous joint projects

Aker Arctic and its predecessors have had a strong involvement in the previous USCG icebreaker projects.

"We provided extensive conceptual development and design support, including hull form development and propulsion line engineering for the medium icebreaker USCGC *Healy*," says Managing Director Reko-Antti Suojanen.

"We also developed the vessel concept for the Great Lakes icebreaker USCGC *Mackinaw* in cooperation with the US Coast Guard. It is one of the first vessels using the "double acting" ship principle, we have developed and the podded propulsion system, invented in Finland. In both projects, model testing was used in the concept evaluations and to support the final work as well."

Aker Arctic has a long history of successful icebreaker designs, including the most advanced and innovative icebreakers designed within the past few years.

Support for shipyards

Aker Arctic always works in close cooperation with its customers, in order to make sure that the final vessel meets the customers' wishes and demands. Another close cooperation partner is the shipyard that will build the vessel.

"There are capable shipyards in the US so there is no doubt that, with assistance in specific matters related to operations in ice and cold environment, they could construct a heavy polar icebreaker," Romu says. "This is where our construction-time support for shipyards comes in handy. We are, for instance, currently assisting the French shipyard Piriou, which is constructing the new French polar supply vessel, in ice related matters. We also supported Guangzhou shipyard in China during the construction of the arctic module carriers, delivered at the beginning of this year."

Successful icebreakers

Aker Arctic has designed one successful icebreaker class after another and has also gained valuable feedback from the operators as well as trials over the past few decades.

"We know what is needed for efficient icebreaking and especially what is needed in extreme conditions. In full-scale ice trials, our icebreaking innovations continue to outperform other designs," Romu highlights.

"Based on this we know that we can design a polar icebreaker, which meets all the USCG requirements without becoming the most expensive icebreaker in the world. A compact vessel, which is economical to build, use, and maintain has many benefits."

Severe winters at the Great Lakes stops vessels

The past winters in the Great Lakes area in North America have been exceptionally hard. Local industries have reported huge financial losses after cargo ships became frozen in the ice and commercial shipping all but stopped during the winter months. The question has now been raised of investing in a new icebreaker in order to avoid similar situations in the future.

Aker Arctic developed the concept for the Great Lakes icebreaker, USCGC Mackinaw, together with the United States Coast Guard.

Among other smaller icebreakers and tug boats assisting commercial vessels in the Great Lakes, there is USCGC *Mackinaw*, which Aker Arctic designed in cooperation with the US Coast Guard in 2005. *Mackinaw* is based on the double acting ship principle, sailing bow first in open water and stern first in heavy ice. Its twin Azipod concept and design were created jointly by USCG, Kvaerner Masa Marine and Aker Arctic.

The oblique icebreaker is able to proceed sideways in ice and create a wide channel for tankers or commercial vessels. The first vessel built, Baltika*, is currently working in 1.5 meter thick ice in the Gulf of Ob. She surpassed all expectations in full-scale tests in 2015.*

Arctech Helsinki Shipyard


Arctech Helsinki Shipyard

"The new Great Lakes icebreaker would have to be capable of assisting even the biggest lake freighters or 'lakers', but unlike them, be compact enough not to be confined to inland waters," says Tuomas Romu. "Having participated in the recent full scale ice trials and seen what such a vessel is capable of, I believe the best solution for the Great Lakes would be our oblique icebreaker concept. It could break a wide channel in the Great Lakes during the winter months and then leave for other tasks through the St. Lawrence Seaway. The icebreaker could also utilize some of the technologies featured in the new Finnish icebreaker *Polaris*."

The first LNG-powered icebreaker ever built was completed in August 2016 in Finland. Polaris *features all the latest technology available for icebreakers.*

Hybrid DAS propulsion adds cost efficiency

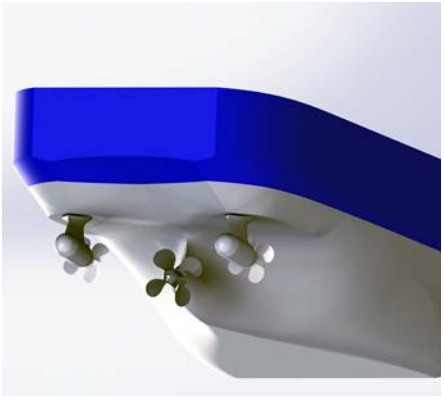
One of the latest icebreaking technologies in Aker Arctic's portfolio is the Hybrid DAS, which combines the superiority of the azimuth thruster propulsion in ice conditions with the cost efficiency of a conventional shaftline in long open water transits. This is one of the propulsion system alternatives proposed for the new United States Coast Guard heavy icebreaker.

"The design with a powerful shaft propeller at the centerline and two azimuth thrusters on the sides adds benefits in varying situations," says Tom Mattsson, senior specialist in ice performance at Aker Arctic.

"In ridges and difficult ice conditions, the vessel can move stern first and use the thrusters for maximum effect. In long open water transits, the shaftline propeller is used for cost efficiency."

Maneuverability in ice will be much better with this solution compared to a conventional icebreaker.

Additionally, the power balance between the thrusters and center propeller can be varied to maximize the efficiency in different operational situations.



Meet Tuomas Romu

Tuomas Romu started his career at Aker Arctic in 2011. Before joining the company as a full-time naval architect, he studied shipbuilding at Aalto University in Finland and arctic technology at the University Centre in Svalbard in Norway. Tuomas has worked as the project engineer in two recent icebreaker projects, Aker ARC 130 A and Aker ARC 124. In addition, he participated in the full-scale ice trials of the oblique icebreaker *Baltika* last year.

When he is not designing icebreakers or travelling in the High Arctic, Tuomas enjoys relaxing at his family's summer cabin. He is also a voluntary SAR boat crewman in the Finnish Lifeboat Institution.

Full-scale ice trials with bronze propeller

In March 2016, two full-scale ice trials were performed in the Bay of Bothnia between Oulu and Kemi, where ice conditions are extremely hard during cold winters. The first trial was to perform ice trials for the Finnish Border Guard's offshore patrol vessel *Turva.* The second trial was to test the newly developed bronze propeller in heavy ice.

FNS Louhi was fitted with the bronze propeller. The level ice tests were performed in 60 to 85 cm thick level ice, both ahead and astern operation mode was used.

The bronze propeller for ice has been developed in cooperation with TEVO Oy and the Technical Research Center of Finland, VTT Oy. Although not as strong a material as stainless steel, bronze has some benefits compared to a stainless steel propeller: better corrosion resistance, easier to manufacture and maintain, not to mention cheaper. Bronze is a widely used marine propeller material in open water and TEVO Oy wanted to find out if it would be feasible to use also in ice-going vessels.

Bronze propeller test on *Louhi*

The bronze propeller was fitted on the Finnish Navy's multipurpose vessel *Louhi*. She is designed specially as an oil and chemical spill response vessel and is owned by the Finnish Environment Institute (SYKE), but manned by the Finnish Navy. *Louhi* is equipped with two azimuthing thrusters with stainless steel propellers, but for this test one propeller was changed to the bronze propeller.

The tests were performed in both ahead and astern direction in 60 and 85 cm thick level ice, 6 m thick ice ridges, and ice channels.

"The conditions for extreme ice conditions were excellent," says Kari Laukia, head for ship design and engineering. "We wanted to test the propellers in as heavy conditions as possible and succeeded in finding different conditions suitable for it."

"In addition to strength measurements, we also took underwater videos in order to see how the ice and propeller interaction took place. After the testing, *Louhi* returned back to drydock and the test propeller was remounted and sent to TEVO for inspection."

The conclusions based on the test results are that the bronze propeller can be suitable for vessels in 1A Super ice conditions. The testing conditions gave reliable results and input for the propeller design for 1A and 1A Super ice class vessels.

FNS *Louhi* was built by Uki Workboat Ltd. in 2011. She is a multi-purpose response vessel designed to operate in all Baltic Sea ice conditions and fitted with extensive mechanical oil spill response outfit, including equipment designed specifically for collecting spilled oil in ice conditions.

Only one quarter of the ice ridge is visible on the surface and three quarters of it is below the surface. If the visible ice ridge measures two metres, this means that there are six metres of ice under water.

Technical details:

Displacement	3,450 ton
Length	71.4 metres
Beam	14.5 metres

4 x Wärtsilä 9L20 diesel engines

2 x 2.7 MW Rolls-Royce Z-drive thrusters

LNG-powered *Turva* in full-scale ice trials

OPV *Turva*, owned by the Finnish Border Guard, is one of the world's first LNG-powered offshore patrol vessels. The official full-scale ice trials were carried out in the Bay of Bothnia in March 2016.

The trials focused on testing basic performance in ice to ensure that targets are fulfilled. She was tested ahead and astern in level ice 60 to 85 centimetres thick, ahead and astern in ice ridges 6 to 8 metres thick, in ice channels as well as in manoeuvring tests. According to the tests, the vessel fulfils all requirements.

Dual-fuel in ice

"It was especially interesting to follow how the duel-fuelled machinery performed in ice conditions," says Kari Laukia. "We now have seen the operation in heavy ice, which can be used for further developing the combination of marine diesel and LNG-fuel."

Aker Arctic was involved in the concept development of the vessel and also performed the ice model tests. She was built by STX Rauma Shipyard and delivered in 2014 to the Finnish Border Guard. *Turva* is mainly intended for border control, but is also a highly capable multipurpose vessel fitted with mechanical oil recovery systems. She has an extensive command and control outfit including the Cassidian TRS-3D radar and a helideck capable of receiving and refuelling Super Puma helicopters both on deck and while hovering. Despite having a bulbous bow, *Turva* can also operate in ice-covered waters.

You can watch the tests on the Aker Arctic YouTube channel (www.youtube.com/akerarctic)

The ice cores were collected during the day and then tested on Turva's aft deck.

Technical details:

Length	95.9 m
Beam	17.4 m
Draught	5.0 m

Wärtsilä 12V34DF dual fuel engine

2 x Wärtsilä 6L34DF dual fuel generating sets

2 x Rolls-Royce Azipull Z-drive thrusters

Controllable pitch propeller at centerline

Top class ice research at Aalto University

Aker Arctic and Aalto University have a long history of cooperation, not least because many of Aker Arctic's employees have graduated as Naval Architects from the University. Arctic marine and ice technology research is strong at Aalto and through various Tekes (the Finnish Funding Agency for innovation) -funded joint projects Aker Arctic helps supporting the research.

”Our cooperation with Aalto University takes place on many levels," says Topi Leiviskä, head of research and testing services at Aker Arctic.

"Basic research on ice behaviour is an important area for both of us, therefore we want to be involved and support the research as much as we can. We regularly employ graduates for thesis projects and many of them have continued to work at Aker Arctic after graduation. We also offer part-time work for students at our ice model testing laboratory."

Unique squared basin

Aalto University in Otaniemi has its own ice model testing facility, which has recently been undergoing renovation and should be ready for use by the end of 2016. The basin is square in shape and measures forty times forty metres, being the only one in the world of this size.

"The university focuses on research projects. We can now rent their basin for commercial projects, where the square shape is beneficial, as there is plenty of space on all sides," Leiviskä says.

It is excellent, for instance, for turning tests, operational tests and manoeuvring tests as well as for tests related to offshore and ice management such as ice movement and ice flowing direction.

"Before the renovation began, we built, for instance, an island in the basin in order to see how ice piles up against the shore," Leiviskä adds.

Current research projects

Aker Arctic supports research projects at Aalto University through various Tekes (the Finnish Funding Agency for innovation) -funded joint projects.

Read Assistant Professor Arttu Polojärvi's description of two important research projects, ICESCALE and ARAJÄÄ, on the next page.

The Aalto Ice Tank is under renovation and will be upgraded significantly for future research.

The Aalto Ice Tank is a multipurpose basin, which is mainly used for ice model scale tests, but can also be employed for tests in open water. The tank is 40 m wide and 40 m long with a depth of 2.8 m. The facility has a rail-bound bridge (orange, see photo) and underneath the towing carriage (blue).

A 40 m wide segmented wedge type wave maker, which can generate both regular and irregular waves, is installed on one side of the basin.

Ice research seminar

A research seminar was held at Aker Arctic in March 2016, where professors and researchers from Aalto University gave presentations on on-going ice research activities.

The topics were:

- Overview on research on ship-ice interaction (Pentti Kujala)
- Stochasticity in full-scale ice load measurements of a ship's hull (Mikko Suominen)
- Risk management of Baltic winter navigation systems (Osiris Valdez)
- Ice load dependency on the conditions the ship is in (Mikko Kotilainen)
- Numerical modelling of model ice failure (Rudiger von Bock und Polach)
- Risk analysis of ice management (Risto Haimelin)
- Overview on research on ice-structure interaction in Aalto (Jukka Tuhkuri/Arttu Polojärvi)
- Statistics of peak loads in the ice-structure interaction process (Janne Ranta)
- Ice-structure interaction in shallow water (Sonja Schneider)

Ice research cooperation projects

Comprehensive understanding of Arctic marine technology is of crucial importance as operations in the northern seas keep on increasing. Finland as an Arctic country and Finnish Arctic technology companies are actively participating in these operations. The safety and efficiency of the offshore structures in the Arctic environment is a topic commonly discussed within the Arctic technology community and even in the public media. The ice loads are a major factor on the safety of these structures, yet predicting these loads accurately remains challenging.

ICESCALE

It is well known that the ice loads on structures are related to the failure and fracture of sea ice, but the detailed physics of the fracture processes are not well understood. This makes the fracture of sea ice an important research area. We know that the results from the fracture experiments on sea ice depend on scale: small sea ice samples appear to be stronger than large ones. The ICESCALE-project studies the fracture of fresh water ice and model ice by conducting unique fracture experiments in the Aalto Ice Tank. The work also includes modelling efforts.

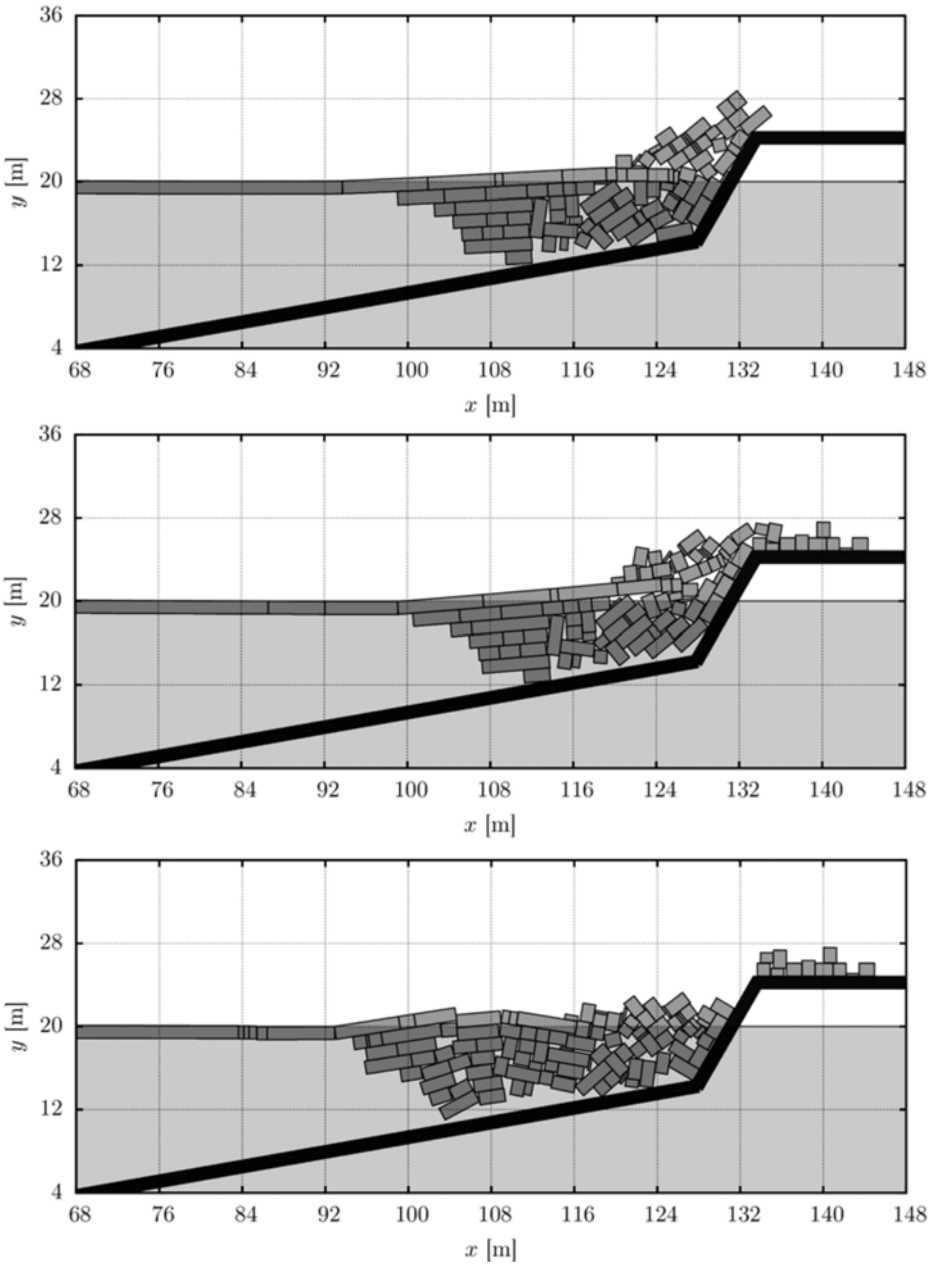
To ensure the success of our experiments, Aalto University has invited Professor John Dempsey as a FiDiPro-professor between 2015 and 2018 to work on ICESCALE. He is very well known for his research on the fracture and constitutive behaviour of sea ice. Professor Dempsey has exceptionally vast experience in high quality experimentation on sea ice. For example, he has been the lead investigator on six field projects in the Arctic and five in the Antarctic, conducting in-situ cyclic, creep-recovery, fracture and tension experiments on floating freshwater and sea ice.

Arttu Polojärvi is the Assistant Professor in Ice Mechanics at Aalto University School of Engineering, Department of Mechanical Engineering.
Photo: Johanna Ketola

ARAJÄÄ

Project ARAJÄÄ concentrates on a variety of topics closely related to design of Arctic offshore structures. The work is based on both numerical modelling and model scale experiments. The goals of the project are closely related to fracture of ice similarly to ICESCALE. On a general scale, ARAJÄÄ wants to improve the reliability and applicability of model scale tests. This should lead to more efficient and streamlined design processes for Arctic offshore structures. The work requires interaction between the Arctic Technology industry and researchers, and ARAJÄÄ increases this interaction through informal meetings discussing central topics in ice mechanics.

In addition, ARAJÄÄ studies ice loads on shallow water structure using numerical modelling and model scale experiments. This work aims to improve understanding of the fundamental mechanisms behind ice behaviour and the causes for ice loads. Numerical modelling helps us to obtain detailed knowledge of the problem, while the model scale experiments give reliable data for validation. We also look into ice management related model scale tests with an aim to understand how to increase the efficiency of ice management operations. We also aim to gain understanding for the implementation of an ice load portal, which, once in operation, could be used effectively in designs of offshore wind turbines for ice-covered seas.



Numerical modelling of the ice-structure interaction process in shallow water. These are performed in ARAJÄÄ together with model scale experiments on the same topic.

Safeguarding winter navigation on the Baltic Sea

There are around two thousand vessels in the Baltic Sea area at any given time, carrying 750,000,000 tonnes of cargo every year. During wintertime, large parts of the sea surface are covered by ice. A two-year EU-funded project called WINMOS was set in place in 2014 to develop maritime winter navigation and safeguard the future needs of icebreaking resources in the Baltic Sea.

The objectives of the project were to ensure sustainable efficient maritime transports round the year and mitigate the barrier effect caused by sea ice by:

- Foreseeing possible changes in the future and analysing the impact on the winter navigation system and the requirements for icebreaking capacity.
- Working out proposals for different concepts and designs of icebreakers and composition of the icebreaker fleet that meet industrial and environmental demands on maritime transport.
- Reducing emissions from existing icebreakers.
- Modernising the existing Finnish-Swedish Icebreaking Management System, IBNet, and improving the accessibility to the information for all relevant stakeholders within maritime shipping.
- Developing training methods for navigation in sea ice.
- Ensuring sufficient icebreaking resources.

The long-term vision is a joint Baltic Sea Icebreaking Service where the European Union and Russia cooperate within a joint winter navigation system.

Aker Arctic's role
There were a total of seven activities in the project, of which Aker Arctic participated in three.

1. Future demand in icebreaking
The predicted impact on the present and future merchant fleet's independent ice going capacity was estimated, especially with reference to new regulations concerning sulphur emissions and the Energy Efficiency Design Index, EEDI. Based on findings from the studies, a holistic simulation model of the winter navigation system performance was worked out. The result of this Activity is of utmost importance for decisions concerning the icebreaking strategy for the period 2020-2030.
"As EEDI limits the engine sizes of future vessels, these will need more assistance in ice than previously," says Ilkka Saisto, hydrodynamics specialist and Aker Arctic coordinator for the WINMOS-project. "This increased demand needs to be planned for."

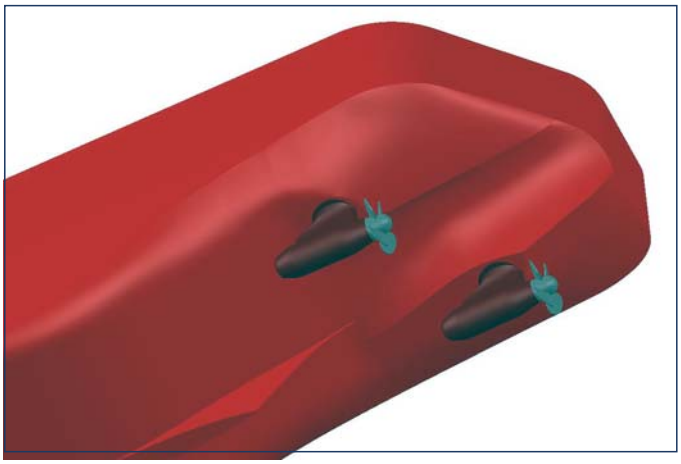
2. Next generation icebreakers
The objective was to assess the optimal composition of the Baltic Sea icebreaking fleet. A study on the required performance (size, design and engine power) of icebreakers for different areas in the Baltic Sea was performed. Available icebreaker concepts for different icebreaker categories in the Baltic Sea system were assessed. The selection of concepts for further evaluation was based on the results of the study together with findings of known performance factors of existing icebreakers and the results from Activity 1.
"The icebreaking Trimaran concept, the Oblique icebreaker, the new Finnish icebreaker *Polaris* and an add-on icebreaking bow developed by ILS were compared to URHO/ATLE class icebreakers," Saisto explains.
A study on fuelling possibilities for selected icebreaker types was performed. The study covered the effect of alternative fuels on bunker capacity, as well as their environmental impact, lifetime costs and operational propulsion efficiency. The pros and cons of various propulsion types were also considered in this study. Based on results from the study, the relative overall efficiency for different selected icebreaker concepts was performed.
Existing model-basin-data (test result in artificial ice) and models was utilised. During the project time, adjustments on power and size of the models were carried out in order to assess their suitability for operations in intended areas.
Studies on commercial and legal aspects and experiences of different ownership, chartering and operating arrangements pros and cons were performed. The study covered several aspects of various arrangements including long-term total costs, risks, control functions and liabilities.
A plan was developed on next generation icebreaker, which will support decisions for new buildings during 2020-2030.

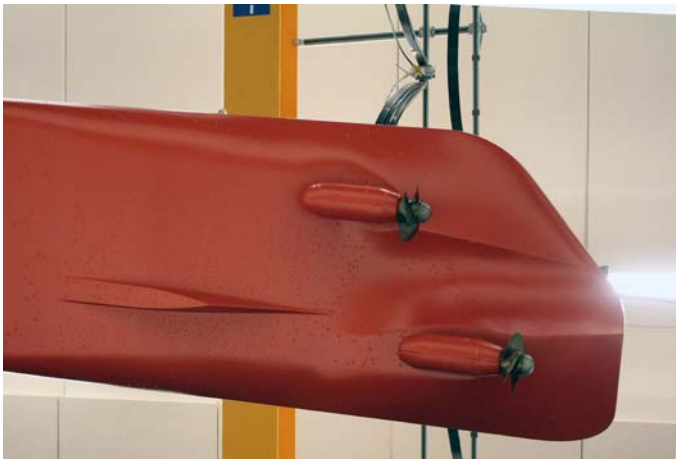
5. The human element and training facilities
Well-trained officers on board ships will reduce the risk of accidents and maintain a high ice navigation performance. The objective of Activity 5 was to facilitate winter navigation training for ship officers. Simulator facilities and a simulator training programme for ship officers were developed. The programme will be adapted to winter navigation conditions in the Baltic Sea.
Relevant skills and their components for ship officers operating vessels in ice conditions was assessed and defined. A Baltic Sea standard simulator training program related to these skills was elaborated. Specific criteria for simulator facilities and individual ship model quality were defined. Specific shortcomings in present simulators and their modelling and presentation technologies were evaluated and listed.
The most critical simulation shortcomings for ice-training simulators were selected for development and improvement in co-operation with simulator manufacturers.
The WINMOS partnership involved public, private and academic entities from Finland, Sweden and Estonia. The project was appointed as a flagship action within the European Union Strategy for the Baltic Sea Region. The main coordinator from Finland was The Finnish Transport Agency. Ilkka Saisto coordinated the project work on behalf of Aker Arctic Technology Inc.

Meet Ilkka Saisto

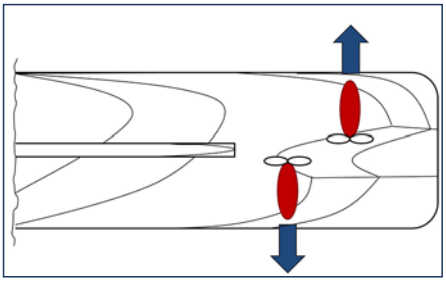
Ilkka joined Aker Arctic in 2014 and is a specialist in hydrodynamics. Open water characteristics are an important feature in icebreakers and Ilkka is involved in most design projects within his area of specialisation. He worked previously at VTT Technical Research Centre of Finland in ship hydrodynamic research and arctic research.
Ilkka enjoys ships and hydrodynamics also in his free time. He has spent his summer vacations on the same sailing boat since he was a child. Nowadays his wife and two teenage daughters accompany him.

New asymmetrical stern improves ice management





Aker Arctic has developed a new stern design specially intended for ice management vessels. Among many other benefits, the design will improve the flushing effect of the propulsion units compared to a traditional propulsion arrangement. The flushing effect of water flow is typically used in ice management operations to clear ice away to achieve open water areas.



Icebreakers and ice management vessels are required to have efficient icebreaking and ice clearing capabilities. Their normal tasks are to clear ice from piers, clear and enlarge ice channels and clear ice ridges, etc. so that other vessels can move and berth without problems.

In a typical arrangement of azimuthing pulling type thrusters, the propellers are located very close to each other when they are turned inwards for the flushing operation. The amount of water they need in order to create the maximum flushing effect might be limited, which causes them to cavitate, vibrate and create noise. The flushing operation is therefore not very efficient if the thrusters cannot be used with full power or they have large forbidden sectors.

"We have now invented a solution to this," Project Manager Riku Kiili highlights. "By changing the stern design to an asymmetrical form, the thrusters can be installed lengthwise away from each other. There is more space in between the pods and when turning them sideways for ice flushing, they get enough water and can blow the ice away using full power."

Model testing results

An extensive model testing series was carried out, lasting totally about ten days. Two different designs of the stern were manufactured and both of them were tested with the same tests:

- level icebreaking capability in two different thicknesses
- breaking out from an ice channel stern first, both directions
- breaking through an ice ridge
- clearing capability of brash ice

The model used to compare the test results was one of the icebreaking supply and stand-by vessels we have designed.

The results from the tests showed that the level ice breaking capability and the breaking out from an ice channel remained, but brash ice and ridge clearing capability was improved with the new design.

Many benefits for ice management vessels

Regarding the open water characteristics of the new stern design, excellent manoeuvrability will remain and directional stability will not be a problem. Movements in waves will be slightly asymmetrical and slamming still needs to be studied, but the new stern form can be designed also to manage and break waves more efficiently astern.

In addition to ice management advantages and improved flushing capabilities, this design showed improved DP potential in some situations. There are smaller limited sectors for propulsors and full thrust with both propulsors can be directed sideways in the same direction.

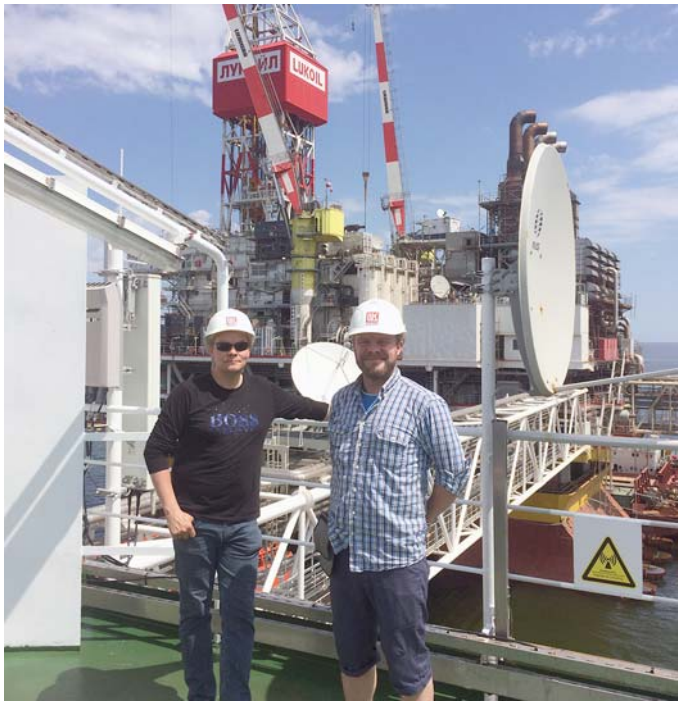
The asymmetrical icebreaking process is similar to the icebreaking Trimaran, where ice is broken and bent downwards in phases. The asymmetrical shape can be designed to allow small oblique icebreaking angles for the vessel, similar to the oblique icebreaker *Baltika*.

The asymmetrical stern will have impacts on the ship size compared to a traditional design. At the same deadweight, the ship length increases, meaning more cargo deck. The cargo deck can be designed to be symmetrical or asymmetrical. On the other hand, if the length of the vessel is kept the same, the deadweight decreases. If the size of the propulsion units determines the breadth of the vessel, with this design the vessel can be narrower, with the benefit of smaller ice resistance. All choices, detailed design and shape of the stern depend on the intended use of the vessel.

"The benefits of an asymmetrical stern for icebreaking ice management vessels are obvious," says Kiili. "Especially for harbour icebreakers, supply vessels or even drillships that need to manage independently in ice."

"Because the propulsion units are not positioned side by side, there is also less risk that a piece of ice will get jammed between the propellers."

Oil platform winterisation check



Ilkka Rantanen and Sami Saarinen visited Lukoil's new Filanovsky oil platform in the Caspian Sea in July 2016 and performed an oil platform winterisation check.

This winterisation check included evaluation of ice resistance, evaluation of the ability to function in extreme cold weather as well as an environmental and oil spill check. Based on the results, we can make recommendations on how to improve certain aspects," Ilkka Rantanen explains.

"All major things are in good order, but winterisation can always be improved in terms of safety. For instance, how to keep walkways and helideck ice free at all times, installation of heating systems for evacuation routes or wind protection for walkways to mention but a few."

The Caspian Sea is a challenging area, especially due to its shallow waters. The area around the Filanovsky platform is about 6.5 m deep, but in other areas the water depth can be as little as 3 m. An additional challenge is that the level varies throughout the year. The air temperature can range from -30 degrees Celsius to +35 degrees Celsius.

"Only about ten per cent of the year is extremely cold, but when this occurs with strong, freezing winds, the ice piles up against the structures," Rantanen adds. "This ice is often a brash type of ice, which is difficult to remove and also does not support walking on. Therefore, it is essential to plan the ability for machines and people to function during this time, how to service the platform and how to evacuate in case of an accident."

The Vladimir Filanovsky oil field is one of the largest oil fields discovered in Russia in the past 25 years. It is located in the northern part of the Caspian Sea. Lukoil's Filanovsky platform is expected to begin production this year.

Aker Arctic has earlier experience from Caspian Sea operations. Among other projects, we designed the five Mangustay shallow draught icebreaking tugs for Caspian Offshore Construction in 2009. These tugs have an exceptional draught of only 2.5 m.

Winter is a challenging time in the Caspian Sea with freezing temperatures and strong winds. In1998, Aker Arctic designed and Kvaerner Masa- Yards built two icebreaking supply vessels for Wagenborg Kazakhstan B.V.

Aker Arctic designed five shallow draught icebreaking tugs for Caspian Offshore Construction in 2009.

United States Coast Guard visits Aker Arctic

Vice Commandant of the United States Coast Guard, Admiral Charles Michel visited Aker Arctic with his delegation in March 2016. The purpose of his visit to Finland was to learn about the Finnish Border Guard's Arctic operations and other Finnish Arctic stakeholders. The visit was hosted by the Finnish Border Guard and supported by other Finnish Arctic stakeholders and partners.

Aker Arctic receives Maritime achievement award

Aker Arctic Technology received the Finnish Maritime Society's Maritime Achievement - Honorary Award in April 2016, for its work in keeping icebreaking knowhow on a high level and for continuously developing new innovative technological solutions for the global market.

The Finnish Maritime Society works for the benefit of the Finnish maritime culture and promotes activities related to the sea. The Maritime Society has long concentrated its activities on the Finnish sea cluster, the companies and associations operating in the maritime sectors.

Since 1986, The Finnish Maritime Society has granted its "Maritime Achievement-Honorary Award" as recognition of major achievements for increasing knowledge and appreciation of maritime culture. This respected award has so far been granted seven times.

As a marine cooperation forum, the Society enhances the importance of shipping and other marine operations to our country, and its target is to increase the interest in and knowledge and appreciation of the maritime sectors.

Mr Mikko Niini presented Mr Reko-Antti Suojanen with the Finnish Maritime Society's Honorary Award in April 2016.

Gas condensate tanker design soon ready

Aker Arctic is designing an Arctic condensate tanker, which will be used to transport gas condensate from the LNG-plant under construction on the coast of the Ob Bay, Yamal peninsula. Gas condensate is a valuable by-product, which is separated from the natural gas before its liquefaction process.

"The basic design of the tanker is in its final stages," says Project Manager Riku Kiili. "GSI Shipyard continues the detail and production design. Steel cutting and production in Guangzhou is planned to begin at the end of 2016."

State-of-the-art Port ice-breaker ready for construction

Basic design including classification documentation for the most advanced port icebreaker in the world, Aker ARC 124, is almost completed. The vessel will be used to support LNG-carriers' operability in Sabetta harbour in the Russian Arctic.

Construction will soon begin at Vyborg Shipyard PJSC. The vessel, ordered by FSUE Atomflot, is planned to be ready in 2018.

The state-of-the-art technical features for this vessel include a four thruster propulsion solution, two in the stern and two in the bow, which will take manoeuvrability to a new level. It will also be competent in thick brash ice in Sabetta harbour. Further technical details is a completely new Onboard DC Grid, developed by ABB, and Wärtsilä's new 31 series main engines, recently acknowledged as the world's most efficient four-stroke engine type.

Paint testing continues

The hull of a vessel needs a protective coating to prevent corrosion and to minimise friction. New improved paints are regularly entering the market and Aker Arctic continues to test their durability and friction protection.

"About 20-30% of a vessel's resistance in ice comes from friction between the hull and the ice. The smoother the hull, the less friction there is, this is evident. Reducing friction saves money and is ecologically important as fuel consumption is highly related to friction," says Structural Engineer Ville Valtonen.

Arctic module carriers busy at work

The two Aker Arctic designed PC 3/ARC 7 Arctic Module Carriers, *Audax* and *Pugnax*, are now busy transporting construction modules to the arctic LNG plant being built in Sabetta.

The two carriers were delivered at the beginning of 2016. The development work was carried out in close cooperation with the owners, ZPMC-Red Box Energy Services, and the vessels were constructed at Guangzhou Shipyard International in China.

We additionally took responsibility for designing and delivering the special propellers suitable for extremely demanding use in heavy ice conditions for the two carriers.

11th Arctic Passion Seminar

The 11th Arctic Passion Seminar was held at Aker Arctic on 3 March 2016. Nearly one hundred Arctic specialists and other shipbuilding, shipping and offshore professionals from around the world gathered in Helsinki, Finland, to discuss the latest developments in the Arctic, as well as on-going and upcoming projects, new ice-going vessel concepts and advances in technology.

The highlight of this year's seminar was demonstrating dynamic positioning in ice using a real DP software adapted to model scale.

The opening speech was given by the Minister of Economic Affairs of Finland, Olli Rehn, who talked about the Finnish experience and perspectives for Arctic development.

Mr Reko-Antti Suojanen gave an overview of the current situation within Aker Arctic and the markets. He also briefly presented the new Arctic Aframax vessel design and new developments for operational services, such as the Ice Load Monitoring System, which will help ship owners in challenging ice operations.

Mr Mikhail Grigoryev, GECON, gave an update on oil and gas development projects in the Russian Arctic in the current condition of low oil prices and also talked about how it will influence the development of Arctic navigation.

Mr Zhou Xuhui presented the world's first PC-3/ARC-7 module carriers.

Mr Valtonen, Mr Sipilä and Mr Michel discussing the new French Polar Logistics Vessel.

The world's first PC 3/Arc7 arctic module carriers were delivered at the beginning of this year. Mr Zhou Xuhui from Guangzhou Shipyard International presented the construction project.

Aker Arctic is supporting the construction of the new French Polar Logistics Vessel at Piriou Shipyard in France. Mr Pierre-Alan Michel, Piriou, and Mr Heikki Sipilä, Aker Arctic, gave a presentation on the vessel and an update on progress made in its construction.

In addition to the seminar presentations, the Arctic Passion Seminar included an ice model test in Aker Arctic's ice laboratory. This year, we demonstrated the operation of a dynamically positioned icebreaking offshore vessel in floe ice using a real DP system adapted to model scale. The test was part of an on-going R&D project between Aker Arctic and Navis Engineering with the aim to develop improved DP-capabilities in ice operations.

After lunch, Mr Evan Martin and Mr Arno Keinonen from Aker Arctic Canada (AKAC) talked about utilising past operational experience to benefit the future. Mr Mikhail Belkin, FSUE Atomflot, followed with an interesting speech about icebreaking assistance to major national Arctic hydrocarbon projects.

ICEYE is quick response radar imagery from small satellites. Mr Tuomas Korpela, Iceye Oy, explained how it works.

Vyborg Shipyard has recently been awarded construction of modern, innovative icebreakers designed by Aker Arctic, such as the two Aker ARC 130 A icebreakers and the advanced port icebreaker design Aker ARC 124 for the FSUE Atomflot. Mr Alexander Solovyev talked about their experiences. Mr Andrey Knyazevskiy, Gazprom Neft Novy Port, then explained what the Aker ARC 130 A will be used for and how the Novy Port development project is moving forward.

Mr Andrew Kendrick, VARD Marine, held a presentation on how they have benefited from Aker Arctic's experience in the design co-operation.

Mr Mika Hovilainen, Aker Arctic, concluded the day with a presentation on the extraordinary sideways moving icebreaker *Baltika* and the experiences from the full-scale tests held in 2015 in the Gulf of Ob, where she surpassed all expectations and finally he gave his thoughts on the future potential of this unique vessel concept.

We would like to thank all guest speakers and participants of this year's successful and interesting Arctic Passion Seminar!

Meet us here!

We will participate in the following events:

SMM Hamburg
6 - 9 Sept 2016

Arctic Shipping Forum North America, Montreal
4 - 6 Oct 2016

ATC 2016, St. Johns
24 - 26 October 2016

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