Aker Arctic Technology Inc Newsletter

March 2015

Arctic Passion News

1 / 2015 / 9

Decades of arctic expertise

In this issue

Dear Reader,

We are currently experiencing significant changes in many respects. In recent decades, development in arctic projects has been quite slow, whereas today there are many big projects underway, e.g. in Sakhalin and Yamal, not to mention the developments in Alaska and the Antarctic region. New regulatory setups are being created, such as Polar classes and the Polar Code.

Everywhere in this industry, we are also experiencing a generational shift. The next generation of arctic experts are increasingly involved in arctic work while the older generation is providing their support. We have successfully managed this knowledge shift and can be tremendously proud of our remarkable team of top professionals: people that design, test and innovate year after year. The work of this team has allowed us to become the world's top specialist in arctic ship technology.

We are all aware of the challenges the Arctic poses to any operation, and joint effort in developmental work is important. This year, Aker Arctic is celebrating ten years of independent operations, and we can clearly see that the global cooperation within various projects with our clients and partners has created great solutions for arctic and ice-related operations. The past decade has been interesting, and the company has succeeded in establishing an important position within the community.

Aker Arctic already had a long history before becoming a fully independent company. The former Wärtsilä Ice Model Basin (1969–1983), Wärtsilä Arctic Research Centre (1983–1989) and Kvaerner Masa-Yards Arctic Technology Centre (1989–2005) were behind most of the world's icebreakers that were built in Finland. The founding of Aker Arctic in 2005 was set to continue the development and design of icebreaking ships, now serving the global markets for shipowners and shipbuilders.

Our ice model testing facility is used continuously in the development of new ships and to solve ice-related challenges. We are strongly engaged in the business of ice-going ship design and engineering, research and development services for ships, related structures and components, as well as arctic offshore structures. In addition to ship design, model and full-scale testing services, we actively take part in ice expeditions, training and other technology services associated with operations in icy or severely cold conditions.

In this issue of Arctic Passion News we describe our current projects. We have also included a special review of the ten years of achievements describing Aker Arctic's past decade. We emphasise the importance of our clients and co-operation partners for teaming up on projects all these years.

On behalf of the entire Aker Arctic team, I hope you enjoy your reading, and let's look forward to the next ten years with great ambition!

Reko-Antti Suojanen
Managing Director

Announcements

Antero Jäppinen has been appointed Project Engineer (electrical systems) for the engineering department at Aker Arctic. He was previously at Edec Oy, where he worked as project manager in electrical design projects. Earlier in his career he worked at Kvaerner Masa Yards, Helsinki as a project engineer for Navigation and communication systems.

Martti Kesäniemi has been appointed Software Engineer. Martti transfers to us from Microsoft Mobile. Martti holds a M.Sc. in technical physics and mathematics, and he has a background in technical computing.

Ilkka Saisto has joined Aker Arctic as Senior Hydrodynamic Specialist in the ship design department. Ilkka transfers from the VTT Technical Research Centre of Finland, where he worked as a research team leader and senior scientist responsible for ship hydrodynamic research.

Toni Skogström has been appointed as a Research Engineer in the Testing Department. He graduated as a Naval Architect from Aalto University School of Engineering in 2015 and his thesis considered the effect of the conical structure angle on the ice-breaking process in model ice.

Please note that our telephone numbers have changed

Tel. 010 3236 300
Fax 010 3236 400

Our website also has a new look and you can now follow us on Facebook, Twitter and LinkedIn, www.akerarctic.fi.

Concept design for Argentinian Special Purpose Ship

In November 2014, Aker Arctic was awarded the contract for the concept design of a new Special Purpose Ship for the Argentinian government.

The Special Purpose Ship for the Argentinian government will be used mainly for transporting equipment and researchers to Argentina's Antarctic base, as well as for research purposes.

“This is a good example of a ship where various customers' differing requirements lead to different ship concepts,” says chief designer Lars Lönnberg who is also responsible for designing the Chinese Polar Research Vessel.

The concept design was completed at the end of February 2015. The ship will be constructed in China and the design work will be carried out in close co-operation with the operators and shipyard.

“It has been a pleasure to work with the Argentinian customer. They have been able to make fast decisions in order to advance the project. This is an excellent example of how governmental acquisitions for polar vessels do not necessarily need a long timeframe. We began initial discussions in May 2014 and the contract was signed in November. Now the concept design is already completed," Sales and Marketing Manager Arto Uuskallio says.

This new order is a continuation of many other governmental icebreaker projects that have been delivered in a short time from Aker Arctic, and thus serve as proof of the increasing interest in the polar areas and the need for reliable and efficient vessels.

Main dimensions

Length overall	about 131.5 m
Length on design WL	about 125.0 m
Breadth maximum	about 23.9 m
Breadth at design WL	about 23.6 m
Draught, at design WL	8.0 m
Draught, maximum	8.3 m
Depth to main deck	11.8 m
Freeboard at maximum draught	3.5 m

Aker Arctic ten years

Aker Arctic celebrates ten years as an independent company this year. From an initial twelve persons, we are today a world-renowned company in arctic technology with close to fifty employees and a turnover of 10 million euros. However, our history begins nearly five decades earlier.

It is 1969 and the 106 000 DWT tanker SS Manhattan tries to prove that the Northwest Passage is a viable commercial route for shipping oil from the Arctic. Humble Oil has modified her for the task with the assistance of Finnish Shipbuilding Company Wärtsilä, which is experienced in building icebreakers. The SS Manhattan gains valuable experience during the voyage through the Northwest Passage and this full-scale experiment with the (at that time) largest U.S. flag vessel operated by Esso (Exxon) marks a significant milestone in arctic transports.

Along this development Esso (Exxon) initiates the idea of an ice model basin, where the performance of the SS Manhattan and possible future vessels is to be tested. Wärtsilä decides to follow through and the first ice model-testing basin in Finland, Wärtsilä Icebreaking Model Basin (WIMB), is ready in 1969.

Ten years later, Wärtsilä decides to expand its ice research facilities and Wärtsilä Arctic Research Centre (WARC) is inaugurated in 1983. This bigger and better facility also serves universities for research purposes and the solid foundation of our cutting edge ice knowledge is established. Unfortunately Wärtsilä Marine goes bankrupt at the end of the 1980s and as a result a new shipbuilding company, Masa-Yards is founded. It takes over also the testing facility and ice research continues under a new name, Masa-Yards Arctic Research Centre (MARC), which later becomes part of the Norwegian Kvaerner group.

Uncertain times

Mr Mikko Niini, previous Managing Director of Aker Arctic remembers how the future of the ice research laboratory was uncertain many times during those years.

"The 1990s were difficult times, the Soviet Union collapsed and our joint projects stopped. Luckily, western oil companies began investing in Russia - in Sakhalin in particular - and subsequently became interested in our services, so we survived. During this time the azimuthing electric thruster was developed, which lead to the revolutionary Azipod® product and Double-Acting Ship concept (DAS™) we invented and developed for ice navigation. The big change for us came when Aker took Kvaerner over and the new management decided to separate the research centre from the local shipbuilding entities. In 2004 I was given the task of managing the change and building a new research facility, but first I needed to find enough partners willing to invest money in it. In addition to Aker Yards, and after many discussions with potential partners, the joint owners became Aker-Kvaerner Oil & Gas, Wärtsilä and ABB."

A day of celebration

"Aker Arctic Technology Inc started operations in January 2005 with 12 persons and from there we began to build our identity as an independent global ice partner," Mr Niini continues.

"At the end of 2005, Aker decided to focus on vessels other than icebreakers and we were able to pick eight key ship designers from Helsinki Shipyard to join us. Two months later, our new facility in Vuosaari Marine Business Park was ready and we could move in. On the inauguration day Mr Göran Wilkman, one of our founding employees, was in the Arctic for full-scale tests of Norilskiy Nickel's first vessel. Through a live call he told us that the vessel had clearly surpassed all design targets – it was a day of double celebration."

Entire ship design projects

"In the beginning, our business was model testing and consulting work but step-by-step we have expanded our services in order to manage complete projects. In addition we provide training for ice operations, which by recent development of the ice simulator now can be carried out with advanced tools. We have built up an organisation that can carry out entire ship design projects in partnership with our customers," says Mr Reko-Antti Suojanen, Managing Director of Aker Arctic.

“Typical for arctic projects is that they extend over a long period of time. From the initial preparations to design, construction and verification, the timeframe can be up to ten, even twenty years. We have become used to this timeframe throughout our long history and have to date many successful complete design projects behind us.

2005 Aker Arctic Technology Inc
We began independent operations in January 2005.

Our roots are in shipbuilding, which makes it easy for us to communicate with shipyards and support them in construction. One growing focus area is offshore projects and fixed structures for the Arctic."

Competence transfer

A few years ago, some of our most experienced employees started to reach the age of retirement and therefore a competence transfer program was set in place to transfer know-how and skills to the new generation of ice experts.

"The competence transfer and the education programs we have for training current and new employees have been successful. Our workforce is steadily growing, with young, bright engineers with a passion for ice swelling our ranks, and soon we will reach a new milestone of 50 permanent employees," adds Mr Arto Uuskallio, Sales and Marketing Manager.

"Looking back at the past ten years, our company has grown and developed through our different customer projects. It is a step-by-step learning curve where the outcome from one project helps us in the next. As a service company, we will continue to develop in ways which will best support our customers in their future projects," Mr Suojanen emphasises.

2013 Ownership changes
The Finnish Government owned investment company, Finnish Industry Investment Ltd, acquired a majority stake of the shares (66,4%) of Aker Arctic from STX Finland in order to keep arctic marine know-how in Finland. Other current minority owners are ABB Oy Finland and Aker Engineering and Technology AS from Norway with 16,8% of shares each.

2014 Turnover reaches 10 Million euros
From twelve persons and a turnover of 3,6 million euros, we are today a world-renowned company in arctic technology with close to fifty employees and a turnover of 10 million euros.

2005 Prirazlomnoye
Our first basic design project, which was an entire ship design project. It gave us the confidence to use the wide range of our know-how to serve our customers. As we had been part of a shipbuilding company, we wanted to stay hands-on in shipbuilding and to receive feedback also directly from the shipyards.

2006 Vuosaari facilities ready
Our new office building and model testing facility in Vuosaari Marine Business Park was ready and Aker Arctic personnel moved in.

2006 Norilskiy Nickel arctic container vessels
Breakthrough vessels with the new, revolutionary Double-Acting Ship (DAS™) technology we developed. Today this technology is more or less the standard in arctic vessels. These were among the first ships to operate year-round in the Arctic and proved that it is possible.

2007 Varandey arctic shuttle tankers
The pioneering trio of arctic tankers designed specifically for the project, built by Samsung and owned by Sovcomflot began to transport crude oil in the Russian Arctic region without icebreaker assistance for the first time in the world.

2010 Yamal LNG project
Development work for the Yamal LNG exports had already begun in the 1990s and continued until 2006. In 2010 the Yamal LNG project moved ahead and we have been involved in the planning and design development of LNG-carriers, Sabetta harbour as well as designing the port icebreakers to ensure efficient all-year operations.

2010 Ice simulator
Aker Arctic's ice simulator was introduced and has been continuously improved since. The simulation tool can be used both for planning vessels and operations and for training the crew.

2010 Turret mooring system
Turret mooring system introduced at the model testing facility. The amount and the characteristics of the mooring lines can be changed according to specifications.

2011 Oblique icebreaker
The first unit of the unique Aker Arctic developed oblique icebreaker concept was ordered by the Russian Government. Initial development work for this concept was underway already in the 1990s, an example of how the time-span for arctic projects can be decades long.

2009 Caspian Sea shallow draught icebreaker tugs
Five shallow draught icebreaking tugs for independent year-round operations in the North Caspian Sea. A basic design project where we also supported the shipyard until all vessels were ready and delivered.

2011 Multimodel testing
Multimodel testing began at our model testing facility. Several vessels can be tested at the same time, which is especially important in testing and visualising ice management operations.

2012 Canadian polar icebreaker
We became a member of the design team for the new polar icebreaker for the Canadian Coast Guard with responsibilities for all ice related technologies.

2012 Chinese polar research icebreaker
Conceptual and basic design began for the highly advanced polar research vessel for China.

2013 Finnish LNG-fuelled icebreaker
The world's first LNG-fuelled icebreaker was ordered by the Finnish Transport Agency. We created the concept design and are also actively involved in the construction together with the owner and the shipyard.

2014 Arctic module carrier
Development of two PC3 class module carriers, which can operate year-round in delivering construction modules from Europe and Asia to the LNG-plant in Sabetta. Design work was carried out in close cooperation with ZPMC-Red Box Energy Services. We are currently supporting the two vessels' construction work in China.

Offshore experts ensure safety

Aker Arctic has recently re-organised its ice technology business into three strategic business units in order to better respond to customer needs: Ship Design & Engineering, Research and Testing Services, and Offshore Services. New Head of Offshore Services, Ilkka Rantanen explains what Offshore Services really is about.

“Most of our offshore projects derive from oil and gas production and their support functions. We have been involved in designing arctic harbours, cargo vessels, vessels for harbour infrastructure as well as designing products related to production such as drillships, oil rigs and production platforms. Floaters and semi-sub structures for either arctic use or other freezing conditions are included in the latter," Ilkka Rantanen, Head of Offshore Services, outlines.

Aker Arctic had already begun offshore conceptual design and model testing in the mid 1970s. Over the decades, unique information has been gathered from various testing, arctic expeditions, shipbuilding and offshore industry.

Preventing emergency

"One of our core services is ice management, an area which will grow in importance in the future. Ice management in short means planning how to operate safely in challenging, freezing circumstances. Accurate predictions and planning are essential when drilling for oil and gas in arctic conditions and this is something we assist the oil, gas, research and drilling companies with globally. We help them to plan when and how to safely operate and when operations need to stop taking into account their equipment, ice situation and ice development. If an operation has to be ended as an emergency, there is a great risk of losing valuable and expensive equipment, which might never be recovered. The very fragile environment must be taken into account and all risks need to be minimised. Therefore predictions are worth putting an effort into," Mr Rantanen emphasises.

Many projects Aker Arctic has been involved in involve so-called winterisation projects. "This means that we make sure that everything works in freezing conditions. We can also assist in converting a structure so that it can function in cold conditions, including the conversion plan, providing a team of specialists and supervising the alteration work onboard. Sometimes our engineering is to analyse conversion plans and help larger organisations in Arctic Packages of design scope.”

“We cover all the cold areas globally, such as Northern Russia, Barents Sea, USA, Canada, Europe and Asia. Our customers are oil and gas companies, ship operators and engineering offices, which don't possess arctic know-how in the same extent as us," Mr Rantanen says.

Fragile environment

"Environmental aspects are an important part of our work, especially at Offshore Services where we deal with fragile areas. Safety in operations, oil spill prevention and oil spill recovery are part of our offshore services," Mr Rantanen continues.

"Our concept at Aker Arctic is unique as we have know-how in both ice management and offshore, in addition to our model testing facility and long history of arctic ship design. This is why our customers turn to us with the most complex projects as we can offer them partnership across an entire project, from initial planning to designing, testing and finally supervising construction and full-scale verification."

Offshore team

Aker Arctic's core offshore team comprises Ilkka Rantanen, Sami Saarinen, Esa Ritari and Cayetana Ruiz de Almiron de Andres. For each customer project these Project Managers gather a project team consisting of experts from Engineering and Testing units within the company.

Cayetana Ruiz de Almiron specialises in harbour design. She is originally from Spain and works with us as a Project Engineer.

Ilkka Rantanen joined Aker Arctic in August 2014. He transferred from STX Finland in Rauma, where his home currently is, and he divides his time between Helsinki and Rauma. Ilkka has a long background in Offshore, both from STX Finland and his earlier work at Hollming Works Group.

Sami Saarinen has been with Aker Arctic for many years and is our true ice expert. He has been on numerous expeditions to the Arctic in order to gather valuable ice knowledge.

Esa Ritari has a solid background in ship design and offshore projects, especially in conversion and retrofit. He joined Aker Arctic from STX Finland in 2013 and has previously worked in Houston, USA, as an expatriate for Metso.

Arctic drillships extend operative window

A common requirement for all drillships operating in arctic areas is ice capability and suitability for cold or arctic climates.

Characteristic for normal drillships intended for open water use is open deck areas. In arctic drillships, on the contrary, enclosure is preferred to effectively enable any required winterisation. Winterisation means ensuring that the vessel, all machinery and equipment function at all times in icy and freezing weather conditions. This poses substantial challenge for the design work. All interior areas as well as crew areas have to be planned with safety as a top priority, with sufficient ventilation and clear evacuation plans. Other challenges are ice related, such as ice loads.

Riser protection essential

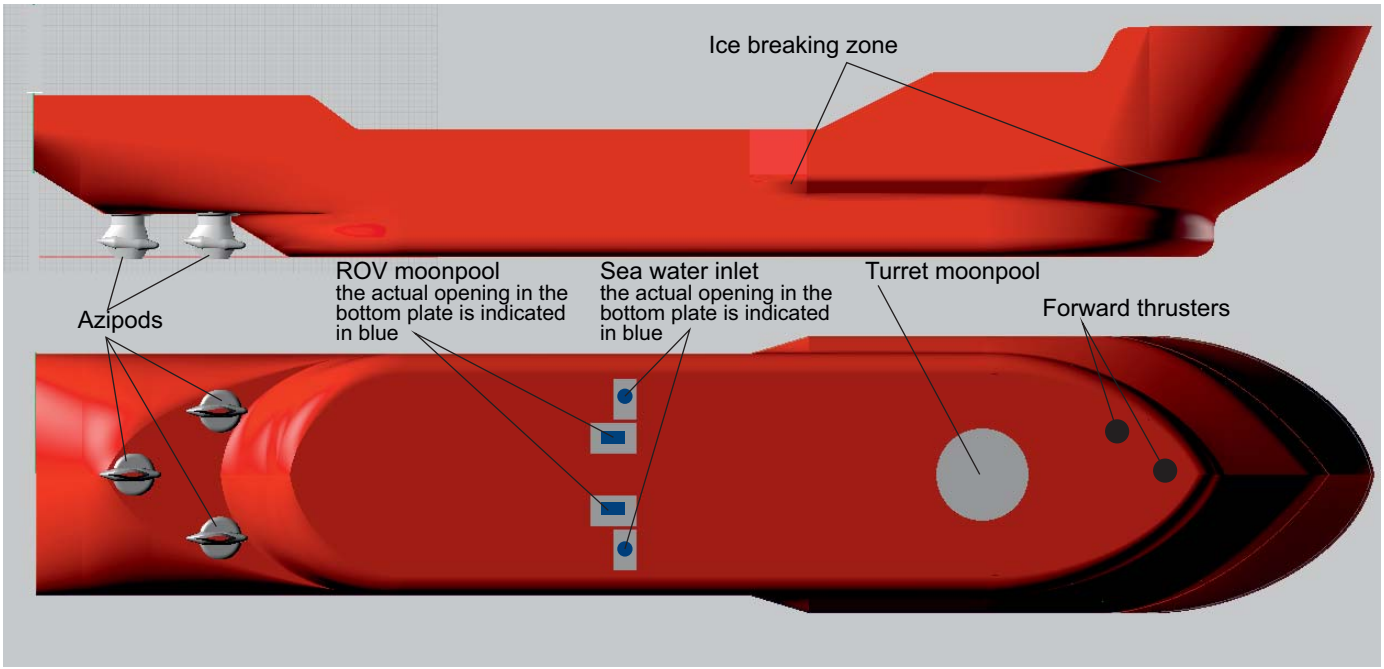
Drillships are either moored to the seafloor with anchors or maintain position using propulsion and dynamic positioning (DP) system.. Essential for both is riser protection, meaning that ice is not allowed to move under the ship to the moonpool area and reach the drilling equipment. This can be managed for example through the hull shape.

"In the Arctic waters, drilling operation is performed during the summer months. With a specially designed arctic drillship, the operative window can be extended. The drillship can arrive safely at the site and begin operations when there is still ice and stay longer towards winter, adding great value to our customers and operators," Esa Ritari, Project Manager at Aker Arctic Offshore Services, highlights.

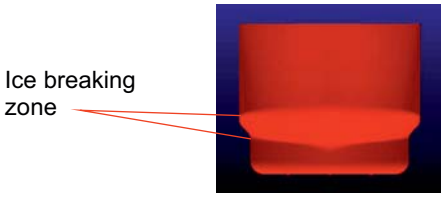
Ice Management Plan

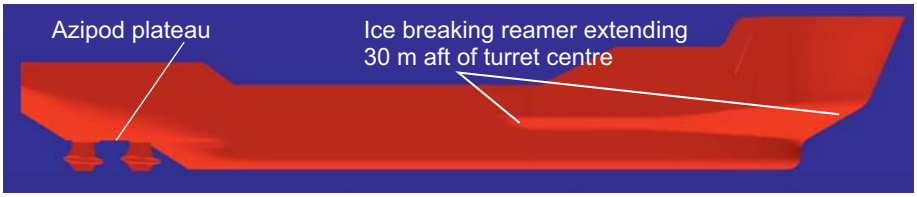
An essential part of designing drillships and planning drilling operations is to make an Ice Management Plan (IMP). The plan is necessary when arriving at the operation site, during operations and when leaving the site. It explains e.g. how to supervise ice movement, what are the safety zones, what is the time needed to make alteration in the operation mode if ice is coming closer or when does disconnecting become necessary. The Ice Management Plan also includes plans for the Ice Management vessels, possibly a supply vessel and evacuation procedures. Equally as important as the Ice Management Plan is to make an Oil Spill Plan. The contents are similar and the plan should already be outlined in the Pre-Feed phase of a project, when equipment and vessel selections are made. Criteria for the recovery equipment depend largely on the area where the operation takes place.

"We have been fore-runners in oil spill recovery in ice and performed pioneering tests already in the early 1980s in our ice laboratory model basin. The Finnish government made a decision in 1979 to research oil spills in ice, after the oil tanker Antonio Gramsci had an accident in the Baltic Sea. After many laboratory tests, we also conducted a full-scale test in 1985 in the harbour of Helsinki Shipyard and results from those tests still form the basis for oil spill recovery in ice today. Development work has naturally continued in cooperation with various interest groups and recently resulted in the development of an icebreaking Trimaran, a concept which can be efficient for oil spill recovery in icy waters," explains Mr Ritari.



Last year we jointly developed the concept of a Moored drillship with Aker Solutions. The drillship is intended for Kara, Beaufort and Chucki Sea drilling, with the hull geometry and propulsion system specially optimised for ice interaction. The ambient temperature design is -40°C and it can work in ice conditions equivalent to 1.5 m level ice.





Challenges in designing arctic harbours

Photo: J.E. Sosnov

Nuclear powered shallow draft polar icebreakers Vaygach and Taymyr at quay in Dudinka harbour.

Docking test in an icy harbour situation.

Arctic harbour design is a hot topic around the world and the need for experienced partners is growing. The challenges are many and Sami Saarinen advises against stepping into projects without strong ice knowledge.

Vessels operating in an arctic harbour and the design of the harbour need to be integrated more closely when compared to an ordinary open water harbour. The reason is simply that operating a vessel in an icy harbour area is much more demanding than operating in open water. Therefore, it is highly beneficial to simultaneously design the harbour layout and the vessels that will operate in that harbour. The same applies whether planning vessels for an existing harbour or planning a harbour for existing vessels, the present design should be taken into account in the design work.

"When designing an arctic harbour, there are a few specific issues that have to be addressed in the design. First of all, it is important to explore how ice is moving both inside and outside the harbour. The prevention of ice from outside the harbour drifting into the harbour is essential, as ice accumulating at the piers can in a worst-case scenario stop operations for a long time. Ice Barriers are used to avoid this and they protect the harbour both from waves in open water situations and from drifting ice when it is cold," Project Manager Sami Saarinen explains.

“Secondly, ice developing inside the harbour needs to be taken into consideration in the operations planning and logistical analyses. Too much ice will slow the process of a vessel reaching its docking place. One method to prevent this is the mechanical removal of ice with icebreakers if the harbour is big enough. Another method is to lead warm water into the harbour basin to minimise ice formation. This can be combined for example with air bubbling, where air creates water movement leading the ice away from the pier. Thirdly, all assisting vessels need to be compatible with both the harbour design and the tankers arriving and departing the harbour."

Designing Sabetta harbour

Aker Arctic has recently been involved in delivering a major project for Yamal LNG, which included developing and designing the LNG-carriers for exports of LNG to the market, the Sabetta harbour and assisting icebreakers to ensure efficient all-year operations in the port and associated region.

"For the Sabetta harbour, we participated in the development of the port concept and the layout. The Liquefied Natural Gas (LNG) poses challenges for the entire logistical chain. LNG is susceptible to transportation stream fluctuations, thus the cargo vessels have to be at the pier ready for loading according to a schedule, otherwise the entire production system has to be turned off, with huge costs involved. With that in mind, we evaluated the performance of the LNG carrier and assisting vessels before beginning the design of the harbour layout. For ice formation control in the terminal, we designed a brash ice control system (BIMS), with warm water directed into the terminal basin combining with an air bubbling system. Furthermore, we optimised the ice barriers for surrounding ice conditions and also considered possible future terminal expansion plans," Mr Saarinen tells.

Aker Arctic has recently been involved in a major project for Yamal LNG, delivering designs for the LNG-carriers for exports of LNG to the market, developing and designing Sabetta harbour, as well as the assisting icebreakers to ensure efficient all-year operations. Pictures from Sabetta harbour in February 2015. (Sami Saarinen)

"There are new harbour projects scheduled to begin in the near future, which we will participate in. It is important to keep in mind that the arctic harbour design is much more suited to the surrounding environment and expected vessel traffic than traditional "open water"-harbour designs. Without know-how in ice behaviour, there will be challenges that are impossible to overcome, so I strongly recommend making use of the arctic know-how we have acquired over the years." ■

Ice expeditions

As part of Aker Arctic's services, we conduct arctic expeditions to gather ice information about new areas. Sami Saarinen has been on numerous trips and lists a few:

"Pechora Sea, Barents Sea, Gulf of Ob, Yamal peninsula, Bay of Bering, Baffinland in Alaska. It is always easier to conduct design work when you have been to a location and have seen what kind of area we are talking about, what type of ice there is and what is the prevailing ice situation. When we travel to a new place, we take measurements that we then compare to the history of the current ice season's weather conditions in order to know if the winter is classified as hard or easy. We can then quite reliably estimate the ice situation during other winters. This is part of our services for our customers as the expeditions support our design work."

Sami Saarinen has been on numerous arctic expeditions gathering information about the ice conditions in these harsh areas. Here in Sabetta February 2015.

Technical solutions to environmental demands

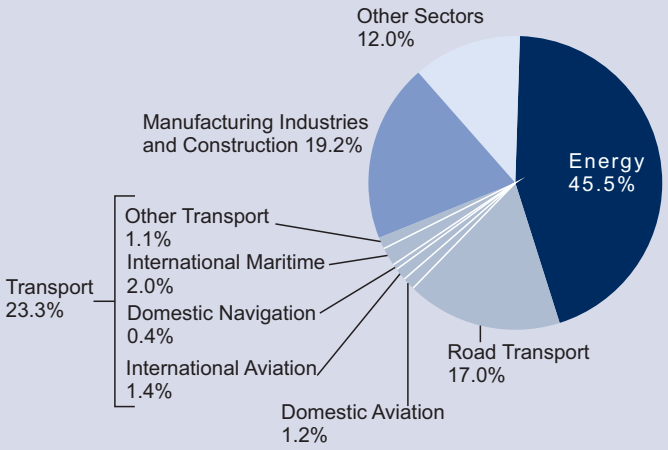
Marine traffic emissions include various products, which are considered harmful for the environment. Aker Arctic has developed technical solutions to meet tightening regulations and tries to keep one step ahead of rules in designing new concepts.

Exhaust gas composition depends on the fuel type used and engine characteristics, such as the engine load. If traditional fuel oil is considered, the exhaust gas contains mainly nitrogen, oxygen, carbon dioxide and water vapour, as well as small quantities of carbon monoxide, sulphur oxides, nitrogen oxides, non-combusted hydrocarbons and particulate matter. Other marine traffic emissions include human waste, paints and other hazardous materials.

Although marine traffic is not a big polluter compared to other methods of transport, industry or electricity production, emissions generated by marine traffic are garnering increasing amounts of attention from all over the world. IMO and other countries have set up limitations for emissions covering various components found in exhaust gases, such as Emission Control Areas (ECA) and Energy Efficiency Design Index (EEDI), Ship Energy Efficiency Management Plan (SEEMP) and Energy Efficiency Operational Index (EEOI), as well as economic mechanisms such as emission trade, bunker fees and international GHG-fund.

CO_2 Emissions 2005

Global CO_2 Emissions from Fuel Combustion



Source: EDGAR 4.0 (JRC/ PBL) 2009 and IEA.

Marine traffic accounts for about 3 % of global CO_2 emissions.

Emission control

The Emission control areas (ECA) currently include the Baltic Sea, North Sea, North American coastline and the United States Caribbean area. Of these, the Baltic and North Seas have SO_X limitations solely and the other two have additional limitations for NO_X and particulate matter (PM).

SO_X emissions are directly related to sulphur content in fuel. The allowed sulphur limits have a three-tier reduction plan on a global scale and a similar approach for ECA zones. The allowed sulphur percentage levels decrease quite rapidly in the ECA, where the very strict limit of 0,1% already came into effect in January 2015. On a global scale, the next drop in allowed sulphur levels is scheduled to be enforced in 2020, with a level of 0,5%. The NO_X limitations have been divided into three steps, of which the two first are already enforced by IMO.

The Energy Efficiency Design Index (EEDI) is a mandatory design method for new vessels above 400 GT. The intent is to reduce CO_2 emissions by regulating the installed propulsion power of new vessels with considerable conversion. At the moment, ships with icebreaking capability of more than one metre and ships with diesel-electric propulsion are excluded from EEDI requirements.

Reducing emissions

There are many possible ways to improve the energy efficiency of ships, for example the hull form, propeller and machinery can be made more efficient and thereby decrease emissions.

Emission reduction can be achieved in various ways either by simply changing the fuel oil from HFO to low sulphuric options like marine diesel or changing the type of machinery system for utilisation of Liquefied Natural Gas (LNG), or by installing systems that purify the exhaust gases to acceptable levels. Scrubber technology can be used for reducing the SO_X emissions of engines. A scrubber's basic function is to wash sulphur components from exhaust gases. For reducing NO_X emissions, there are catalysers for marine applications, so called SCR-types (Selective Catalytic Reduction)

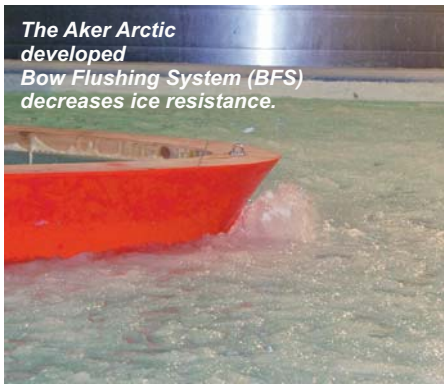
Aker Arctic's solutions

"Methods for cleaning emissions are good, but it is important to remember that the emissions are still there, they are just treated so that they don't escape into the atmosphere. Additionally, some of the cleaning equipment affects the performance of the ship's machinery to a certain extent," Mr Kari Laukia, Head for Ship design and Engineering, emphasises.

"Our approach at Aker Arctic is to design lean solutions, which lower vessels' efficiency needs and do not affect the operational capabilities of ships. Our purpose is to design a vessel that takes into account all emission demands and is also efficient in operations. This is especially important in ice, when engine loads can vary considerably and the dynamic capability of the propulsion has an important role."

One example is the LNG-fuelled vessel. LNG-fuel has no SO_X and very low NO_X and CO_2 emissions and therefore fulfils emission requirements. But, a diesel engine using LNG-fuel has lower engine load vs. speed capacity compared to a diesel engine using normal marine fuel oil. When moving in ice, the reaction time for propulsion increases and the LNG fuelled engine would need to react fast in order to win high propeller ice loads. .

"Our solution to this is to either design a hull form that minimises propeller/ice interaction, or to design a vessel with more temporary power/torque. However, the latter is more expensive and therefore we usually strive to optimise the hull form," Mr Laukia explains.



The Aker Arctic developed Bow Flushing System (BFS) decreases ice resistance.

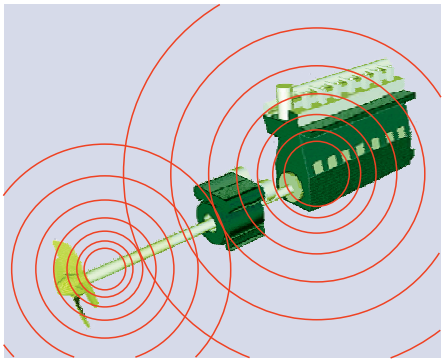
Located in the bow, the Aker Arctic developed new auxiliary system called the bow flushing system (BFS), which is used in harbours as normal side thruster but in channel ice as a vertical thruster, thus decreasing the ice resistance and simultaneously decreasing the needed propeller power, is a further option. Model tests with a standard tanker have demonstrated a decrease of needed propeller power of more than 10% for 1A class vessels and of more than 20% for 1A Super class. It is also a good solution to retrofit BFS on existing vessels.

"We are constantly developing new hull forms and bow forms, which require less and less power to perform the same icebreaking as before. We can design a vessel to use LNG as its main fuel and optimise the propulsion concept. But, as most of the vessels also have open water requirements, we often have to make compromises. There is no standardised option available, for each vessel we have to take into account the operational profile before deciding on the optimal solution."

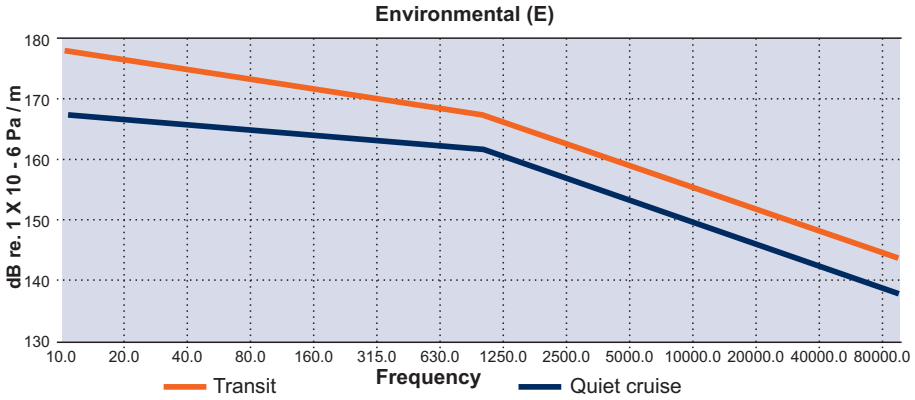
Underwater noise

One of Aker Arctic's specialities is designing research vessels, which today need to fulfil the limitations for underwater noise. Underwater noise is generated mainly from the propulsion units, the machines inside the ship, the auxiliary equipment and especially propellers. Some guidelines are available, e.g. in the DNV rules there are two requirements for underwater noise, either Environmental class E or Research class R.

"Low noise vessels have to be designed from the beginning as such, it is practically difficult to reach low noise criteria in existing vessels. So far, noise requirements only concern some special vessels but this might change in the future. Our know-how in this area will then be of use," Mr Laukia assures.



Main underwater noise generators.



Maximum allowable noise levels in 1/3 octave bands environmental class notation SILENT-E. Source: Det Norske Veritas AS.

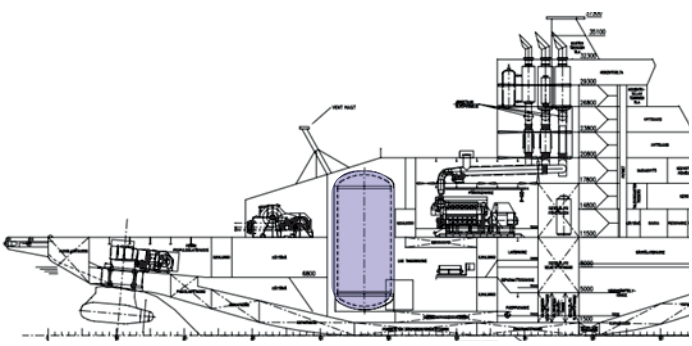
Experience in LNG-vessels

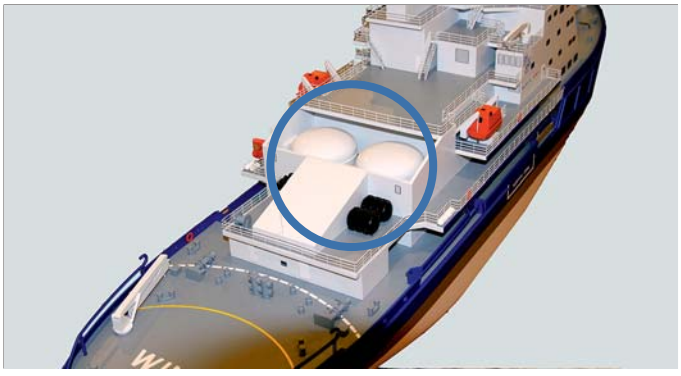
Aker Arctic has gathered years of experience in designing LNG-fuelled vessels.

"We have recently developed LNG-tankers for Yamal LNG, where the boil-off gas from transporting LNG is used as fuel. The hull of the Finnish patrol and coast guard vessel *"Turva"* for the Finnish Border Control is our design, as well as the concept of the new icebreaker for the Finnish Transport Agency, which will be the first LNG-fuelled icebreaker in the world. We also made a concept and feasibility study for an LNG-fuelled river icebreaker quite recently for one of our customers," Mr Laukia says.

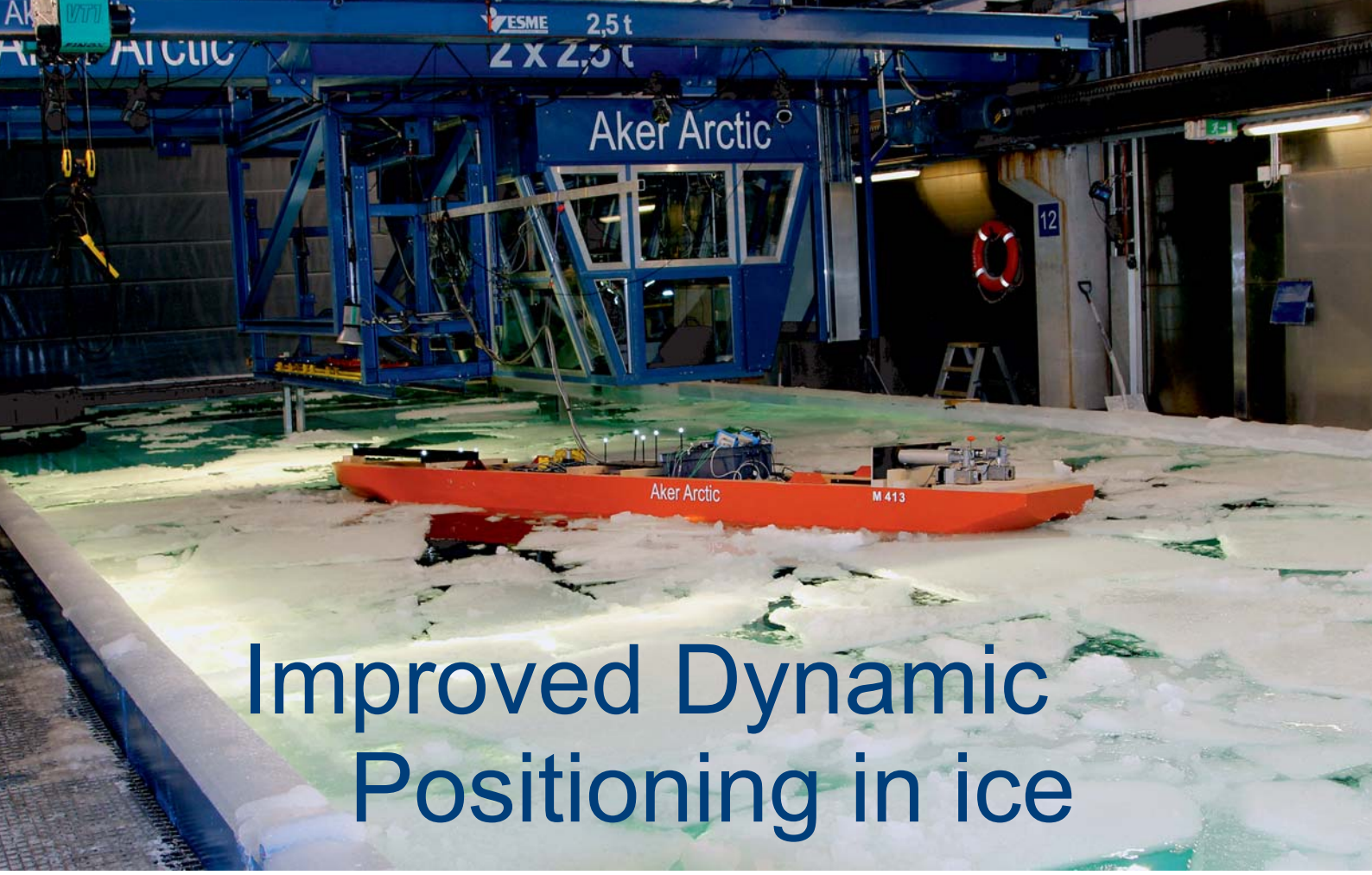
Photograph: Cha gà José/CC BY-SA 2.0

Finnish patrol and coast guard vessel "Turva" uses LNG-fuel.





LNG fuel can with today's technology also be used for ice-going vessels and icebreakers, which are exposed to fast power variations. Dual-fuelled Diesel-electric machinery of a Finnish icebreaker concept. (Picture: Aker Arctic)



Improved Dynamic Positioning in ice

With the help of the Dynamic Positioning system, a vessel can automatically keep its position by using its own propellers and thrusters. The system works well in open water but in ice conditions the performance varies. We are now developing a better version for ice use, which is ready for pilot studies at our model testing basin.

Dynamic Positioning or DP system is an automatic control system used to keep a ship in position and on heading or moving it with a specific heading into a certain direction. The DP system resists the environmental forces such as wind, current and waves. It works well in open water, but in ice conditions it does not always function as desired. Therefore we are now developing a version that will work better in ice. The development work is being made in cooperation with Navis Engineering Oy, a company specialising in DP equipment.

DP for model testing ready

"We have been working on the new version for a year now. Our target was to develop better algorithms for the system and to improve the performance in ice. Another goal was to build needed equipment for a functional DP system for our ice-testing basin. We wanted to improve our model testing possibilities and also to further develop the DP system by studying how the improved system works in ice," Project Manager Riku Kiili says.

The equipment for the model testing basin is now ready for use. The models will be equipped with better thrusters, tailored systems for positioning, various sensors and a connection link to the computerised DP system.

"We already have a Qualisys camera system that gives detailed information about the model position and its movements. The DP computer is now connected to this camera system. We can also make more accurate measurements of reaction speed, movements, turns, speed, torque and thrust," says Veikko Immonen, responsible for technical development.

Challenges with ice

"Most specialised vessels have DP systems, but they don't work well in ice as the system easily gets confused. In open water, the wind, wave and current forces are relatively constant and do not change quickly. Ice forces on the other hand are high, change fast and circumstances can vary from open water to big ice ridges. Ice is simply so powerful that a DP system and a ship's propulsion cannot react fast enough," Mr Kiili explains.

Model DP in action. Qualisys cameras are used for position referencing.

"An additional challenge is the cold temperature, which means that the equipment has to be winterised so that it does not freeze. Positioning can become a further difficulty, as GPS signals are not always exact in the far North and other position referencing systems can be affected by fog and snowfall. Part of the challenge is to avoid the ice reaching the propellers."

"In more severe ice conditions the DP system needs information about the surrounding ice field and a method to forecast incoming forces. If the ice loads could be forecasted in advance, the ship's machinery and propulsion would have enough time to react. There is still a lot of development to be done. Now that we have the DP system in place for model testing, we can use it for customer projects to help find the solutions for challenging operations," Mr Kiili highlights. ■

Yamal LNG Port of Sabetta feasibility studies, Captain Sampo Karppinen from ZPMC - Red Box Energy Services is steering. In the picture Captain Karppinen is reversing the Heavy Module Carrier in 1 m level ice and and in the picture above right he is maneuvering the vessel to the quay in 3 m brash ice.

Ice simulator attracts attention

Aker Arctic's ice simulator was displayed at the SMM Exhibition in Hamburg last September and at the NaviGate Exhibition in Turku in November. Many interested parties approached us and praised the visual choices and real feel of the simulator. Since then, new features have been added and more will come.

With the ice simulator, operations in ice can be simulated and vessel's behaviour in ice can be practised in advance. It can also be used for planning, e.g. when vessels have not even been constructed yet and plans are still possible to change.

The ice simulator has been praised as visually appealing and very realistic. Ice breaks in the simulation in the same way as in real life and ice and vessel interaction is correct.
“Last month for example, we had icebreaker captains join us at the Finnish Maritime Academy Aboa Mare in Turku to test the ice simulator," Project Manager Jorma Koponen says. "Their comments were truly positive.

According to them, a training tool like this was unthinkable a few years ago. They thought it was useful and the effects of ice were clearly present. They also gave us valuable input on how to further improve the simulator tool.”

New features

Radar function is a newly added feature, which is unique to our ice simulator. When a vessel navigates in an ice field, the radar shows the tracks or the openings in the ice field exactly as in real life, without using a “ScanFaker”. This is a valuable feature since the radar is an important tool in real life when the operator determinates where to navigate and tries to find the most safe and economical route through an ice field.

"Software Developer Mr Martti Kesäniemi has joined us from Microsoft to strengthen our team and will further develop the program. New features will be added in relation to icebreaking and towing functions will be improved. Inclining effect, the breaking of ice, and pressing and moving ice fields will be added too. When customers buy the program, they might want new features and this can be considered, if they are feasible, therefore improvements depend slightly on what our customers wish for," Mr Koponen points out.

Captain Tom Ekegren from Arctia Shipping tried the ice simulator at the Finnish Maritime Academy Aboa Mare in Turku. According to him, a training tool like this was unthinkable a few years ago. He thought it was useful and the effects of ice were clearly present. Captain Ekegren also gave us valuable input on how to further improve the simulator tool.

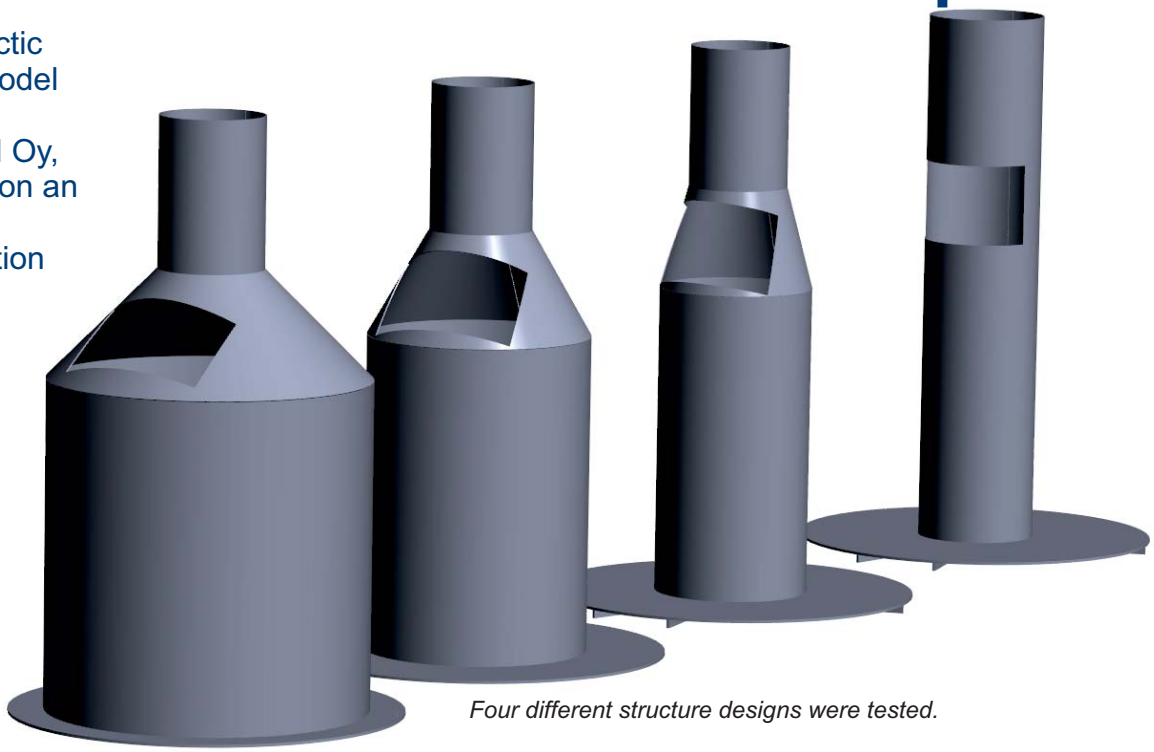
Feasibility study for Yamal LNG

Last year, our first feasibility study was conducted for Yamal LNG using the ice simulator. Aker Arctic has designed the concepts for LNG-carriers for exports of LNG to the market, as well as designing an Arctic heavy module carrier for transporting LNG train modules to the site along with the assisting icebreaking tug to ensure efficient all-year operations. The ice simulator was programmed to include the exact design of the port, one Arctic heavy module carrier and one icebreaking tug. Our customer could then navigate the vessels in different weather and ice conditions and test how the harbour and vessels will work and if there was any need to adjust plans.

“The Polar Code will include compulsory ice navigation training for deck officers before going to Polar areas. Using our ice simulator would be the easiest way to arrange training, so we believe it will become very useful in the future. We have now installed a small ice simulator at the Helsinki headquarters to use as a test bench and maybe even for customers to try, in addition to the full mission bridge simulator tool available at Aboa Mare in Turku," Mr Koponen explains. ■

Ice model tests for Technip

In 2014, Aker Arctic performed ice model tests for Technip Offshore Finland Oy, where ice loads on an offshore wind turbine's foundation structure were studied.



Four different structure designs were tested.

Four different structure designs were tested during the test series, one straight cylinder and three conical structures, with various cone angles.

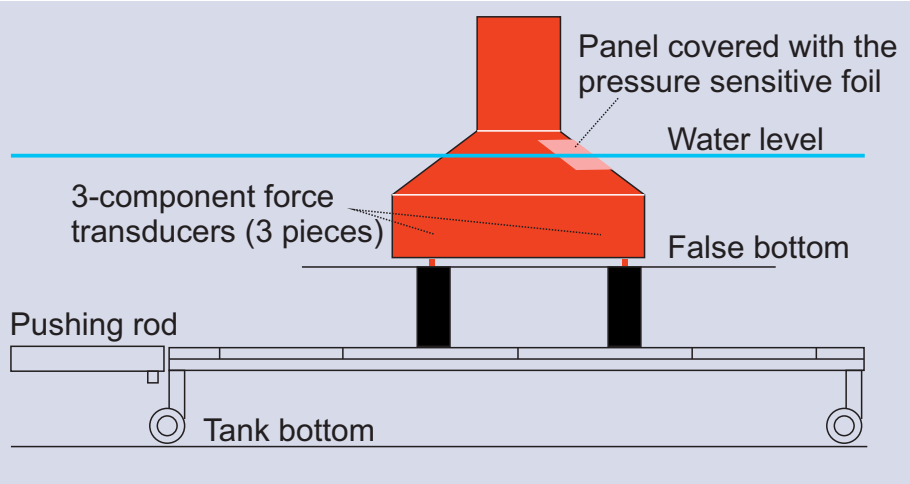
Three separate measurements were made for each structure: global ice loads were measured from the base of the structure, local loads were measured from the panel, which was located at the water line and, additionally, the pressure distribution of the panel was measured with pressure foil provided by the Technical Research Centre of Finland (VTT Oy).

Testing method

"The test series consisted of six test days. Each model was tested in 0.6 m thick ice and two of the models also in 1.0 m thick ice," says Topi Leiviskä, Riikka Matala and Jukka-Pekka Sallinen from Research and Testing Services, who planned, performed and analysed the tests.

“The ice movement was simulated by moving the model instead of ice. The model was fixed to an underwater carriage, which was pushed through the ice field at the desired ice drifting speed.”

"The test ice conditions were level ice and an ice ridge. A triangular ice ridge was constructed for this purpose. The models were first moved through the ice ridge and then through the level ice. We tried to find the most challenging situations possible," Ms Matala continues.



Test arrangement

“Tests were recorded with several video cameras from various angles. Three of the angles and a load measurement signal were synchronised to a quad-view video feed, which gave us an opportunity to visually observe how ice impacts affect the ice loads,” Mr Sallinen explains.

Reasons for testing

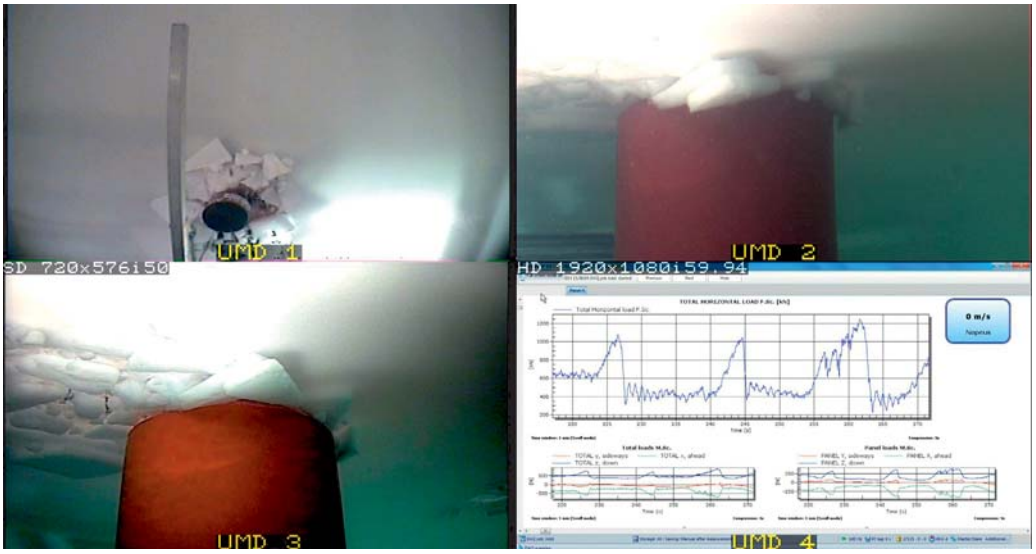
There were two reasons for performing the tests. The main reason was to survey the cone angle effect on ice loads and vibrations on structure in order to find the technically and economically optimal design, because the customer plans to build wind turbines in areas where there is ice movement.

The potential wind turbines are intended for the Baltic Sea area, where ice thickness is usually about 0.6 m. Only in extreme situations can the ice grow up to 0.8 m thickness.

"The second reason was to calibrate a new mathematical model for ice loads, which is created by the Technical Research Centre of Finland (VTT). For this purpose the test series included additional ice measurements, e.g. ice-ice friction, compressive strength and punch-testing," Ms Matala outlines.

Ice conditions at testing

Three video views and a load measurement signal were synchronised to one video to improve analysis.

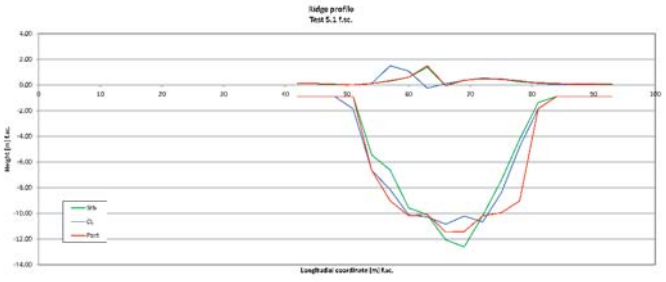


Benefits of tests

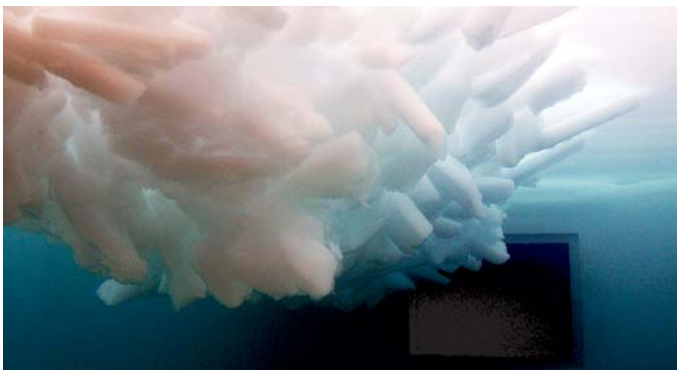
The test results will be used to choose the optimal structure design.
Additionally, ice-induced vibrations can become a challenge and by using the results from the tests the chosen structure can be optimised with structural design to bear vibrations.

"Our customer Technip Offshore Finland was actively involved in the model testing and analysing work and we are now planning further testing," Mr Leiviskä says.

"This systematic test programme provided new information from the interaction between the ice and the structure," adds Senior Engineering Manager Jukka Leppänen from Technip.

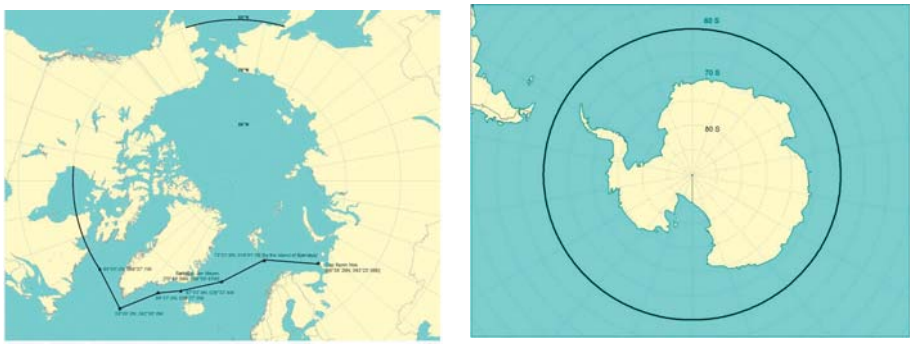


For this project a new technique to create a triangular profile ice ridge was used. This method can also be used for other tests in the future.



Polar Code adopted

During the 94th session of the International Maritime Organization IMO's Maritime Safety Committee held in November 2014, the International Code for Ships Operating in Polar Waters, commonly referred to as the Polar Code, was adopted as well as related amendments to the International Convention for the Safety of Life at Sea (SOLAS).



The Arctic map was updated to include the specific coordinates where the Polar Code applies. The Antarctic map remained untouched and the Polar Code will apply on all areas south of latitude S 60 degrees.

The planned date of entry into force is the first of January 2017 for new ships. Older ships will have to meet the requirements by the time of their first intermediate or renewal survey after first of January 2018.

The Polar Code will be mandatory under both SOLAS (International Convention for the Safety of Life at Sea) and MARPOL (International Convention for the prevention of Pollution from Ships).

Compulsory operation manual

According to the Polar Code, each vessel operating in the Polar waters has to have a vessel specific Polar Water Operation Manual (PWOM) onboard.

"This is something we at Aker Arctic will be able to help our customers with. A list of proposed contents can be found below. Until now, there has not been a decision on how this manual will be administered," says Arto Uuskallio, Sales and Marketing Manager and following IMO's decisions.

"One part of the Polar Code concerns training. A general guidance is in place already for what kind of training will be required, but development work continues on this matter. Our ice simulator will be an excellent tool to use for training once the criteria are clear. A decision was made that it will be possible to use an Ice Advisor while sailing in Polar areas if the crew does not have the sufficient experience required by the Polar Code. No exceptions from the rule will be allowed, even for single journeys."

Evaluation model for vessels

A correspondence group has been founded to outline an evaluation model for vessels and freezing areas under the working name "Polaris". The idea is to create a mathematical formula for different ice conditions that enables captains to evaluate whether they can enter and operate their vessel in a certain area. Icebreaker assistance also has to be evaluated as part of this system. A working group will very likely be initiated to further develop this matter during the next meeting.

"The Polar Code is the first mandatory legislation for ships addressing potential hazards unique to Arctic and Antarctic environment, such as ice, remoteness and rapidly changing severe weather conditions, and provides goals and functional requirements related to ship design, construction, equipment, operations and training, as well as search and rescue. The newly adopted resolution has received criticism from different parties for being too much of a compromise and therefore not the powerful directive it was envisioned to be. In order to keep the schedule, many challenging issues had to be left out from the first version of the code. But at least now it has been developed to a certain stage and the development work will continue. The code will be updated with so called circulars, which will include updates to the Polar Code," Mr Uuskallio outlines.

Model of Polar Water Operation Manual

1. Operational capabilities and limitations
Chapter 1 - Operation in ice
Chapter 2 - Operation in low temperatures
Chapter 3 - Communication and navigation capabilities in high latitudes
Chapter 4 - Voyage duration

2. Ship operations
Chapter 1 - Strategic planning
Chapter 2 - Arrangements for receiving forecasts on environmental conditions
Chapter 3 - Verification of hydrographic, meteorological and navigational information
Chapter 4 - Operation of special equipment
Chapter 5 - Procedures to maintain equipment functionality

3. Risk management
Chapter 1 - Risk mitigation in limiting environmental condition
Chapter 2 - Emergency response
Chapter 3 - Coordination with emergency response services
Chapter 4 - Procedures for maintaining life support and ship integrity in the event of prolonged entrapment by ice

4. Joint operations
Chapter 1 - Escorted operations
Chapter 2 - Convoy operations

Ice conditions	Tankers	Passenger ships	Other
Ice free	Not applicable	Not applicable	Not applicable
Open waters	Basic training for master, chief mate and officers in charge of a navigational watch	Basic training for master, chief mate and officers in charge of a navigational watch	
Other waters	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.

A rough draft is in place for the kind of training which will be required, but development work is still continuing concerning this matter. Our ice simulator will be an excellent tool to use for training once the criteria are clear.

Seakeeping test for icebreaking trimaran

A series of seakeeping model tests was made for our Trimaran concept in August and October 2014.
These tests were made because the hull form and proportions of the icebreaking Trimaran differ significantly from all existing vessels.

Seakeeping tests of the Trimaran concept, motion in waves with H_s = 4.0m, T_p = 9.0s and φ = 45°

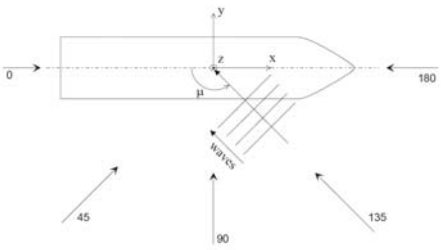
Seakeeping tests of the Trimaran concept, motion in waves with H_s = 4.0m, T_p = 9.0s and φ = 180°

Pictures on the left:
Seakeeping tests of the Trimaran concept, motions in waves with H_s = 4.0m, T_p = 9.0s and φ = 135°

The seakeeping tests of the icebreaking Trimaran were made in cooperation with the Technical Research Centre of Finland (VTT) in their test basin.
The test matrix was fairly comprehensive and included both regular and irregular waves and five different encounter angles (0°-180°) with zero vessel speed and various wave heights and frequencies. In addition, a 180° encounter angle was tested with velocity ahead. Tests with regular waves were conducted with a constant wave height of 1.0m and over a wide wave frequency range to obtain RAOs for different quantities. The motions and accelerations were tested in irregular waves using JONSWAP wave spectrum and significant wave heights of 2.0m and 4.0m to gain deeper understanding of the behaviour of the Trimaran concept and to measure maximum loads. The instrumentation included force measurements between the main hull and side hulls, accelerometers at different locations, relative motion sensors to measure the relative wave elevation, global movement measurement and slamming pressure sensors on the cross-deck.

Early results and observations

"The analysis of the test results is not wholly available yet but the observations made during the tests, and preliminary results, indicate that the Trimaran behaves rather well in waves, and no major problems were found. The roll angles and accelerations are very moderate despite the large GM. Even in 4.0m significant wave heights the side hulls stay in water and do not submerge excessively. Generally, the motions of the vessels were moderate in all tested conditions with zero speed. The largest accelerations and motions were measured in the bow of the vessel, while the stern had lower accelerations and smaller motions, which is favourable for using the large stern deck as a working deck. The clearance between cross-deck and water surface also seems sufficient, as only a very few, low energy contacts between cross-deck bottom and waves were observed," Structural Engineer Ville Valtonen explains.



The test matrix was fairly comprehensive and included both regular and irregular waves and five different encounter angles (0°-180°).

“Based on the early results and observations, the vessel can operate in 4.0m significant wave height without problems. With stern waves, the 4.0m significant wave height seems to be about the upper limit, but in beam or head waves, it seems that even more severe sea states would not cause any major issues. It has to be noted that larger waves tend to have longer periods, and are therefore less severe for a relatively small vessel, as the wavelength exceeds the vessel dimensions significantly, whereas waves with a length fairly similar to the vessel dimensions are likely to cause the most severe motions. Some examples of the vessel motions in waves are shown in the pictures above. The results of these tests will be used to further develop the hull form and vessel concept," Mr Valtonen says.

Oblique icebreaker begins operations

The Aker Arctic developed Oblique icebreaker *Baltika* has begun services in Kronstadt, outside St. Petersburg. The official delivery ceremony was held in St. Petersburg on 20th February 2015.

"After delivery, the vessel will enter into operation. Our aim is to perform full-scale ice tests this spring," Chief Designer Mika Hovilainen says.

The Oblique icebreaker is a unique concept with an asymmetric hull, which enables sideways movement for icebreaking or oil spill collection.

Arctic module carrier under construction

Aker Arctic has designed two Polar class heavy module carriers for the safe transportation of construction modules for the Yamal LNG plant in Sabetta. Construction of these carriers is now underway in China.

“Our responsibility was first the design concept and then the basic design work, which was completed before construction began in October 2014. The development work was carried out in close cooperation with the owners, ZPMC-Red Box Energy Services, and they are now supervising the construction work at Guangzhou Shipyard International in China," Project Manager Heikki Sipilä says.

"The vessels are challenging to build as they are unique, high powered and heavily ice-strengthened so as to manage the harsh conditions in the Arctic. The first vessel should be ready, according to schedule, in February 2016, and the second vessel two months later. After the ship delivery we will participate in full-scale ice trials to ensure the vessel meets the capability requirements and to confirm its operational functionality."

Cooperation agreement for Novy Port

A cooperation agreement has recently been signed with Samsung Heavy Industries for assistance in the design of the tankers for Arctic project Novy Port.

Novy Port is a new loading terminal development, planned in the Gulf of Ob, which will be used for oil shipments from a nearby oil field to Murmansk. Gazprom Neft will construct the loading terminal and Samsung Heavy Industries has been contracted to construct six tankers for the oil shipments. A cooperation agreement, which includes e.g. model tests for the tankers and assistance in the design, has been signed with Aker Arctic.

Two icebreakers based on Aker ARC 130 A concept developed by Aker Arctic will be constructed for assisting the tankers in the harbour and on their route to the terminal and during loading operations. The first vessel with similar concept (Aker ARC 130) is currently being built in Finland for the Finnish Transport Agency and will be the first LNG-fuelled icebreaker. The icebreakers for Gazprom Neft will be slightly different as they will not use LNG as fuel and will have a stronger hull and more power than the Finnish icebreaker.

The Aker ARC 130 A concept.

Aker Arctic participates in winter navigation project

Sea ice is a barrier that hampers unimpeded sea transport in the Baltic Sea area and has an impact on transport and trade within the European Union.
The icebreaking services provided by countries around the Baltic Sea is an important part of the maritime infrastructure and is a prerequisite for trade and sea transports all year round.
A EU project to safeguard winter navigation has been set in place, in which also Aker Arctic participates.

The winter navigation system in the Baltic Sea can be divided into three parts: traffic restriction, ice and traffic management, and icebreaker assistance. As part of the Trans-European Transport Network TEN-T, the EU-funded WINMOS project aims to safeguard resources for the future, improve environmental performance and develop cooperation between national icebreaking services.

"There are seven parts to the project, of which Aker Arctic participates in parts 1,2,5 and 7," Mika Hovilainen, the Aker Arctic representative in the WINMOS-project presents.

1. Study on future demand of icebreaking capability
The aim is to create a simulation tool for simulating winter navigation systems on the Baltic Sea. It will be used to evaluate how the entire transportation system works when circumstances change. Decisions on future strategy require assessment on which way is the most efficient in the future. It also includes studies on how new legislation, such as EEDI, affects icebreaking needs and maritime traffic overall.

2. Concept study on next generation icebreaker
To create and evaluate how different icebreaker concepts work, e.g. the Icebreaking Trimaran and the Oblique icebreaker. Different selected concepts shall be compared to Atle/Urho class icebreakers. In addition a study of fuel possibilities, different ownership, chartering and operating arrangements and financing options will be compiled.

3. Improvement of environmental performance
Several of the existing Baltic Sea icebreakers have old engines that generate emissions that should be reduced. A pilot project with a new fuel injection technique will be implemented on an existing icebreaker.

4. Deployment of next generation IB-Net
The high frequency of arrivals and departures from ice-infected ports require an ITS-tool to manage the icebreaking activities and close cooperation between Finnish and Swedish icebreakers. The existing Icebreaking Network IBNet tool is becoming outdated and is in need of modernisation.

5. Human element and training facilities
Marine officers require specially designed training for operations in low temperatures and navigation in ice-infested waters. The Aker Arctic developed Ice simulator is being used as part of improved training possibilities for marine officers.

6. Technical upgrading and life extension of the icebreakers
Actions must be taken to ensure that existing icebreakers are upgraded to meet icebreaking demands in the future. A program for upgrades and enhancements will be set in place.

7. Acquisition of new icebreaking resources
A significant amount of Baltic icebreakers are getting old. In order to ensure year-round maritime traffic, new resources must be built. As part of this project a new icebreaker concept will be developed and built for the severe ice conditions in Northern parts of the Baltic Sea.

"The project will continue until the end of 2015. The project partners are administrations and governmental enterprises in Finland, Sweden and Estonia: Swedish Maritime Administration, Finnish Transport Agency, Estonian Maritime Administration, Finnish Meteorological Institute, Aalto University, Aker Arctic technology Inc, ILS Ltd, ImageSoft Ltd. and University of Applied Sciences Novia. One of the key question is how new energy efficiency requirements and environmental protection legislation impacts the Baltic Sea transportation system in different winter conditions," Mr Hovilainen points out.

China's Vice Premier Wang Yang visited Aker Arctic

The Vice Premier of China, Wang Yang, visited Finland in November 2014 on the invitation of Finnish Prime Minister Alexander Stubb. Economic issues, trade between Finland and China, matters concerning agriculture and forestry, and cultural issues were among the main themes of the visit. Premier Wang Yang also visited Aker Arctic on the 19th November. Aker Arctic is designing an advanced polar research vessel for the Polar Research Institute of China.

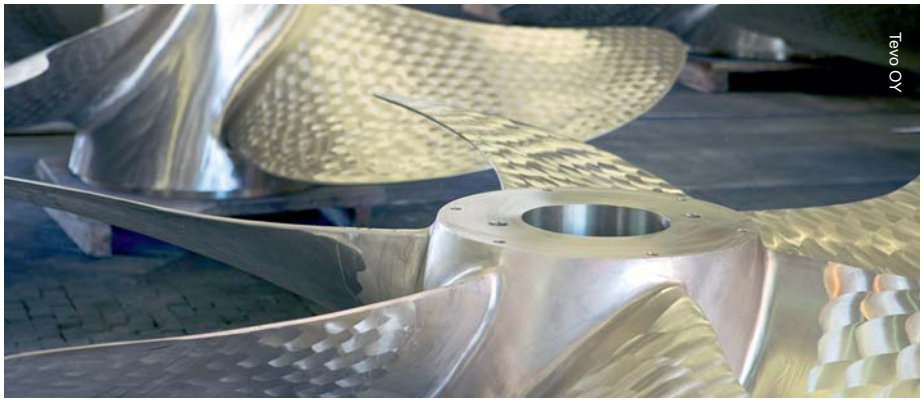
Celebrating Aker Arctic's 10th anniversary

Aker Arctic celebrates ten years as an independent ice technology company this year. For this occasion, all current and retired employees accompanied by their partners gathered for a special evening celebration in January.

The festive event took place in the centre of Helsinki at Ostrobotnia's Ballroom, which is located in the historical Ostrobotnia building dating from 1912. Through its 100 years of existence, it has been a popular place for student gatherings. The ballroom itself is decorated with paintings of prominent persons from Finnish history. Managing Director Reko-Antti Suojanen, retired Managing Director Mikko Niini and Chairman Ole Johansson spoke at the event and reminisced about historical events in the company's past, leading Aker Arctic to become the company it is now. Nearly five decades earlier, the first model-testing basin in Finland was ready and having gone through different owners, Aker Arctic finally became an independent ice technology company in January 2005. From initially twelve persons, there are now close to fifty employees and the turnover is 10 million euros. The hard work all have done in order to achieve this was well worth celebrating!

Read more about Aker Arctic's history on page 4.

Ice propeller development proceeds



The ice propeller development project by Aker Arctic, the Technical Research Center of Finland VTT Oy and TEVO Oy is proceeding. The target of the project is to develop the design by using bronze material, which is suitable for ice going ships. Special emphasis is put on the dimensioning and low noise criteria. Aker Arctic´s responsibility is the market analysis, which creates the requirements for the design, dimensioning criteria and design of the test propeller. The plan is to install the real propeller on a vessel and make full-scale tests in ice. VTT will develop the programs to be used in the design and make the test arrangements. TEVO is heading the project and also manufactures the test propeller. The target is that the project results are available in spring 2016.

The bronze propeller has many benefits such as good corrosion resistance, it is easy to manufacture and maintain and it has a competitive price.

Aker Arctic's ice simulator was shown at SMM Exhibition in Hamburg last September and at NaviGate Exhibition in Turku in November. Many interested parties approached us and praised the visual choices and real feel of the simulator.

Meet us here!

We will participate in the following events:

Arctic Shipping Forum, Helsinki
24 - 26 February 2015

ATC Copenhagen
23 - 25 March 2015

OTC Houston
4 - 7 May 2015

Moscow International Oil & Gas (MIOGE)
23 - 26 June 2015

Neva 2015, St. Petersburg
22 - 25 September 2015

Marintec China 2015, Shanghai
1 - 4 December 2015

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