Railotech

Arctic Passion News

No. 1 | 2026 | issue 27

WE ARE NOW RAILOTECH

In this issue

Page 4
Finland's new icebreaker

Page 7
Propulsion for polar icebreakers

Page 9
Icebreaker technology for naval ships

Page 24
We are now Railo Technology

Table of contents

Subscribe to our social media accounts to catch the invitation links to events.

Front cover

Since April 2025, Railotech has been developing a new medium-class icebreaker for the Finnish Transport Infrastructure Agency to replace the 72-year-old *Voima*. The purpose of the new icebreaker is to improve the efficiency of Finnish icebreaking operations. The vessel will be deployed to the Bothnian Bay in early winter and later transferred to the Bothnian Sea or the Gulf of Finland as conditions intensify during the season. The concept design, including comparative model testing, has been completed, and the project is entering the tender phase.

Read more on page 4.

Contact details

RAILO TECHNOLOGY INC.
Merenkulkijankatu 6, FI-00980 HELSINKI
Tel.: +358 10 323 6300
www.railotech.fi

Meet us at these events in 2026

March	23 – 26.3. The Nordic-Baltic Marine Forum, Helsinki, Finland
April	19 – 22.4. Sea–Air–Space, Maryland, USA
	29.4.– 1.5. U.S. Coast Guard Academy Industry Day, USA
May	12 – 15.5. Maritime Arctic, Victoria, Canada
	31.5. – 5.6. ISOPE, Orlando, USA
June	7 – 12.6. OMAE, Tokyo, Japan
September	1 – 4.9. SMM, Hamburg, Germany

Arctic Passion News 1/2026
ISSN 2342–7965, ISSN 2342–7973, Editor in chief: Mika Hovilainen, Texts: CS Communications Oy,
Layout: adeve.fi, Printed in March 2026, Grano Oy

Arctic Passion News 1 / 2026

Dear Reader,

The past year has been one of the most consequential in our company's history. A shifting geopolitical landscape, a growing global focus on the Arctic, and rapidly evolving customer needs compelled us to reassess our direction.

These forces also created new opportunities. Arctic expertise is no longer a niche capability but a core element of international security and strategic infrastructure.

Following the change in ownership, we have taken a defining step by transitioning from the name Aker Arctic to Railo Technology, operating globally under the Railotech brand. This is more than a rebranding; it reflects our strengthened independence, broader technological capabilities, and long-term strategic intent. We are positioning ourselves for a future in which Arctic technology plays an increasingly important role.

The acquisition of Bluetech was another pivotal milestone. Its purpose was to deepen our design expertise and scale our capacity for larger, more complex programmes. Both organisations will continue under their own brands and as independent business units, preserving their distinct strengths. Together, however, we form a more capable entity, combining agility with scale.

Internationally, the year marked a decisive shift. We are establishing a U.S. subsidiary — one of our most important strategic initiatives in years. Demand for Arctic capability in the United States is accelerating, particularly within government programmes. A local presence enables us to engage at an early stage in acquisitions where design decisions will shape Arctic operational readiness for decades to come.

Cooperation between Finland and the United States in icebreaker development also advanced significantly. The memorandum of understanding signed in October 2025 on a new icebreaker class based on Finnish expertise underscored the strategic importance of our capabilities.

A central outcome is the Arctic Security Cutter programme, comprising 11 icebreakers. Six are based on the MPI concept we have developed, with construction in both Finland and the United States.

The programme strengthens the role of Finnish engineering in Arctic security while deepening transatlantic technological cooperation.

Meanwhile, the global icebreaker market is undergoing structural change. Ageing fleets, the Arctic's growing strategic importance, and tightening environmental standards are reshaping priorities. Icebreakers are increasingly viewed not only as enablers of winter navigation, but as instruments of national resilience and security.

Through the ICE Pact, Finland, Canada, and the United States are jointly building future Arctic capability, reinforcing long-term demand for advanced icebreaking and ice-capable vessels.

In Finland, we are contributing to the next generation of icebreaker design. The new B+ class introduces a novel propulsion architecture optimised for life cycle efficiency over a 50-year service life, combining operational performance with energy efficiency. This reflects an important shift toward sustainable, future-ready icebreaking.

We are navigating the most significant transformation in our company's history: a new identity, a stronger group structure, expanding international reach, and next-generation technologies. The scale of change is considerable, but so is the opportunity. Our focus is clear: to build the foundation for the next generation of Arctic capability, rooted in Finnish expertise, distinctive in character, and globally influential.

Sincerely yours,

Mika Hovilainen
Managing Director

Finland's new icebreaker advances to tender

Since April 2025, Railotech has been developing a new medium-class icebreaker for the Finnish Transport Infrastructure Agency. The concept design, including comparative model testing, has now been completed, and the project is entering the tender phase. The objective is to sign the shipbuilding contract in autumn 2026.

The Finnish government has launched a programme to renew the national icebreaking fleet, beginning with *Voima*, Finland's only B-class icebreaker. Commissioned in 1954, *Voima* turns 72 this year, and remains the world's oldest icebreaker in active service.

The purpose of the new medium-class icebreaker is to improve the efficiency of Finnish icebreaking operations. The vessel will be deployed to the Bothnian Bay in early winter and later transferred to the Bothnian Sea or the Gulf of Finland as conditions intensify during the season.

Railotech was awarded the design contract to develop three outline design alternatives, two of which were progressed to tender-level design for the Finnish Transport Infrastructure Agency. With a planned service life exceeding 50 years, an extensive model-testing programme was conducted to identify the most suitable option for a changing ice regime, while also ensuring cost efficiency in acquisition, operation, and maintenance over the icebreaker's full lifecycle.

Tailored hull form for changing winters

Seven out of the past ten winters in the Baltic Sea have been classified as mild. The hull form of the new icebreaker reflects this shift in operating conditions: instead of predominantly stable landfast ice, the vessel is more likely to encounter dynamic and fragmented ice fields characterised by heavy ridging, slush barriers, and extensive areas of open water.

Optimising the design for efficient performance in the ice regimes prevailing within the intended operational area is a key design driver in every icebreaker project.

"The bow is sharper and more wedge-shaped with a moderate stem angle compared to traditional icebreakers designed for operation in thick unbroken ice," says Chief Designer Tuomas Romu from Railotech.

The new icebreaker must also be capable of fast and economical transit in open water. In addition to icebreaking performance, the hull has therefore been streamlined for improved hydrodynamic efficiency, high-speed convoy operations, and reduced slamming, an undesirable characteristic of many traditional icebreaker designs.

Two propulsion concepts thoroughly evaluated

Both tender concepts feature an azimuthing propulsion unit in the bow to enhance operability, as escorting and assisting commercial vessels is one of the icebreaker's primary tasks. The assistance speed target of eight knots was successfully achieved.

The new icebreaker will primarily assist commercial vessels calling at Finnish ports during winter. Smaller than the A-class icebreakers, it will operate at a significantly lower cost while improving the overall efficiency of Finland's icebreaking system.

The key difference between the two concepts lies in the stern propulsion arrangement: one design employs two conventional shaftlines and rudders while the other is equipped with two azimuthing propulsion units. Although a triple-azimuth propulsion, pioneered by Finland's newest A-class icebreaker *Polaris*, has proven to offer superior manoeuvrability, it also entails higher acquisition and maintenance costs.

For this reason, the Finnish Transport Infrastructure Agency sought to determine whether an alternative solution could deliver the required operability at a lower lifecycle cost. The results exceeded expectations.

Comprehensive model testing to support decisions

All design alternatives were subjected to extensive model testing, including ice model tests, open-water tests, manoeuvrability trials, and seakeeping assessments. This enabled a reliable comparison of performance, operability, and manoeuvrability, as well as a comprehensive 50-year lifecycle cost evaluation.

The results demonstrated that the twin shaftlines combined with an azimuthing bow propulsion unit fully met the Finnish Transport Infrastructure Agency's operational requirements, while offering significant long-term cost savings. As a result, the decision was made to proceed with this propulsion configuration.

"The concept featuring twin shaftlines and an azimuthing bow propulsion unit was shown in the concept design study to be more affordable but still very capable. The azimuthing bow propulsion unit provides high agility and excellent performance in brash ice," says Maritime Specialist Lauri Kuuliala, Finnish Transport Infrastructure Agency.

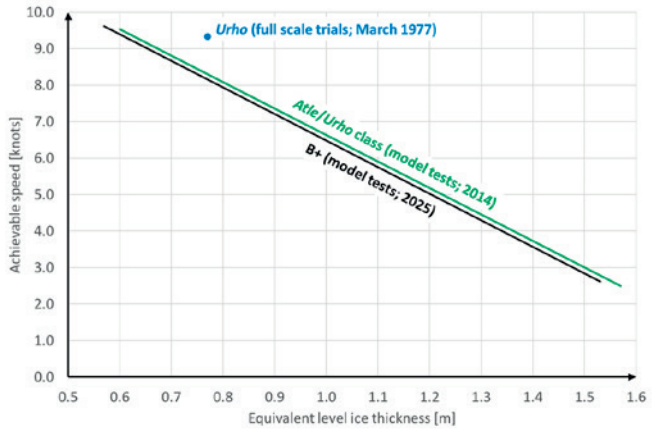
Ice model testing included escort trials in which the icebreaker model was fitted with a scaled towing notch and used to tow another vessel in the ice basin. A few weeks of systematic evaluation during the design phase can translate into substantial savings in fuel consumption and maintenance costs.

Performance exceeds requirements

The new Finnish icebreaker's technical solutions are based on proven, state-of-the-art technologies. The vessel's power plant has been future-proofed with the possibility to adopt methanol fuel at a later date. Energy efficiency is further enhanced through a battery energy storage system and waste-heat recovery.

Ice model tests indicate that the new icebreaker can achieve speeds exceeding 8 knots in 80 cm-thick level ice and over 9 knots in 60 cm ice, both clearly surpassing the initial performance requirements specified by the Finnish Transport Infrastructure Agency. Additional tests demonstrated the vessel's ability to maintain continuous motion even in 1.5 m-thick level ice. Manoeuvrability and ridge penetration capability were also assessed as excellent.

"Although the new icebreaker is not intended to replace the bigger A-class icebreakers, in terms of icebreaking capability it's in fact not that far from the much bigger and more powerful *Urho* class," notes Romu. "Perhaps we should refer to it as a 'B++' class icebreaker."



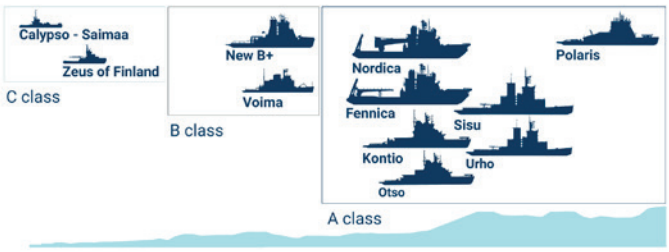
The Finnish Transport Infrastructure Agency initially targeted a B+ icebreaker, but our development work has resulted in a vessel approaching the performance of the Urho class.

Workshops with professional mariners

Human factors have become an increasingly important aspect of ship design. Given the long service life of an icebreaker, the vessel must also function as a safe, efficient, and comfortable working environment.

To support this, a series of workshops was held with professional mariners currently serving on Finnish icebreakers. Each session focused on a specific area of the vessel: the wheelhouse, machinery spaces, accommodation quarters, and — most critically — the towing arrangement, which is essential for escort operations.

"The opportunity to involve experienced end users has led to practical improvements across multiple areas of the design," says Romu.



Finnish icebreakers are classified based on a three-tier system with Class A being the largest. The new icebreaker will replace Voima, Finland's only B-class icebreaker, in service since 1954.

Delivery scheduled for 2029

The Finnish Transport Infrastructure Agency received the complete contract documentation from Railotech in December 2025 and is preparing to launch the shipyard tender process in spring 2026. The target is to sign the construction contract in autumn 2026, with the new icebreaker entering service in 2029.

"The cooperation and efficient procurement process reflect the approach used for *Polaris* and demonstrate how a high-quality icebreaker project can be delivered on schedule," says Romu.

"Our project team was able to make timely, well-founded decisions, and Railotech's project team demonstrated strong capability in rapidly implementing those decisions into the design while providing clear technical guidance throughout the process," adds Kuuliala.

The design and acquisition of the new icebreaker are supported by funding from the European Union's WINMOS III programme and its successor, WINMOS IV. WINMOS IV has been granted €90 million, approximately half of which is allocated to Finland's icebreaker renewal programme.

Technical details

Length: (incl. towing notch)	About 96 m
Beam:	About 24 m
Icebreaking draught:	7-8 m
Displacement:	About 7500 tonnes
Hull structure:	Extra high strength steel, stainless steel cladding at the ice belt
Ice class:	Polar Class 5 Icebreaker(+)
Bollard pull:	At least 120 tonnes
Propulsion power:	About 10.5 MW
Icebreaking endurance:	20 days
Cabins:	18 crew and 12 passengers

Ice propulsion contracts for polar icebreakers

The Polarstern II project. Picture courtesy of Alfred-Wegener-Institut/ TKMS.

At Railotech, our expertise extends beyond icebreaker design and model testing to the engineering and delivery of ice-strengthened propellers and complete shaftlines. Our latest contracts include the design and delivery of Polar Class 2 propellers for advanced polar icebreakers, as well as complete shaftline packages. The vessels will also feature Railotech's patented Hybrid DAS™ hull concept.

The new Polarstern – German research icebreaker

In December 2024, the Alfred Wegener Institute awarded Thyssenkrupp Marine Systems the contract to build the successor to *Polarstern*, Germany's new flagship for climate and polar research. The 160-metre multidisciplinary research icebreaker will feature extensive scientific facilities and accommodation for 60 scientists and approximately 50 crew members.

The new *Polarstern* will be equipped with two PC2-rated azimuth thrusters. These 9 MW thrusters will provide full 360-degree rotation and high manoeuvrability in ice.

Complementing this arrangement, Railotech will deliver the complete propulsion package for the centre shaftline, including a specially designed 5.4-metre stainless steel propeller optimised for continuous ice operation. The propulsion system design will be finalised in 2026, with delivery scheduled for the end of 2027.

The hull will incorporate Railotech's patented Hybrid DAS™ configuration, combining two azimuthing propulsion units with a central fixed shaftline. Often described as "the best of both worlds", this arrangement integrates the manoeuvrability of azimuthing propulsion with the robustness and design flexibility of a conventional shaftline. The twin-azimuth hybrid concept has increasingly replaced the traditional triple-shaft configuration used in polar icebreakers since the late 19th century.

Canadian polar icebreaker (Seaspan)

In March 2025, the Government of Canada awarded Seaspan's Vancouver Shipyards Co. Ltd. the construction contract for the first new heavy polar icebreaker for the Canadian Coast Guard, which will be named CCGS *Imnaryaq*, under the National Shipbuilding Strategy. The 158-metre vessel, developed by Railotech, will rank among the most advanced and capable icebreakers in service globally.

Railotech has designed and delivered the ice-strengthened Polar Class 2 stainless steel propeller for the icebreaker's 12-MW centre shaftline. The propeller has a diameter of six metres.

Development of the Canadian polar icebreaker programme began in 2012 and resumed a decade later with a comprehensive design update. Railotech's experts were responsible for designing the hull form, structural ice strengthening, performance optimisation, stability analysis, and winterisation, in addition to providing continuous technical support to Seaspan's design team.

The performance of the selected Hybrid DAS™ hull form and propulsion configuration was verified through advanced ice model testing at Railotech's ice laboratory in Finland, complemented by open-water tests. These tests confirmed that the propulsion system delivers the thrust required to meet both icebreaking and open-water performance criteria, ensuring compliance with the Canadian Coast Guard's operational requirements in Arctic conditions.

Unrivalled expertise in ice propulsion

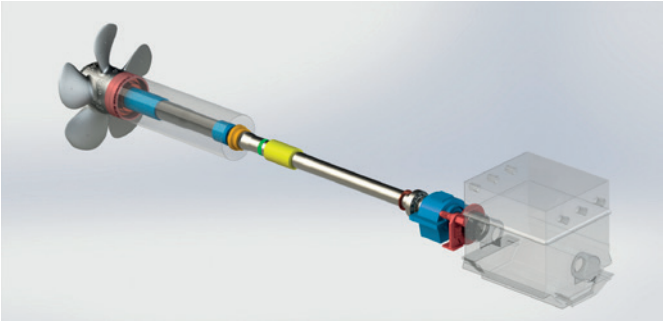
All Railotech's development work follows a disciplined engineering feedback loop: model-scale testing, full-scale operational data, performance measurement, and continuous improvement – a process refined over decades.

In addition to deep technical specialisation, many of our engineers have direct shipbuilding background, giving us first-hand understanding of construction processes and practical integration challenges.

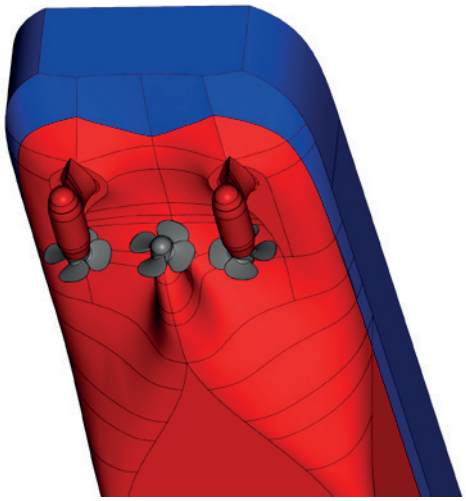
"Our expertise is built on a thorough understanding of hull – propulsion interaction and the ability to integrate shaftline systems seamlessly into complex ice-class hull structures. This interface, combined with our huge databank of built high-ice-class vessels, is the foundation of our know-how," says Kari Laukia, head of equipment and special projects.

Railotech delivered its first Polar Class propulsion systems more than a decade ago. Since then, multiple successful projects have enabled the development of highly efficient procurement processes and reliable project-execution methodologies.

"We are proud to have been selected to supply the shaftline systems for the most advanced polar icebreakers currently under construction," Laukia adds.



Railotech will deliver the complete propulsion package for the New Polarstern's centre shaftline, including a specially designed 5.4-metre stainless steel propeller optimised for continuous ice operation.



The Polar icebreakers will also feature Railotech's patented Hybrid DAS™ hull concept. ■

The Canadian Polar Icebreaker, developed in co-operation with Seaspan, is under construction at Vancouver Shipyards in Canada.

Finnish corvettes – icebreaker technology for naval ships

Photo Finnish Defence Forces

Finland's harsh and changeable winter seas demand vessels that can be trusted in any weather. When the Finnish Navy set out to create a new class of multirole corvettes capable of operating year-round across all of Finland's maritime domain, they approached their trusted partner, Railotech. Today, the Pohjanmaa-class corvettes under construction stand as the result of more than a decade of engineering, research, and collaboration.

In 2010, the Finnish Navy launched the ambitious Squadron 2020 programme. The goal was to renew the fleet used for surveillance and defence of Finland's maritime borders. Seven aging vessels would eventually be replaced by four highly capable, multirole corvettes.

From the outset, the Navy's vision was bold. The new vessels would need to repel sea-based attacks, safeguard vital maritime connections, operate seamlessly in the labyrinthine archipelago, and manage stormy and shallow waters, while remaining fully functional in all Finnish weather conditions.

Winters vary every year

The main challenge of Finnish winters is their unpredictability. The southern Baltic may remain ice-free, while the northern reaches turn into a shifting mosaic of ice, sometimes thin and navigable, sometimes hardened into towering pressure ridges. Calm level ice can stretch out like a frozen plain, but wind and currents can quickly churn it into chaotic layers of broken floes and brash ice.

Open water areas can be equally demanding, with storm winds driving waves over six metres high. Freezing spray can encase deck equipment overnight, while snow, sleet, rain, and fog arrive in quick succession, challenging not only the crew but also sensors and weapon systems. As climate patterns become less predictable, extreme and rapidly changing conditions are becoming more common.

Seeking expertise from Railotech

To turn vision into reality, the Finnish Navy turned to Railotech, a long-standing, trusted partner with deep expertise in ice-capable vessels, for guidance: what kind of ship could meet all their needs?

Early discussions revealed several conflicting requirements that would shape years of work. High speed and efficiency in open water traditionally conflict with the rugged strength required for ice. Low underwater noise, essential for anti-submarine operations, typically pushes designs in yet another direction.

As feasibility studies progressed, one conclusion became clear: no existing propulsion system in the world combined all these properties. A joint research programme was therefore launched to develop a military-standard, low-noise propulsion system, combining the Navy's open-water performance demands with the required ice capability.

The research programme included theoretical studies, model testing, and later full-scale trials. A breakthrough idea emerged using bronze as a test material to simulate various load conditions. Although bronze is commonly used in open water, it is typically dismissed as insufficient for higher ice-class vessels. Its modifiability, however, made it ideal for experimenting with multiple design variations.

Full-scale trials in the real Baltic

By 2015, it was time to step beyond the laboratory. The Finnish Navy's multipurpose oil and chemical spill response vessel *Louhi* became the testbed. On a cold winter morning, engineers replaced one of her original propellers with a bronze prototype, the culmination of months of modelling and simulation.

The test results were promising. A second round of trials followed a year later, this time pushing the propeller harder. In 2017, the minelayer *Hämeenmaa* participated in an additional series of full-scale tests to verify the final design requirements.

Finally, after years of refinements, the propulsion system developed for the Finnish Navy emerged as something truly unique: a fully tailored solution to meet the Navy's specified requirements.

In 2019, Railotech received the formal order to manufacture and deliver the complete shaftline package. Full-scale validation in *Louhi*'s third test confirmed performance in ice.

The Finnish Navy's multipurpose oil and chemical response vessel Louhi was used to validate the propulsion design in three different tests. One of her stainless-steel propellers was exchanged for a bronze propeller during each test.

A hull designed for the propulsion

With the propulsion defined, Railotech engineered, together with Rauma Marine Constructions, a perfectly matched hull form through our standard concept design process. This ensured a design that met the customer's stringent requirements and allowed seamless integration with the novel propulsion system, reducing risks for the shipyard.

"Our understanding of how the hull form interacts with propulsion in both ice and open water is the foundation of our engineering work," explains Kari Laukia, head of equipment and special projects at Railotech.

> *"Our understanding of how the hull form interacts with propulsion is the foundation of our engineering work."*

According to Laukia, silent operations add another layer of complexity, requiring that the hull form, shaftline, and propulsion remain in balance. If one element is off, the entire balance shifts, which is why having a single company provide the full solution is advantageous.

He adds that expertise in integrating the shaftline interface with the ship hull – including appendages – to optimise the hydrodynamics at the stern is essential for vessels operating in seasonally freezing waters.

Construction progressing at full speed

Construction of the first Pohjanmaa-class corvette began at Rauma Marine Constructions in October 2023. By late 2024, the first set of shaftlines and propellers were delivered to the shipyard. The ship is now in the afloat outfitting phase, during which the propulsion system is being installed. Testing will begin once installation is complete.

Construction of all four Pohjanmaa-class corvettes is progressing at full speed at Rauma Marine Constructions. Photo courtesy of Rauma Marine Constructions.

The second corvette is already taking shape in the yard. Most of the equipment has been delivered, with propulsion installation scheduled before the launch in spring 2026. Hull assembly of the third vessel is underway, and the keel for the fourth was laid in January 2026.

Railotech's work will culminate in the full-scale ice-trial, when the first completed ship undergoes final testing. The Squadron 2020 programme aims to achieve operational capability by 2029, when all four corvettes will have been delivered to the Finnish Navy.

Equipped for advanced border control

Once fully operational, the multirole corvettes will enhance Finland's year-round maritime surveillance capabilities, protect maritime connections, and secure national territorial integrity. They will also form an essential part of NATO's capabilities in the Baltic Sea.

The vessels will be equipped for minelaying, reconnaissance, surveillance, anti-air missile operations, and anti-submarine warfare. At 117 metres in length and with

a deadweight of 4,300 tonnes, they will be the largest Finnish warships of their class.

All ships will feature Railotech's advanced Ice Load Monitoring System ILMS, which uses hull-mounted sensors to inform the bridge crew about ice-induced loads. The system helps navigators determine whether loads remain within safe limits and supports informed decisions, for example, adjusting speed for safer ice operations.

All equipment has undergone comprehensive winterisation engineering to ensure flawless performance in all temperatures. Even during ice-free periods, freezing waves and icy precipitation can coat the ship in ice.

A partnership built on trust

Throughout this demanding project, the Finnish Navy and Railotech have worked in close co-operation. The collaboration has relied on close dialogue, mutual trust, and the step-by-step, customer-focused development approach for which Railotech is known, beginning with defining the Navy's specific needs and evolving into the final design.

As the fourth and final vessel entered construction in January 2026 and the first sea trials approach, the Pohjanmaa-class stands as a testament to perseverance, innovation, and the long tradition of Finnish excellence in ice-capable ship and propulsion design.

A notable spin-off from the development programme was the creation of a new dimensioning method for using bronze in ice conditions. This breakthrough enabled the design and delivery of a bronze propeller for the tug Calypso, which can be operated together with the detachable bow Saimaa to keep fairways open.

To ensure successful operations, it is essential to understand how the vessel behaves and withstands different ice conditions. In the design work, this has meant carefully evaluating the hull form, structural strength, propulsion system performance and winterisation.

Antarctic science: The French polar logistics vessel L'Astrolabe

L'Astrolabe can accommodate up to 60 people, including crew and scientists, combining the functions of supply vessel and research platform during her transits to Antarctica.

For decades, Railotech has helped nations and research institutes reach the farthest corners of the Earth – from Arctic ice to Antarctic seas – through purpose-built vessels designed to endure nature's toughest tests. As part of our 20th-anniversary series, we look back at the creation of the polar logistics vessel L'Astrolabe.

In January 2015, Railotech was approached by the French shipyard Chantiers Piriou seeking an ice specialist who could turn an initial polar-vessel concept into a state-of-the-art ship capable of withstanding the frozen seas of Antarctica. The vessel was being commissioned for three French institutions: *Les Terres Australes et Antarctiques Françaises* (TAAF), the *Institut Polaire Français Paul-Émile Victor* (IPEV), and the French Navy.

The goal was to build a ship that would replace both the 1966-built patrol vessel *L'Albatros* and the 1986-built polar logistics vessel *L'Astrolabe*. The new ship would resupply the French Antarctic base at Dumont D'Urville during the southern summer, and, when the season closed, she would patrol the tropical waters around Réunion Island in the Indian Ocean.

Decades of polar experience

The initial concept for the vessel was prepared by the French engineering company Marine Assistance. Given Railotech's strong background in supporting Antarctic programmes, the research institutes and the French Navy were eager to ensure our involvement in the subsequent design phases. The project needed the insight of people who truly knew ice.

"We have designed numerous ships for the Arctic and Antarctica, and conducted several research expeditions to the polar regions since the 1960s, gaining deep experience and respect for the forces at play in such environments," says Chief Designer Lars Lönnberg.

Railotech's task was to ensure that the vessel could operate safely and reliably in the demanding conditions.

By June 2015, the contract was signed, with a demanding two-year timeline to design, test, and deliver a ship capable of challenging the polar regions. Marine Assistance would remain as the owners' advisor, but the design and technical responsibilities were passed on to Railotech and Piriou Shipyard.

Redesigning for the ice

When our engineers first reviewed the initial concept, they quickly realised the design would need major revisions to meet both the Polar Code and Special Purpose Ship (SPS) Code. These rules mandate that even if a ship's hull is damaged, it must remain stable and afloat with limited heel, and be safe for everyone aboard.

Working within strict dimensional limits – no extra length or beam – our designers reshaped the hull, rearranged internal spaces, reinforced the steel structure, and developed the design further to meet the classification society Bureau Veritas' ice-class requirements.

Putting design to the test

Two months later, the ice model tests confirmed her capabilities: breaking 80 cm of level ice at two knots, operating in areas with second-year ice, and navigating through coastal ice up to one metre thick at full concentration (10/10).

The team then turned to seakeeping tests to see how the vessel would behave in the roaring waves of the Southern Ocean. Managing icebreaking capabilities alongside good open-water performance requires careful optimisation to achieve the right balance. The tests demonstrated *L'Astrolabe's* capability to handle both extremes.

Her diesel-mechanical propulsion system was chosen for efficiency during long open-water transits. In ice operations, however, a diesel-electric power transmission system is usually favoured, and, when combined with azimuthing propulsion, can greatly improve a vessel's operability in ice. Therefore, additional resistance and propulsion tests were performed to fully assess the vessel's performance under all conditions.

Multiple roles in a compact design

By January 2016, design work and model testing were complete. Despite her compact size, *L'Astrolabe* was designed to be a true multi-mission vessel carrying large quantities of supplies, containers, heavy machinery, pallets, liquid drums, and personnel, all vital for the remote Dumont D'Urville base. Her aft deck doubles as a working platform with an A-frame for lowering oceanographic equipment, while a helicopter landing area adds further versatility.

Below deck, her four Wärtsilä 8L20 main engines deliver 6.4 MW of propulsion power through two shaftlines. For each shaftline, a pair of engines is connected to a reduction gear, primarily used for the bow thrusters. Two auxiliary generator sets provide electricity for the ship. All engines meet IMO Tier III regulations.

The controllable pitch propellers (CPP) on both shaftlines allow the ship to change speed without reversing engine rotation. This setup provides fast response times – a critical feature for when the ship operates in tough icy conditions. High above the deck, an aloft conning station equipped with advanced surveillance systems supports both research and patrol duties.

"We succeeded in fitting all functions into this compact design, although it proved to be quite a puzzle," Lönnberg highlights.

Support throughout construction

Railotech's contract with Piriou Shipyard also included technical support during construction. Her steel hull was first built at CRIST in Gdynia, Poland, before being towed to Concarneau on France's Atlantic coast, for outfitting and final completion at Piriou Shipyard.

Our experts made regular trips to both Poland and France over the entire construction period to check hull reinforcements, provide guidance, and verify that all ice-navigation features and winterisation requirements were implemented correctly – crucial details essential for safety and performance in Antarctic conditions.

Inclining tests were performed in May 2017 to verify the vessel's lightweight and centre of gravity, followed by open-water tests a month later. These trials confirmed the ship's performance in speed, endurance, noise, vibration, turning, and manoeuvrability.

Ready for the ice

In September 2017, *L'Astrolabe* was delivered exactly on schedule. Her first assignment took her to Réunion for patrol duties, followed by a voyage to Tasmania for cargo loading. Then, in early 2018, she embarked on her maiden crossing to Antarctica. Since then, she has completed up to five round trips per season between Hobart and the Dumont d'Urville station in Antarctica.

According to Piriou Shipyard, after the delivery of *L'Astrolabe*, collaboration with Railotech was highly constructive, and sharing Railotech's experience in the design and construction of Arctic vessels proved particularly valuable. Together, the two companies identified the best technical solutions to achieve the required performance and meet the tight delivery schedule.

"Our interest in Antarctic science goes far beyond commercial considerations," says Lönnberg. "As climate and ice conditions continue to change, staying closely connected with the latest polar research is essential. It is the only way we can continue designing vessels that are truly suited to the challenges of future Antarctic missions."

Technical details	
Length	72 metres
Beam	16 metres
Draught	5.2 metres
Deadweight	1,600 tonnes
Open-water speed	14 knots
Propulsion power	6.4 MW
Icebreaking	80 cm level ice
Ice class	BV Icebreaker 5
Complement	60 people

Ice trials with RRS Sir David Attenborough

In early December 2025, Rob Hindley, Juuso Lindroos and Sami Saarinen travelled to the Falkland Islands to board RRS Sir David Attenborough for a second round of ice trials in the Antarctic. The objective of the joint operation, involving British Antarctic Survey, Lloyd's Register, Kongsberg Maritime and American Bureau of Shipping, was to evaluate the ship in a variety of ice conditions, using hull and propulsion monitoring systems.

In 2022, a Railotech team joined the polar research vessel RRS *Sir David Attenborough* to conduct its ice trials, a standard set of Railotech procedures to ensure that the vessel fulfils contractual performance specifications in ice. In addition to the trials, the team also worked to calibrate the installed Ice Load Monitoring System (ILMS) and refined the vessel's operational limitations. The overall aim was to help the operator, British Antarctic Survey (BAS), understand the ship's capabilities in ice.

This time, what made the programme genuinely groundbreaking was that, for the first time, propeller, shaft and hull ice loads were measured simultaneously. Once combined and analysed, the data will be used to set limitations for the ship, specific to the Antarctic ice conditions that it operates in. This will allow BAS to maximise the use of the ship, while knowing the ship's safety limits.

In addition, the results aim to advance the overall understanding of how ice loads on the hull, propeller and propulsion line interrelate, which may ultimately lead to updates to the Polar Class rules.

Searching for suitable ice fields

The area initially selected for the trials was the Weddell Sea. This region typically contains sea ice year-round. Ice conditions are, however, highly variable, and the search for optimal testing conditions relied on a combination of satellite imagery and drone surveys. The intention was to find a variety of ice conditions that would represent the expected limits for the ship, as well as to find ridges and rubble ice to maximize the amount of propeller-ice interaction.

Sailing through the pack ice, the concentration of ice varied, which provided good data points for typical operating conditions. Further South, the ice concentration soon neared nine tenths, enough room for the ship to move, but continuous forward progress was often difficult. The ice was a mix of first year, multi-year and glacial ice. The air temperature was around zero for most of the transit, with the ice being near its melting point making on-ice measurements challenging.

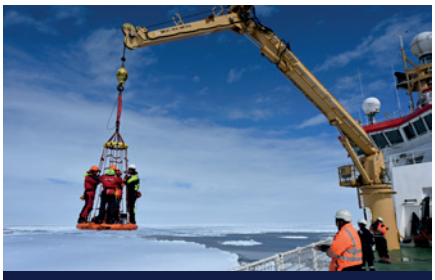
Sailing through the pack ice, the concentration of ice varied, which provided good data points for typical operating conditions.

After a week in the Weddell Sea, a decision was made to sail West to the Antarctic Peninsula, in search of a greater variety of ice conditions, including targeting several fjords for level, fast ice. The intention was to locate fast ice that could be used for more systematic testing, aiming to obtain correlation between the ice thickness and the ice loads measured on the ship's hull, the propeller blade and the propulsion system.

"We spent about two weeks in ice in total," says Sami Saarinen from Railotech, who was responsible for the on-ice measurements. This was his third Antarctic expedition.

The trials process

Testing of ships in ice is always a balance of seizing opportunities as they arise and being methodical. For these trials, the team was fortunate that the instrumentation onboard the ship was running continuously as the ship moved through the ice. When particular ice features, or ice conditions that were considered representative of the area were identified, the Railotech team was lowered onto the ice to measure its properties, including thickness, salinity and temperature, and to collect ice cores for compressive strength testing.



One of the Railotech team's tasks was to measure the ice properties, to provide a "ground truth" understanding of the conditions the ship was operating in.

For ridge testing, ice measurements were taken before the vessel broke through the ridge. The ship then proceeded through the ridge while data was collected on propeller ice loading.

RRS Sir David Attenborough is the UK's flagship polar research platform, enabling scientists to study climate change, biodiversity and ocean processes in the Earth's polar regions. Photo courtesy of BAS.

Dive operations formed a unique and critical part of the programme. Divers were deployed beneath the vessel twice daily to download data from sensors installed on the propeller blade and to recharge the instruments. This approach was adopted to enable data from the propeller blade to be examined daily, rather than having to wait until the end of the trials and a dry docking to access the data logger content.

A collaborative effort of international experts

The project brought together leading international expertise in polar vessel design and performance. Railotech led the ice trials, drawing on extensive experience in polar ship design and full-scale ship – ice interaction measurements.

Lloyd's Register installed the instrumentation on the propeller shafts and borescopes, which were used to visually observe ice pieces interacting with the propeller. Kongsberg Maritime supplied the instrumented propeller blade, used to measure the loads directly. American Bureau of Shipping (ABS) Canada contributed lidar, camera and thermal imaging systems to characterise ice conditions in real time as part of the ICESIGHTS Research and Development campaign jointly run by Railotech and ABS Canada. BAS coordinated field operations using satellite imagery and drone surveys to identify optimal testing locations. To complement the propulsion system measurements, Railotech took responsibility for measuring ice loads on the ship's structure.

"These trials were truly one of a kind," says Rob Hindley, Head of Consultancy & Technology Development at Railotech, and leader of the Railotech ice trials team. "Direct measurements of propeller ice loads are fundamental to advancing dimensioning practices for safe and sustainable polar shipping, yet the complexity has meant they are rarely undertaken."

Results expected to provide new insights

According to Saarinen, the results will deepen understanding of the interrelationship between ice loads on the ship and the surrounding ice characteristics. By combining visual observations of ice conditions, ice surface profiling, physical ice measurements, and recorded load data, the team will be able to identify correlations between the ice the ship encountered and the loads acting on the vessel.

He adds that this voyage built upon the first ice trials, leveraging previously gathered data while exploring the phenomena in greater depth using the latest technology. The collaboration between different organisations, each contributing specialised expertise, proved highly valuable.

"Analysing the full dataset will be complex, but it will produce extremely valuable causal relationships and correlations," Saarinen says.

Endurance's lessons for modern icebreaker design

More than a century after Sir Ernest Shackleton's legendary Antarctic expedition, the fate of his ship the *Endurance* continues to captivate historians, engineers, and polar researchers. In 2022, that legacy intersected directly with modern ice engineering when Professor Jukka Tuhkuri of Aalto University joined the Endurance22 expedition to locate the wreck and reassess one of polar exploration's most enduring myths.

The Endurance22 expedition departed from Cape Town bound for the Weddell Sea in Antarctica – the location of the *Endurance's* last recorded position before she sank in November 1915. By that time, the vessel had been trapped in compressive pack ice for months. When she was finally crushed, her crew moved to the surrounding pack ice and camped under extreme conditions.

Bringing closure to the legend

The search for the shipwreck was conducted aboard the modern South African research and logistics vessel *S.A. Agulhas II,* built in Finland in 2012, an example of how far polar vessel design has evolved since Shackleton's era. Organised by the Falkland Maritime Heritage Trust, the mission aimed to locate the wreck and close a historic chapter in maritime exploration.

The Endurance22 search expedition travelled onboard the South African research and logistics vessel S.A. Agulhas II, built in Finland in 2012.

"After the *Titanic*, the *Endurance* is probably the second most famous shipwreck in the world," notes Tuhkuri, Professor of solid mechanics at Aalto University in Finland, and one of the world's foremost ice researchers. "Shackleton became a symbol of leadership under extreme adversity by bringing his entire crew home alive after losing the ship."

Endurance under full sail in Antarctica by Frank Hurley, about 1915, Mitchell Library, State Library of New South Wales, Australia.

On 5 March 2022, after weeks of searches with an advanced underwater autonomous vehicle, the wreck was located about three kilometres beneath the Weddell Sea pack ice. The discovery generated immense global attention and renewed interest in both the expedition and the vessel itself.

Structural analysis challenges the myth

The expedition also triggered a deeper technical investigation. Tuhkuri authored the book Jään Voima (The Power of Ice) and published a peer-reviewed structural analysis in Polar Record (Cambridge University Press, October 2025), addressing a question long taken for granted: **Why did the *Endurance* actually fail?**

Contrary to popular belief, the vessel was not the strongest polar ship of her time in structural terms. By examining original hull drawings and correspondence in archives, Tuhkuri concluded that the *Endurance* had

Jukka Tuhkuri is Professor of solid mechanics at Aalto University in Finland, and one of the world's foremost ice researchers. Picture by Mikko Raskinen, Aalto University

been designed primarily for Arctic summer operations at the edge of pack ice. Those environments are dominated by impact loads from drifting floes, not sustained compressive forces.

Antarctic pack ice conditions, by contrast, are characterised by vast compressive ice fields that impose prolonged lateral pressures on hull structures. Such conditions require fundamentally different structural solutions, including diagonal reinforcement to prevent hull collapse under squeezing loads – features the *Endurance* did not possess.

Tuhkuri further established that Shackleton was aware of the elevated risk and knowingly accepted it, a decision that ultimately proved structurally catastrophic.

Implications for modern icebreaker design

According to Tuhkuri, the relevance for today's ship designers is unambiguous. Ice is not a uniform operating environment. Load mechanisms vary dramatically by region, season, temperature, and ice morphology.

"In ship design, it is fundamental to define the exact ice environment the vessel will encounter, quantify the expected loads, and design the hull accordingly," Tuhkuri emphasises. "A ship optimised for one ice regime should not be assumed safe in another."

This principle underpins modern mission-specific design philosophies and the growing emphasis on clearly defined operational envelopes. The *Endurance* case remains a reminder of what happens when environmental assumptions diverge from structural reality.

The value of scientific reassessment

Tuhkuri also highlights the broader importance of rigorous scientific analysis.

"Over a century ago, *The Times* described the *Endurance* as the strongest ship ever built. Based on structural evidence, they were able to correct the record."

His research has also been adopted by *The New York Times* as part of an educational STEM case study, illustrating how technically grounded narratives can bridge engineering, history, and public understanding.

Warm ice: a new design variable

Beyond historical analysis, the expedition produced valuable new field data for Tuhkuri's current research project. While *SA Agulhas II* paused to deploy the submersible, Tuhkuri conducted measurements of one-metre-thick Antarctic ice near its melting point, conditions increasingly common as polar temperatures rise.

To date, most climate research has focused on ice extent and thickness. Less attention has been paid to how warming alters ice as a material, and how this affects structural loading on vessels.

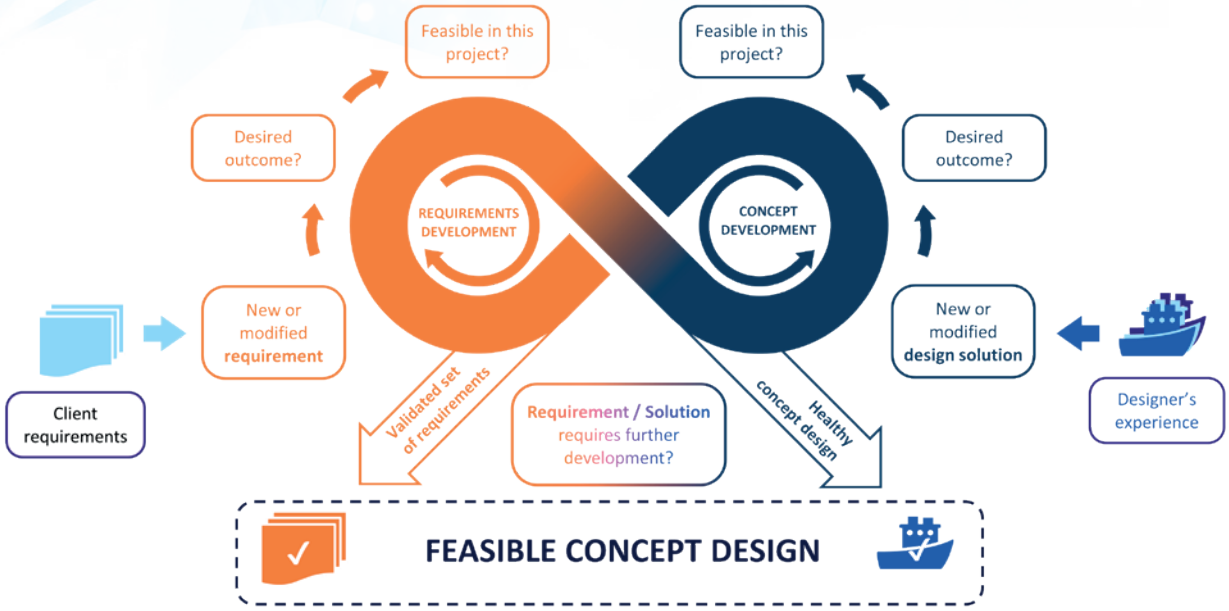
"Ice loads follow the relation F=pA," Tuhkuri explains, where F is force, p is pressure, and A is contact area. "Cold ice generates high pressures over small contact areas. Warmer ice, however, produces lower pressure distributed over a much larger area, resulting in load patterns that differ significantly from traditional design assumptions."

His observations indicate that warm ice also exhibits unexpected deformation behaviour, with direct implications for hull loads, local plating stresses, and operational safety.

"We are already seeing that softer ice conditions create a false impression of safety. Vessels without adequate ice strengthening are sailing into previously inaccessible regions. In structural terms, they are repeating the mistakes made with the *Endurance*," Tuhkuri concludes.

Endurance by Frank Hurley, Internet archive

The key to a successful icebreaker project



Designing a modern icebreaker is a complex undertaking. With nearly 80 successful icebreaker designs behind us, we know that true success begins with a high-quality concept design, grounded in deep expertise and experience.

Compared with many other vessel types, the global icebreaker fleet is small. These ships are mission-specific, operating in harsh conditions where ice is present or poses a risk. Their tasks range widely, and each mission brings its own requirements. An icebreaker must also be feasible to construct, fit within a defined budget, and be cost-efficient to operate. No single design can be a perfect match for every scenario.

Icebreaker design also differs fundamentally from conventional ship design. Due to the unpredictable operating environment, the design variables are tightly interconnected, and icebreaker performance depends on the specialised knowledge of ice mechanics and propulsion in ice. Without prior icebreaker design experience, it is nearly impossible to make the right main design decisions.

Taking shortcuts creates unnecessary risks

The idea of skipping the concept design phase by using an existing design and adapting it for a different mission with minimal changes has time and again proven to be a high-risk option. What may initially appear as a safe shortcut often leads to an endless labyrinth of changes, corrections, and compromises.

"The risk is late delivery and an unbalanced vessel carrying undesired remnants of the parent design," says Head of Sales and Marketing Arto Uuskallio from Railotech. "In addition, rules and regulations are constantly changing, which may mean that previous designs are no longer allowed."

A tailored concept created by an experienced designer, by contrast, ensures the ship is optimised for its actual tasks and conditions from the beginning. This will ultimately save both time and money.

"Investing in an icebreaker is a long-term commitment. Cutting corners in the crucial concept design phase is never in the owner's or operator's best interest," adds Uuskallio.

Laying the foundation

The following design phases provide the technical implementation for the boundary conditions defined during the concept design. They are straightforward when the underlying concept is sound. However, experience in basic design alone does not qualify one to create a healthy concept.

At the beginning of the concept development, the customer typically has a list of requirements. The designer's role is to understand these needs and clarify for the customer how they interact, what trade-offs exist, and which targets are realistic. This process relies on solid expertise and experience built over numerous previous projects.

Through detailed discussions, the customer and designer jointly agree on a set of realistic and achievable requirements, as well as their correct interpretation. These requirements form the foundation for the concept development.

The design loop

The designer then begins outlining the ship: main dimensions, weight and power relationship, hull form, propulsion, winterisation, and key outfitting. Close and continuous dialogue with the customer is essential. Each decision narrows the options and affects later choices. A skilled designer understands which decisions must be made early, which can wait, and how every selection impacts performance, guiding the customer in the right direction.

The design loop allows a return to earlier steps when needed. Complex topics such as new alternative fuels can also be separated for deeper study before being reintegrated into the main design stream.

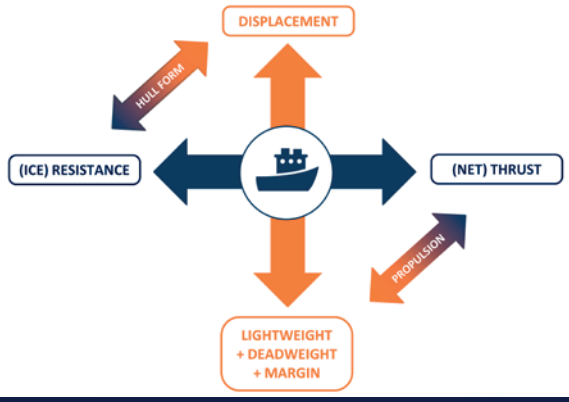
"Inexperienced designers might not even recognise potential problem areas, let alone solve them," says Lead Naval Architect Tuomas Romu from Railotech.

Core elements of concept design

A successful concept design relies on both quantifiable methods and deep organisational knowledge built over decades of icebreaker design, research and development – and, in Railotech's case, more than 700 model test series and over 150 full-scale trials.

"The entire design package must be in balance for the vessel to float, move forward, be constructable, and function in freezing conditions," notes Uuskallio.

A fundamental design driver of every icebreaker is the *weight-performance balance*. It consists of two seemingly independent, but actually coupled, force-balance equations: the *weight equation* in the vertical direction and the *performance equation* in the horizontal direction. Together, these essentially determine how large and powerful the icebreaker must be to meet its performance goals.



The key challenge is finding the correct balance between two perpendicular force-balance equations.

It is often said that icebreakers incorporate three key features: shape (icebreaking hull form), power (propulsion), and strength (reinforced hull). However, there's a fourth feature: functionality. Icebreakers operate in cold, dark, and icy conditions. The vessel and its essential systems – including the crew – must remain functional throughout their environmental envelope.

Icebreakers must remain functional in extreme conditions.

Selecting the proper ice class

Ice strengthening ensures the ship can withstand ice loads and is optimised for the operating environment. Selecting the correct ice class is complex, as ice-class rules do not describe how to design icebreaker structures or determine icebreaking capability, engine power, or safe operating limits.

"Without proper expertise, there is a serious risk of inadequate strengthening of critical hull areas and propulsion components," Romu explains. "Over-dimensioning, on the other hand, results in a ship that is heavy and unnecessarily expensive to build and operate."

Railotech has gathered the world's largest database of ice conditions and developed tools for determining correct ice strengthening over the past 70 years. The Ice Load Monitoring System (ILMS), installed on operating vessels, continuously feeds new data, enabling accurate predictions even as conditions change with the climate.

"We are the only company able to advise customers on the correct ice-class selection," says Uuskallio. ■

Predicting performance in ice is a central part of concept design.

Research projects at Railotech

As the leading company in icebreaker design and technology, Railotech puts considerable effort into research & development to support authorities' decision-making and the ongoing refinement of the Finnish-Swedish Ice Class Rules.

Sustainable, safe, efficient, and environmentally friendly year-round navigation to and from Finnish and Swedish ports, as well as an efficient winter navigation system, is important for our industry and the competitiveness of our countries.

The Winter Navigation Research Board is a Finnish-Swedish cooperation administering a joint winter navigation research programme, based on a bilateral agreement between the Finnish Maritime Administration and the Swedish Maritime Administration. Here is a brief overview of our latest research topics, as part of the Research Board's programme.

IB Beam impact

The existing icebreaker fleet in the Baltic Sea has reportedly faced difficulties when assisting large ships in heavy channels. Although such extreme conditions are rare, it was important to examine whether a wider icebreaker would perform more effectively under similar circumstances.

The project explored the effect of the icebreaker beam on the resistance experienced by assisted vessels in heavy channels through experimental methods. The goal was to determine whether increasing the icebreaker beam from 24 metres to either ~28 metres or ~32 metres would offer significant advantages.

The tested ice condition represented a heavy brash-ice channel, which has thick side ridges or "cheeks" to realistically restrict the lateral movement of the ice mass in the channel.

Model ice was used to produce the surrounding level ice field for the brash-ice channel. After that, the channel was filled with solid fresh-water ice cubes to produce brash ice with a target thickness of 1.5 m. According to Matala, the ice cubes model realistically all processes considered significant in ship's ice resistance in an unconsolidated brash-ice channel.

The technically interesting test project provided valuable insight into the impact of displaced brash-ice mass within the limited space of the channel.

Discrete element method – fluid dynamics

Ice model testing is a proven method in the Finnish-Swedish Ice Class Rules to verify a merchant ship's performance for granting ice class. However, current ice model testing techniques face challenges from hydrodynamic effects at higher speeds.

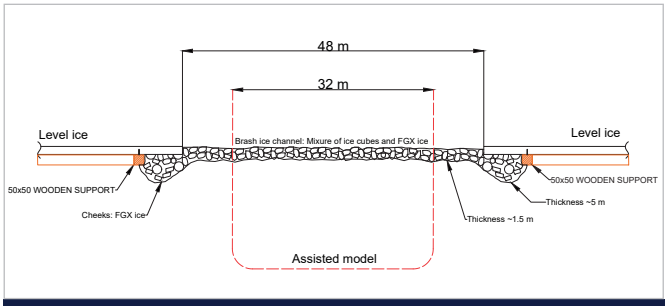
The combined discrete element method-computational fluid dynamics (DEM-CFD) simulation method has shown potential to support model tests in providing a more comprehensive evaluation of ship performance in the standardised rule channel in the future.

In a previous review, we concluded that no existing open-source codes could be directly applied in such a scenario. Therefore, this project aimed to review coupling methods of DEM-CFD for developing a simulation framework.

Dr Hanyang Gong from Railotech found that the CFDEM and PhasicFlowPlus codes are the most suitable open-source packages available that can be used for simulating brash-ice ship model tests.

A demonstrative simulation of a hull in brash ice was performed by using CFDEM as a proof of concept. The simulation was able to capture water and ice flow around the hull qualitatively, but further work is required to validate the simulations against model test results and to obtain quantitative results on ice resistance on the ship model.

The research work was also augmented by Dr Malith Prasanna, a research scientist at VTT in Arctic renewable energy. He gained experience using DEM models to simulate ice loads on offshore structures during his postdoctoral researcher tenure at Aalto University.



The tested ice condition for the IB Beam project represented a heavy brash-ice channel.

Frame stability evaluation

Structural engineer Ville Valtonen has continued to develop alternative methodology for structural dimensioning under the Finnish-Swedish Ice Class Rules (FSICR).

Sufficient stability of framing members is important to ensure load-carrying capacity and, thus, safety against ice loads. Currently, sufficient stability is ensured by a minimum thickness requirement, which is similar in both the FSICR and the IACS PC Rule.

According to Professor Claude Daley, the current minimum thickness requirements in the rules are too conservative for flat-bar frames (resulting in excess weight) and insufficient for flanged members (leading to buckling and tripping failures, i.e. ice damage). In 2003, Daley suggested that improved criteria should be developed. However, the same formula is still used in both the PC and FSICR Rules.

Previously, evaluating frame stability has been rather complicated, as the available tools have been either laboratory tests with semi-scale steel structures, analytical formulas, or non-linear finite element analysis without iteration.

With the tools Valtonen developed for the HULLFEM I-III projects, it has become possible to solve inverse problems related to ice-strengthened ships with non-linear FEM. Instead of solving the response of a given structure, these tools allow for automatic iteration to solve for the minimum structure that fulfils the given criteria for given load. This allows for finding the minimum thicknesses that guarantee sufficient stability.

During 2026, Valtonen will study minimum thicknesses by using non-linear FEM analysis to provide improved frame stability requirements, which would allow weight savings and improved safety. According to Valtonen, the improved formula could be directly implemented into the FSICR (and IACS PC Rules).

Stability failure of frame web in laboratory test in the 1980s.

Model test procedure update

The model test guideline for determining the minimum required power for Finnish-Swedish ice classes needed an update to better simulate the current situation.

Realistic determination of a ship's resistance at the set performance point (5 knots in a brash-ice channel of certain midpart thickness) is essential for fair and functional determination of the required minimum power.

According to our understanding, the current procedure functions well for traditional ice-going merchant ships but is not optimal for some modern, open-water-optimised bow forms with vertical or near-vertical bow shapes. Therefore, modifications were introduced, driven by the need to equally consider all bow shapes and the need for better-standardised testing conditions that reflect representative natural conditions.

Additionally, the current procedure considers significantly large-beam ships similarly to small-beam ships, while in reality, the channel in nature is relatively wider for small ships.

Key updates suggested incorporating requirements for realistic simulation of interactions between ice fragments and setting a target speed for a model test experiment. It was also proposed to change the friction coefficient correction formula.

In addition, to these improvements in the simulation of brash ice around ships with different shapes, a significant update in channel width and average thickness of the brash-ice mass in the model test was proposed to better account for significantly wider ships.

The goal is to ensure consistent and accurate performance predictions across different ship models and test facilities, ultimately leading to more equal and functional determination of the required minimum power for ice-class ships.

SNAIL

A project for 2026 is being planned in which the full-scale channel profile will be measured.

The measurements will be used to validate earlier results on the full-scale correlation of ship channel tests. The same data will also be applied to validate calculation methods describing how channel thickness develops over the winter season.

"The project provides an opportunity for several employees to participate in fieldwork, which is critically important for comprehensive professional development," says lead research engineer Rikka Matala. ■

NEWS IN BRIEF

Multi-Purpose Icebreaker.

Six Arctic Security Cutters for the U.S. Coast Guard

The U.S. Coast Guard has awarded contracts for the construction of six Arctic Security Cutters based on the Multi-Purpose Icebreaker (MPI) design developed by Railotech and Seaspan ULC.

Two icebreakers will be built by Rauma Marine Constructions Oy in Finland and four more by Bollinger Shipyards in the United States. The first Finnish-built Arctic Security Cutter is expected to be delivered in 2028, followed by the first U.S.-built vessel in 2029.

The MPI design will meet the evolving mission requirements of the United States Coast Guard – even in the harshest Arctic conditions. It is a flexible platform, adaptable to a wide range of missions and, most importantly, designed from the keel up for North American Coast Guard operations. The shared multi-mission design with the Canadian Coast Guard fleet will create the world's largest single class of modern icebreaking vessels, optimising interoperability and maintenance support.

Incorporating the latest technologies, the MPI reflects Railotech's long-standing expertise in ice-going vessels. It represents the next stage in icebreaker evolution, integrating lessons from past vessels, proven technologies, and modern design practices into a ready, comprehensive North American icebreaker package to serve the region.

Safety on the Northwest Passage

In 2025, international voyages on the Northwest Passage began slightly later and ended earlier than in the previous year. While most voyages were uneventful, one incident underscored the risks of Arctic navigation.

On 6 September, the Dutch cargo vessel *Thamesborg* ran aground in the Franklin Strait, near the uninhabited Tasmania Islands. Canadian icebreakers quickly responded to supervise the situation, and the cargo was transferred to two other vessels. The ship remained stranded for five weeks before being refloated with assistance from the Estonian multi-purpose icebreaker *Botnica* and the local tugboat *Beverly M I*.

Fortunately, there were no injuries or pollution, but the episode serves as a reminder of the urgent need for enhanced safety measures. Navigational charts of the Northwest Passage remain incomplete, and local emergency resources are limited, as highlighted by the necessity of bringing in an icebreaker from across the Atlantic.

Finnish icebreaker *Sisu*.

Happy birthday Sisu!

The Finnish icebreaker *Sisu* turned 50 years old in January 2026. For half a century, she has contributed to Finnish winter navigation and security of supply. Her sister ship *Urho* turned 50 last year.

Sisu and *Urho* were both completed at Wärtsilä's Helsinki shipyard in the 1970s and represent the traditional icebreaker architecture of the *Urho* class. The vessels were designed to withstand the demanding ice conditions of the Baltic Sea and to ensure smooth maritime traffic even in the challenging conditions of the Bay of Bothnia. *Sisu* and *Urho* are an important part of Finland's winter navigation system and remain two of Finland's most capable icebreakers, deployed in the most demanding ice conditions. ■

Building the next chapter

When Railotech acquired its long-term design partner Bluetech Finland in 2025, it marked more than a strategic response to the growing global demand for icebreakers. It brought together two companies with complementary expertise and a common belief in innovative engineering.

Bluetech Finland was founded in 2013 by a small group of naval architects with an ambitious goal: to develop the world's most energy-efficient bulk carrier. Mikko Hakulinen, today the director of engineering, joined the company that same year as a summer trainee.

The concept became a success, but as global markets shifted and uncertainty grew, the company made a strategic decision to broaden its focus. What began as a single-product venture evolved into a full-service ship design office – capable of supporting complex projects across multiple vessel types.

Over the past decade, Bluetech has grown into an international organisation of about 100 professionals, operating from offices in Finland, Vietnam, and India. The company works closely with three Finnish shipyards – Helsinki, Rauma, and Turku – in addition to other international yards and shipowners, providing concept design, basic design, and production design across all the disciplines needed to get ships built.

A familiar partner

Long before the acquisition. Bluetech supported Railotech on several demanding projects, including the Arctic Condensate Tanker and Ponant's polar cruise ship. Those collaborations laid the groundwork for trust, but joining forces revealed the full picture.

"For us, it has been an eye-opener to truly understand what Railotech does," Hakulinen says. "The depth of know-how behind their icebreaker designs is remarkable."

Where Railotech brings decades of focused expertise in ice-capable vessels, Bluetech contributes the breadth of handling the full design chain. Hakulinen believes the combination will prove powerful.

Complementary strengths

According to Hakulinen, their joint path has started off well, with an eagerness on both sides to learn from each other and to create something greater together.

Together, Railotech and Bluetech now form a team of approximately 150 professionals, capable of executing large and complex assignments – from the first outline of an idea through concept, basic, and production design.

As global demand for advanced icebreakers continues to grow, Railotech and Bluetech are no longer just collaborating project by project. They are building the next chapter together – stronger, broader, and better equipped to meet the challenges ahead. ■

ANNOUNCEMENTS

Jari Hurttia has joined Railotech as Business Development Manager.

Jari graduated from Helsinki University of Technology (now Aalto University) with a Master of Science (Technology) in 1997, and an Executive MBA in 2008. Jari began his career in the marine industry in the 1990s and has since held a range of advisory, management, and leadership roles in hi-technology export companies, gaining extensive experience in international business development and growth.

Timo Lotti has joined Railotech as Business Development Manager in the Equipment Business and Special Projects team.

With an academic background in electrical engineering and business administration, Timo brings extensive experience in marine and offshore technologies spanning three decades. Since the 1990s, Timo has held a broad range of roles, from Automation Design Engineer to various managerial positions, combining hands-on technical expertise with business leadership.

Ilja Rautiainen has joined Railotech as Project Manager in the Equipment Business and Special Projects team.

Ilja completed his Master of Engineering degree in Marine Engineering at Turku University of Applied Sciences in 2024. Prior to joining Railotech, Ilja held various design and project management roles at Helsinki Shipyard and ABB, gaining a decade of hands-on experience in complex marine projects. ■

WE ARE NOW RAILO TECHNOLOGY OY

To better reflect our global authority in icebreaker design and the Finnish heritage at our core, we are sharpening our brand and changing our name. From March 2026, we are Railo Technology – or Railotech for short.

The name symbolises an open lead in the ice, formed by natural forces such as wind, current, and ice movement. A lead can open suddenly and refreeze just as quickly. It is a dynamic phenomenon, and a powerful metaphor for what we do: understanding ice and enabling safe passage through it.

Five decades at the forefront

For more than fifty years, we have led the development of icebreaker design and performance in Finland. Born from the necessity of keeping Finnish ports open year-round, our expertise has evolved into a globally recognised centre of excellence in icebreaker technology.

We carry forward generations of accumulated knowledge, applied through rigorous research, extensive ice-model testing, polar fieldwork, and full-scale operational validation, to design high-performance vessels capable of operating reliably in the world's most demanding ice conditions.

An independent authority

During our first three decades, we operated as part of the Finnish shipbuilding industry, adapting our name as ownership structures changed. As global shipbuilding shifted toward higher-volume commercial production, the strategic importance for Finland of maintaining an independent, specialised authority in icebreaker and ice-going vessel design became clear.

In 2005, all accumulated Finnish ice-technology know-how – spanning 36 years of ice model testing, polar research, icebreaker design, and full-scale measurement data – was consolidated into the independent company Aker Arctic Technology.

This independence has enabled us to work across shipyards, projects, and vessel types on multiple continents. With every vessel delivered, we have accelerated our learning, deepened our expertise, and strengthened our position as the industry's technical reference point.

Since our establishment, 59 icebreaking vessels based on our designs have been put into operation worldwide, with 36 more under development. Our knowledge base is built on more than 700 ice model test series and over 150 full-scale measurement campaigns. Our specialists have participated in numerous polar expeditions and contributed extensively to research.

This service envelope has enabled shipyards all over the world to build superior vessels based on our forward-looking designs, while providing our customers with confidence and peace of mind in the most demanding ice operations.

Railotech reflects what we do

In 2025, we further strengthened our project execution capabilities through the acquisition of Bluetech Finland. At the same time, Aker Solutions, one of our founding companies, divested its ownership stake. In March 2026, we completed the next step in our evolution by becoming Railo Technology.

In Finnish, railo refers to an ice lead – a narrow split in the ice. We believe this is a fitting name for a company whose expertise lies in making the impossible navigable, while remaining firmly rooted in the Finnish icebreaking heritage. We know ice and how to work with it to open new frontiers.

A new look – the same mission

Alongside our new name, we are introducing a refreshed visual identity: a new logo, colour palette, and website that more clearly reflect our global leadership in ice-going vessel design.

While our appearance evolves, our mission remains unchanged. As Railo Technology, we continue to develop innovative, cost-efficient, and supremely reliable solutions for operating in ice, creating long-term value for shipowners, shipyards, and stakeholders across the entire maritime ecosystem, with the same passion and rigour that have defined our work for more than five decades. ■