Aker ARC 131

Aker Arctic

The Innovative Multipurpose Harbour Icebreaker Trimaran Tug

Trimaran Icebreaker

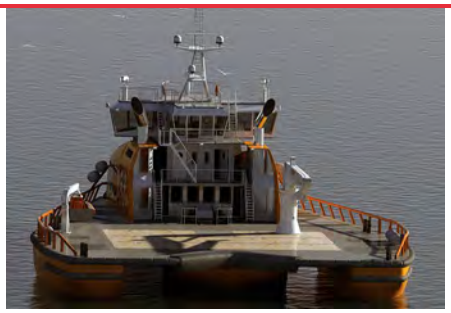
One of the latest innovations in icebreaking is the use of a trimaran concept. Aker Arctic tested its ARC 131 design in its ice basin in different ice conditions and operation modes. The results were encouraging.
The surprising conclusion was that a trimaran was able to operate in thick ice conditions, the concept was able to create a channel twice the width of a channel of a traditional icebreaker, but with the same propulsion power!

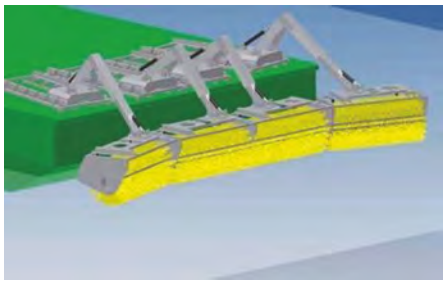
Trimaran concept extents the operational capabilities of the tug with best practices

Oil spill response vessel

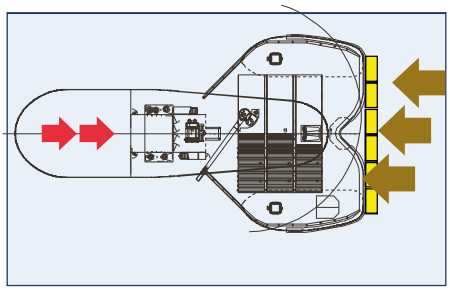
R&D work on a new trimaran icebreaker concept Aker ARC 131 has been realized with focus on improved marine research capabilities and oil combatting capabilities in ice.
The Finnish Environment Institute has developed a new brush system which today is believed to have the best capability for Arctic oil spill response.
The first installation of the oil brush collector is already in use on multipurpose vessel *Louhi*, delivered 2011.

Novel oil brush collector could be a standard feature on all modern icebreakers. This is today expected to be the best mechanical device and should in the future be fitted with necessary unit plug-ins and collecting tanks onboard any Arctic OSV.

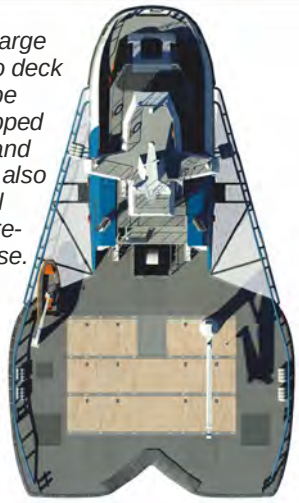




The SYKE oil combat module: Can be built in 6 m brush width, securing a 24 m wide sweeping area.



Separated oil is collected into containers on cargo deck, from which off- and onloading is easy and quick.



The large cargo deck can be equipped fast and easy also for oil spill re-sponse.

Multipurpose service vessel

Due to the large, 210 m^2, 5t/m^2, deck area the vessel is suitable for large light deck cargos such as buoys etc.

Also the stability of the vessel makes it very suitable for maintenance research works, for example for lighthouses and windmill parks. The vessel to be equipped with

Fire fighting resque vessel

Fire remains one of the top three causes of loss for marine vessels in the World Fleet, and is a major risk in harbour operation as well.

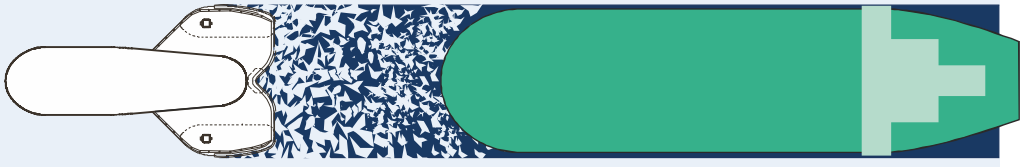
For fighting of external fires the vessel is provided with equipment meeting the requirements of Fi-Fi1 class and can be further equip quickly according to tasks for coastal and rescue towing.

Escort icebreaker

The Trimaram tug is designed to create a wide channel, abt 27 m wide which makes it excellent for assisting wide cargo vessels in ice.

The vessel has at the same time adequate astern going capabilities and good manoeuvring capabilities in ice.

Escorting in level ice of 0.4 m thickness at 7 knots!



a new generation of trimaran icebreaker tug will provide the highest degree of year-round escort towing capability.

Trimaran Icebreaker

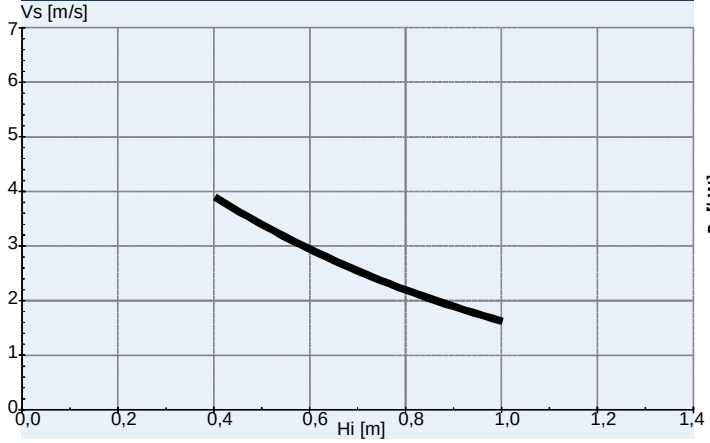
Trimaran gives high potential for cost-efficient icebreaking and for port and harbour operations

Aker Arctic conducted recently screening studies for assessing the suitability of the Aker ARC 131design for manoeuvring in icy waters. The results were encouraging.

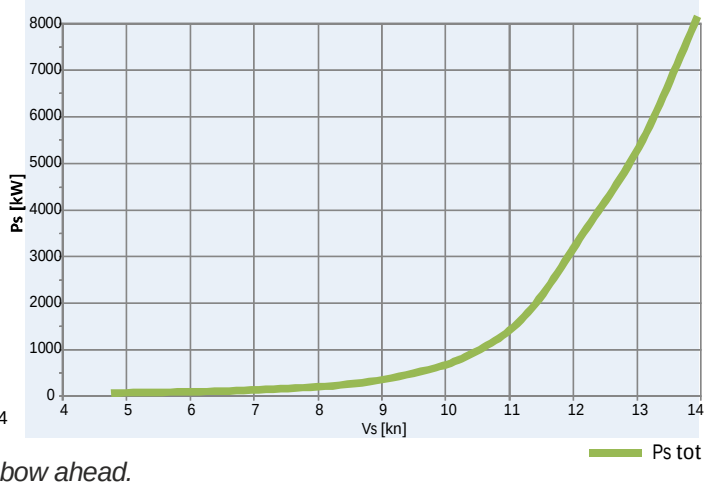
After having found the right location for the side hulls, a preliminary icebreaker concept was created and tested. The surprising conclusion was that a trimaran was able to operate in thick ice conditions, the concept was able to create a rather clean channel twice the width of a channel of a traditional icebreaker, but with the same propulsion power! The penetration astern through ridge fields did not either create any problems for the concept. Therefore the way forward has already been made; next phase will be development of two Aker Arctic designs, one for oil combat icebreaker, the other for special dry cargo movements in the Baltic Sea and Arctic waters. DP 2 system for station keeping ensures the seismic and service us of the trimaran.

Trimaran Icebreaker

Icebreaking harbour tug Aker ARC 131 icebreaking capability in level ice, ahead

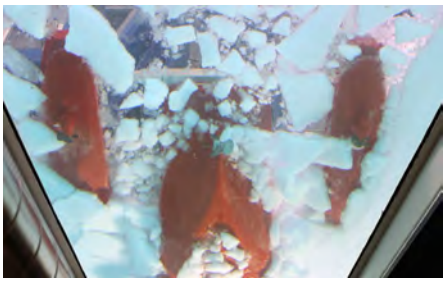


Trimaran power- speed prediction at calm Baltic Sea water (1 CL propeller Ps max =3.5 MW, 2 side propellers Ps max =2 x 1.7 MW)



Breaking level ice bow ahead.

Breaking wide channel in level ice bow ahead.



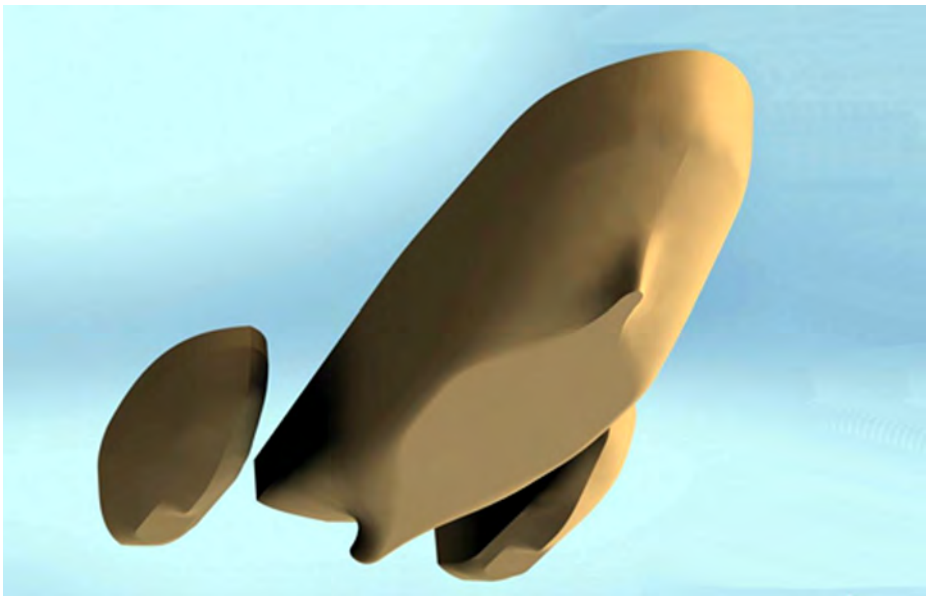
Breaking through thick ridge stern ahead.

Breaking out of channel with excellent manoeuvrability.

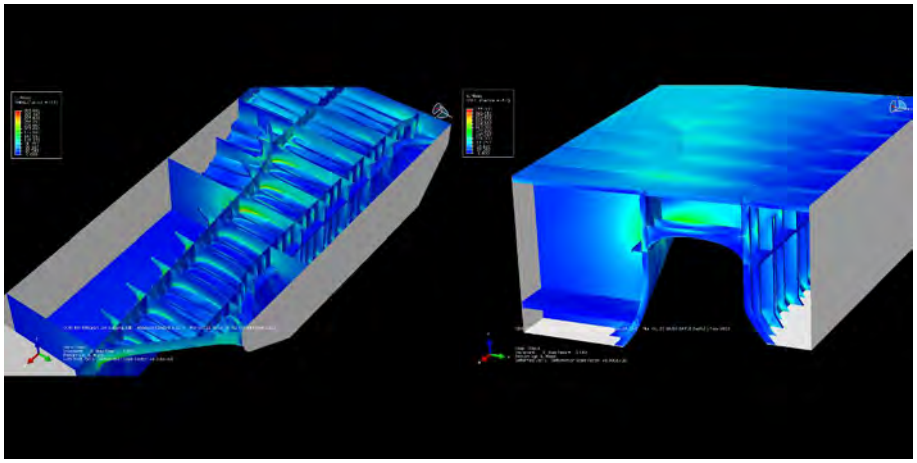
Dimensioning loads for icebreaking trimarans

The dimensioning principles of cross-deck structures of icebreaking trimarans chosen for calculating the dimensioning loads were derived for the conditions of the Baltic Sea for both open water and first-year ice.

These methods were examined by calculating the loads for an example ship with the length of 44.8 m and a beam of 25.6 m. The structural responses from the loads were compared with a finite element model.



The Trimaran hull used for concept development



Results from calculating maximum ice loads during the vessel's lifetime using finite element method

Simplified ship hull was used for determining dimensioning ultimate ice loads.

Trimaran Icebreaker

The load cases studied in open water included still water, wave and slamming loads. Wave loads were calculated with the static-balance method and the classification rules of GL and LR. Rule formulas of the LR trimaran rules could not be used for the icebreaking trimaran, because the size of the side hull exceeds the applicability limits of the rules. Thus a static roll angle method from direct calculation procedure was used instead.

In the calculations made, the largest of all loads were the wave loads.

Slamming loads may also be significant and further research will be studied during this Spring.

Impact of ice loads

The studied loads in ice included loads from icebreaking, compressive ice, beaching and manoeuvring. Icebreaking loads were of the same magnitude as wave loads, and only slightly lower. Thus icebreaking loads are significant in dimensioning.

Loads from beaching on ice ridges were significantly smaller than icebreaking loads and are not significant in dimensioning.

The loads from both compressive ice and manoeuvring were lower than icebreaking loads, manoeuvring being the larger of these two. Due to the different orientation of these forces, the manoeuvring had to be considered in dimensioning.

As the trimaran can operate both ahead and astern, ice loads were calculated in both operating modes.

Calculations of ice loads were based on data from long term measurements and Aker Arctic's database and experience, which includes a wide range of measurements gathered by icebreakers over decades. Results were also verified against this data.

The dimensioning loads for the trimaran tug are wave loads, icebreaking and manoeuvring in ice. The results suggest that the cross deck structure of an icebreaking trimaran similar to the example ship can be feasibly built.

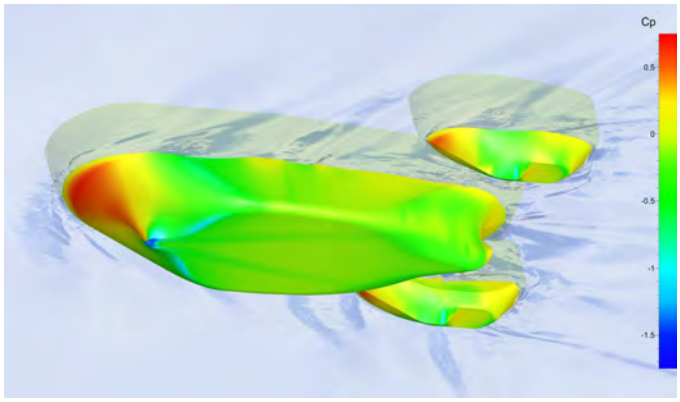
The dimensioning methods developed can also be used for icebreaking trimarans with different main dimensions

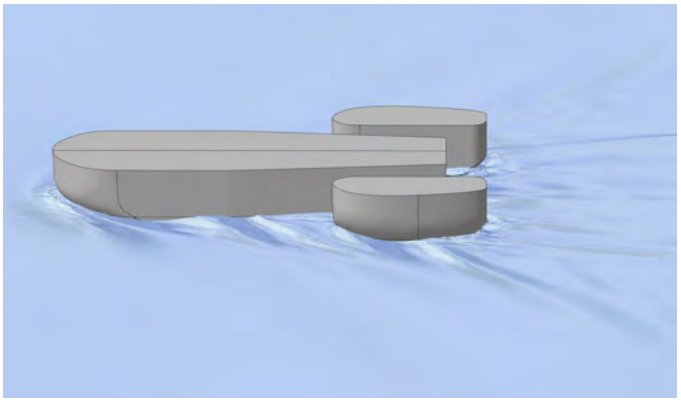
Local ice conditions have to be taken into account, in addition to the ice loads, for dimensioning loads for an Arctic trimaran. Ice loads from multi-year ice are different to first-year ice loads and for instance Caspian Sea has the additional challenge of shallow waters. The best option is to tailor every vessel for its operational destination.

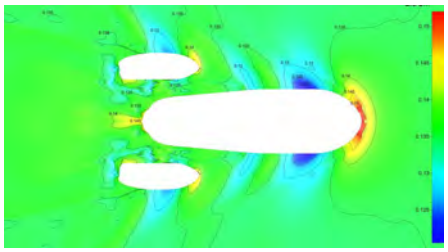
Construction verified

A step in the development project was to study the dimensioning principles of cross-deck structures of icebreaking trimarans to establish how the steel structure should optimally be constructed as well as to ensure that the construction does not become too heavy. The conclusions are encouraging and suggest that the trimaran tug is suitable for icebreaking and oil spill combat as well as cargo carrier.

Aker Arctic optimized trimaran design for multipurpose use, also in open water







To ensure power, economy, cargo carrying capacity and manoeuvrability required in open water harbour operations the trimaran design was studied with CDF- program. Requirements in open water manoeuvring were achieved convincingly.

The open water feasibility studies concluded that the trimaran design would result in substantial operational cost savings to be adobted as a multipurpose use.

Trimaran Icebreaker

Aker ARC 131 Harbour Icebreaker Trimaran Tug

The vessel is an Icebreaking harbour tug for year round operation in Baltic Sea. The tasks of the vessel are:

- Operation as an escorting icebreaker tug, assisting cargo vessels mainly in Bay of Riga.
- Operation as an ice management vessel in harbour brash ice conditions.
- Servicing fairways in open water conditions (buoy tender, lighthouse services).
- Standby oil recovery vessel.
- Fire-fighting vessel.
- Multipurpose salvage tug.

The vessel shall be equipped with the following features:

- Top notch towing.
- A deck crane for supply and service works.
- Possibility to be equipped with oil recovery equipment's.
- Fire-fighting equipment.
- Emergency towing.

Special features

The vessel is of trimaran type, with a main center hull and two pontoons at sides. The main icebreaking direction is in ahead mode. The tug is designed to create a wide channel, abt 27 m wide which makes it excellent for assisting wide cargo vessels in ice. The vessel has at the same time adequate astern going capabilities and good manoeuvring capabilities in ice. Due to the large deck area the vessel is suitable for large light deck cargos such as buoys etc. Also the stability of the vessel makes it very suitable for maintenance works, for example for lighthouses and windmill parks.

Main dimensions

Length over all	44.8 m
Length in waterline	42.1 m
Breadth	25.6 m
Draught, at design waterline	5.0 m
Draught, ice operation abt.	4.5 m
Note: Superstructure in AL Lightweight abt.	1130 tonnes

Capacities displacement

Displacement, at 5.0 m draught abt	1600 tonnes
Deadweight, at 5.0 m draught abt	470 tonnes
Cargo capacity at 5.0 draught abt	200 tonnes

Operating range

Fuel stores included in the specified deadweight are sufficient for 5 days operation at 100% propulsion power. Provision stores and fresh water are carried for 1 week

Cargo spaces Cargo deck area abt 210 m^2

Speed, propulsion, ice going properties

The bollard pull of the vessel is about 78 ton at 100% of shaft power

Speed and power

Maximum trial speed in open water will be at least 12 knots at 100% of shaft power

Ice going properties

The vessel is designed as an icebreaking tug, with icebreaking capability both ahead and astern. Breaking level ice of 0.4 m thickness at 7 knots. Theoretical breaking capability abt.1.2 m.

Manoeuvring, station keeping capability

The Vessel to be equipped with DP 2 system for station keeping.

Design criteria, rules and regulations

All relevant rules and regulations will be complied with as far as they are in force at the date of the Contract and known to become applicable to the subject vessel, as far as practicable for trimaran type vessel.

Classification The vessel is attended to be designed and built under initial survey of Lloyd's Register notation
Ice Class Notation: FSICR 1A Super/RMRS Arc 5 Tug

Ambient conditions, temperatures

The vessel, machinery and accommodation will be designed for operation in following ambient conditions:

Air temperature	+35°C to -30°C
Water temperature	TBD

Electric voltages and frequency

Main generators, propulsion network	690 V
Ship service power network for large consumers	440 V
Smaller consumers, lighting	230 V

Cargo handling and project specific needs

Cargo deck The cargo deck area is about 210 m^2, 5t/m^2

Oil spill equipment

The vessel is designed for use of standard oil spill recovery containers. The equipment is lifted onboard.

Fire fighting equipment

For fighting of external fires the vessel is provided with equipment meeting the requirements of Fi-Fi1 class.

Machinery (diesel-electrical propulsion)

Main diesel engines

High speed diesel engines 5 x 12 cylinder, total power abt. 8.5 MW

Propulsion system

The Vessel is equipped with one shaft line propeller and two pulling type azimuth thrusters.
Power of the shaft line is 3500 kW, 3.5 m fixed pitch propeller.
Power of each azimuthing thruster is 1700 kW, abt 2.2 m fixed pitch propellers.
All propulsion units are driven by electrical motors.

Harbour diesel engine

Emergency diesel engine

Heating boiler

Icebreaker type cooling system

Sewage treatment plant

General outfit and ship's systems

Thrusters with tunnels

One (1) swing out azimuthing RIM thruster 300 kW

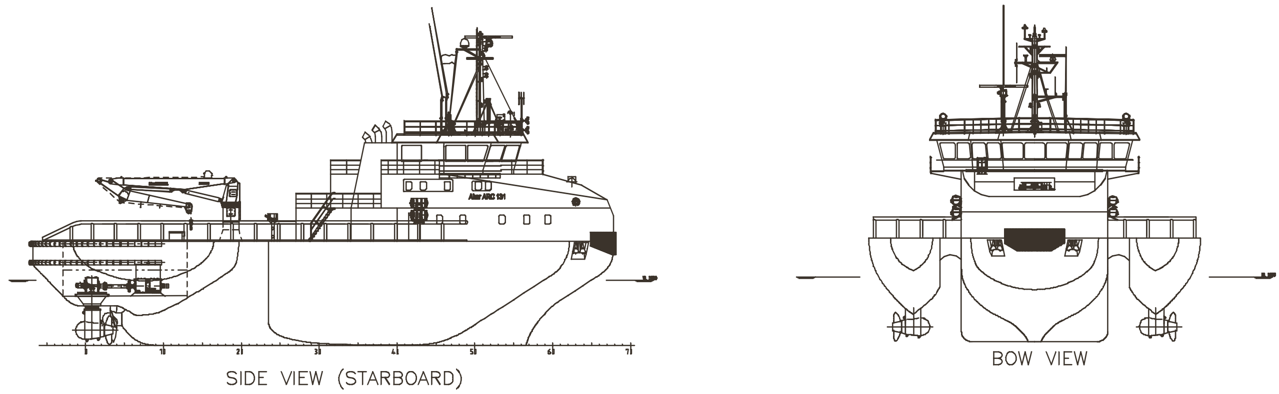
Life rafts with equipment According to Rule requirements.

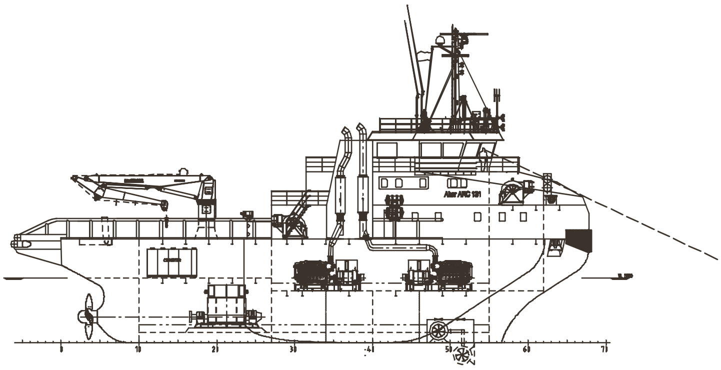
Crane One deck crane (5 t/15 m) to be installed.

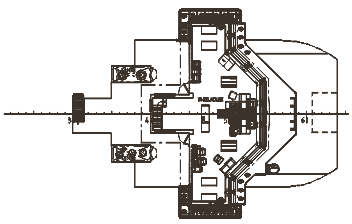
Trimaran Icebreaker

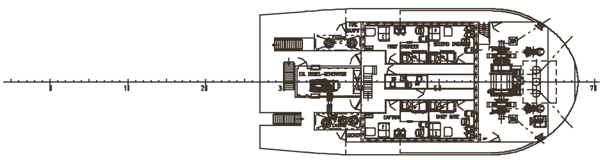
Trimaran Icebreaker

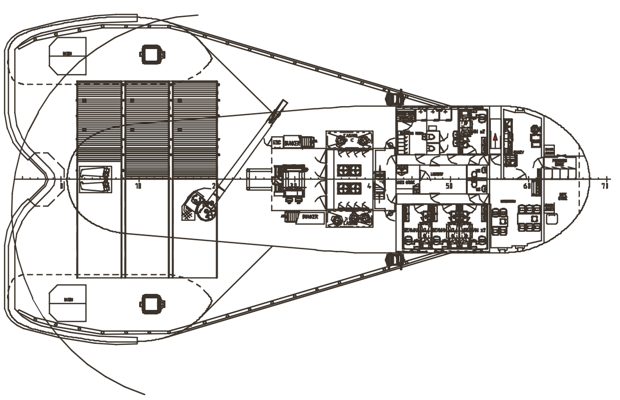
The Innovative Multipurpose Harbour Icebreaker Trimaran Tug











The trimaran tug will be outfitted to the highest standards for a crew of up to ten (10) people. The normal operating crew for short runs will be four (4), and for longer voyages with up to seven (7) people.

STATUS
1 VERY PRELIMINARY
T. Heikkilä
2013-09-30
Aker Arctic
General Arrangement
PRELIMINARY
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Aker Arctic Technology Inc- the Full Service Ice Technology Partner

Aker Arctic Technology Inc has more than 50 years of systematic experience in developing ships for efficient operation in ice through design, model testing, full-scale testing, collecting of ice data and assistance in ship construction.
The full-scale correlation database is the widest in the world.

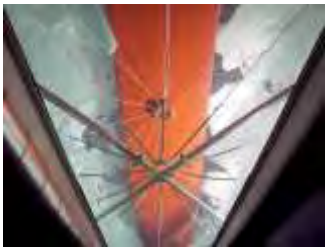
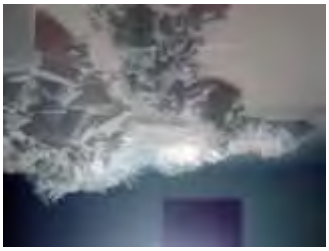
100 *Clients from 12 countries*

200 *Full scale field tests and expeditions*

450 *Model test series*

270 *Published papers in conferences and journals*



Aker Actic Technology Inc has more than 40 years of experience in developing ships and structures for efficient and economic operation in icy waters.

Aker Arctic is now running its 3rd generation ice model testing facility in Helsinki engaged in the business of research and development services, design and testing of icebreakers and other ice-going vessels as well as structures for arctic oil and gas field operations.

In addition to model and full scale testing services, the company offers all kinds of consulting, design and engineering services, field expeditions, training and other technology services associated with technologies and operations in icy or severely cold conditions.

A portfolio of ice going ships is also available for shipowners and ship-yards.

Our past references include 60 per cent of all the world´s icebreakers, many Arctic or Antarctic research vessels and quite a number of different type of cargo vessels and offshore structures.

The ice model technique developed by us and the FGX model ice is being used in various other research institutes both in Finland and Russia.

Aker Arctic offers a full range of services from theoretical studies to field measurements. The possibility to combine our long-term co-operation partners, local and international, in ice research work allows for the best practises for project objectives.

Our full- scale correlation data base is the widest on the world.

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