

Technical Requirements of the New Swedish Heavy Polar Icebreaking Research Vessel

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**POLARFORSKNINGS
SEKRETARIATET**
SWEDISH POLAR RESEARCH SECRETARIAT



Technical Requirements

Heavy Polar Icebreaking Research Vessel



Concept illustration of the new polar research vessel. Illustration by Peter Mild.

General

The vessel is a Heavy Polar Icebreaking Research Vessel designed for Research, Icebreaking, Ice Management and Escort operations in Polar (Arctic and Antarctic) environment. It is also designed and suitable for open water operations world-wide.

The vessel to be built and equipped for following primary roles:

- Research operations in polar areas,
- Icebreaking in polar waters including multi-year ice,
- Escorting and assisting vessels under polar conditions,
- Ice management operations,
- Re-supply for both onshore and offshore operations in Polar areas.

As an example, the vessel should be capable to escort and assist other vessels during a fibre-optic cable-laying operation as well as during maintenance and repair year around of such fibre-optic cable.

The vessel is optimized for low environmental impact operation. Power plant to be a redundant, IMO DP-2, dual-fuel methanol/diesel gen-set machinery. A battery energy storage system to be installed for emission free operation, spinning reserve and peak-shaving. Polar environment to be specially considered.

The vessel is double-hulled, with forecastle and accommodation forward. Special attention has been paid to the design of the vessel for minimizing ice accretion and all exterior working positions are also protected as far as possible.

The technical requirements in this document are defined in dialogue with the Swedish Polar Research community, the Swedish Armed Forces, Swedish Agency for Marine and Water Management

(Dimensions and capacities below are not finally decided, only given as guidance)

Main Dimensions

Length over all	about	140.0	meters
Length in waterline	about	137.0	meters
Breadth at dwl, midships	about	28.0	meters
Breadth maximum	about	32.0	meters
Draught, at design waterline	about	10.5	meters
Draught, scantling	about	11.0	meters
Depth to main deck	about	15.0	meters

Capacities

Methanol	about	TBD	m3
Marine DO	about	TBD	m3
Lubrication oil	about	TBD	m3
Water ballast	about	TBD	m3
Potable water	about	450	m3
Sludge	about	300	m3
Bilge	about	500	m3
Grey water	about	850	m3
Heli fuel	about	30	m3

No oil pollutant or waste liquid tanks are located adjacent to the shell, except grey water tanks. Methanol tanks to be arranged as efficiently as possible to optimize capacity.

The vessel to be arranged for "Ship To Ship" bunkering operations.

Cargo Space

There is an open cargo deck aft with a total area of abt. 2000 m² with a capacity of minimum 150 TEU. Fittings for both 20ft and 40ft containers to be provided. Utilities for

containerized laboratories to be provided in at least 20 positions on aft deck supplying gas, electricity, hydraulic power, IT, water, sewage etc.

Endurance

Endurance in polar operations to be at least 100 days. Basis average propulsion power of 50 %. 120 persons onboard in 76 cabins and zero dumping principle. The vessel to have methanol tank capacity for at least 25 days operation at an average propulsion power of 50%.

Environmental conditions

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

Ambient conditions

Design temperature	+40°C to -40°C
Minimum air temperature	-50°C
Sea water temperature	+32°C to -2°C

Accommodation

	Cabins	Beds
Captain Class with bedroom	2	2
Owner Class with bedroom	2	2
Senior Officer with bedroom	12	12
Crew single	16	16
Special personal	44	88
Total	76	120

Registration

The vessel to be registered in Sweden and operated under the Swedish flag.

Classification and Authorities

General

The vessel shall meet all regulatory requirements for world-wide operations.

All relevant rules and regulations are to be complied with as far as they are in force at the date of the contract and/or known to be applicable to the subject vessel.

Classification

The vessel is to be designed and built under survey of an IACS Classification society with the following notations or equivalent: **ICEBREAKER, ICE CLASS PC2, SPS, DPS-2, HELIDECK, WINTERIZATION, DE-ICE, CLEAN, SILENT, etc.**

Rules and Regulations

The vessel is to meet the requirements of relevant rules and conventions.

National rules

The vessel is to meet the requirements of national rules of Sweden and EU.

Certificates in general

All necessary certificates for world-wide operation of the ship to be supplied.

Performance

Hull Form

Bow form to be designed for icebreaking and ramming in multi-year ice and still maintaining favourable sea keeping and open water resistance characteristics.

Aft ship form to be designed for icebreaking with one centerline propeller with a duct and two azimuthing pods.

Hull form to be designed taking into consideration ice movement around hull for minimum of ice interaction with the propulsors.

Sea Keeping

Special consideration shall be paid to sea keeping performance of the Vessel to maintain sufficient behavior also in rough seas in DP-operations and during transit.

Open Water Performance

The vessel to have the following performance in open water conditions:

- maximum speed in open water in trial conditions to be at least 17 knots at 85 % of propulsion power.

Ice Performance

The vessel to have following performance in ice conditions with ice flexural strength 500 kPa:

- to break 1.8 m level ice at a continuous speed of 5 knots ahead
- to break 1.2 m level ice at a continuous speed of 3 knots astern
- continuous operation in 2.5 m level ice with ice flexural strength 700 kPa

Rolling Period

In normal loading conditions in open water, the rolling period to be not less than 12 sec.

Hull

The vessel to have double hull and double bottom were practicable. Transverse frame and longitudinal stiffener spacing to be abt 800 mm. The entire vessel including superstructure to be constructed with a system of continuous longitudinal, transversal bulkheads and decks to provide a robust and vibration free design.

Ice strengthening

The hull structures to be dimensioned to meet the requirements of IACS Ice class PC2 with additional strengthening in the stern and other hull areas exposed to ice forces.

Materials

Generally High Tensile steel and Extra High Tensile steel up to the yield strength of 500 MPa is to be used for side shell and framing constructions, in cargo deck constructions or in other parts of the vessel where advantageous to the design and production friendliness.

The minimum ambient air temperature as in General Vessel Description is to be accounted for when selecting steel grades for outer hull and deckhouse structures.

Main Deck

Main cargo deck is to be strengthened for 10 ton/m² cargo load.

Suitable number and positioning of fitting for lashing of cargo on main deck inclusive of containers shall be provided.

Heeling/Stabilizing Tanks

Two (2) combined heeling and stabilizing tanks shall be provided. Heeling system to be able to heel the vessel 4 deg. P and SB.

Water Lubrication System

A water lubrication system to be arranged in the bow.

Heat traced nozzles to be fitted in bow for a water capacity of 22000 m³/h.

Moon Pool

One moon pool size 7.2 x 7.2 m shall be arranged in the midship area. Moon pool to be provided with a remote controlled watertight hatch at the bottom of the vessel and a weathertight hatch at main deck level with corresponding strength. Moon pool to be provided with an indoor working area. This working area to have a side shell door (4 x 4 m) enabling CTD deployment. Foundations to be prepared for installment of traverse.

Wet laboratory space (150 m²) indoor next to moon pool.

Multi-beam Sonar (reserved space)

Space to be allocated for a Multi-Beam Sonar system in double bottom. Space to be connected with required cables to the bridge. Sensor location to be arranged to avoid interference. The detailed sensor arrangement shall be to Owners' acceptance and approval.

Painting General

All steel and equipment to be protected by painting suitable for the harsh polar environment. The detailed painting specification to highest standards shall be to Owners' approval.

In surface preparation and steel work the standard SFS 8145 or other mutually agreed international or national standard is to be followed.

Abrasion Resistant Icebreaker Paint

Outside of hull, moon pool, sea chests:

Pre-treatment:	SFS 8146-06
Painting:	1 x epoxy solvent free 500 µm

Cathodic Protection

The complete underwater hull and propulsors are to be protected by an impressed current system. The system to incorporate a rectifier supplying an automatically regulated direct current to permanent anodes distributing protective current to the submerged structure of the vessel. Sensor electrodes to regulate the current to a magnitude, which meets requirements for cathodic protection under varying conditions.

Ship's Equipment

Bow Thrusters

Two (2) transversal bow thrusters of abt.1100 kW power, diameter 2.2 m in tunnel is to be installed in the bow.

Dynamic Positioning (DP-2) System

A dynamic positioning system according DP2 requirements of IMO and classification society shall be provided. Two computer systems are to be arranged in the wheelhouse technical space.

An independent backup joystick system with automatic heading control to be included.

Bridge Layout

The vessel to be equipped with an integrated bridge system in order to facilitate safe navigation in ice. The bridge system should be based on unrestricted visual sight from the bridge, careful layout of interaction devices, integration of electronic equipment. Full maneuvering station on starboard bridge wing and slave station on port side.

Space on the bridge to be allocated for 5 working stations for example for meteorologists, Multibeam-operators, Air-control center and other functions.

Aft Bridge

Maneuvering station to be arranged on the aft part of the superstructure with full view on aft deck (not on main bridge deck level). The operator shall have full view forward via a camera system.

Communication Equipment

One (1) complete communication station system according to GMDSS A4, 2 Inmarsat C Standard, V-sat, etc. Communication capacity during operation in polar areas to be specially considered.

Anchoring and Mooring Equipment

The vessel to be equipped with anchor winches, anchors, and anchor chain in accordance with Classification requirements.

Mooring winches and deck mooring equipment to Classification requirements.

Deck Cranes

One (1) Electro- hydraulic deck crane of knuckle boom type with integrated hydraulic power unit shall be arranged on starboard side of the Vessel.

The crane shall have capacity of 25 tonnes /15 m outreach and 15 tonnes /25 m outreach. Hoisting speed 30 m/min at full load. Deck crane shall be radio remote operated. The crane shall be designed for ship-ship and ship-shore operations.

One (1) Electro- hydraulic deck / provision crane of knuckle boom type with integrated hydraulic power unit to be arranged on starboard side of vessel, being able to handle provision and accommodation ladder. The crane to have capacity 8.0 tonnes at 12 m outreach.

One (1) Electro- hydraulic deck crane of knuckle boom type with integrated hydraulic power unit shall be installed aft with the capacity of 50 tonnes /30 m outreach. Reinforcement for crane pedestal shall be made to hull structure.

A-Frames

Aft main deck to be structurally reinforced for two hydraulic operated A-frames, to ensure that a later installation can be made if required.

Safety working load (SWL) for the A-frames to be 60/25 tonnes.

Foremast

A foldable foremast to mount scientific equipment at least 25 above sea level.

Foredeck, launch platform

An open launch area (10 x 10 m) for drone and balloon operations shall be arranged.

Hatch in the bow

The possibility to mount a horizontal structure to mount ice-surveillance equipment.

Mast on bridge roof

The top mast on the bridge roof to be provided with a platform suitable for installation of met sensors. Arrangement to be of Owner's approval.

Bridge roof

Space for 2 x 20' containers on the bridge roof.

IT & scientific equipment

5 climate-controlled server-rooms to be arranged. Network onboard to be fibre-optic.

Helicopter deck + hangar

Helicopter deck + hangar to fit 2 helicopters to be arranged.

Life Saving Equipment

Lifesaving appliances to be provided for 120 persons.

Two (2) fully enclosed lifeboat according to regulations.

Two (2) fast rescue boats with inboard engine.

Life rafts for 100 % of persons each side shall be provided.

Survival suits.

Other equipment according to regulations.

De-icing and Winterization

De-Icing and low temperature (-40 °C) measures shall be built to classification requirements.

All materials and liquids exposed to low temperature shall be suitable for the purpose.

Electric heating for railings, stairs, escape ways, air pipes etc. defined in the Rules to be provided.

Sufficient amount of steam outlets with hoses for de-icing to be provided to cover the whole vessel.

Accommodation

Accommodation to be of high West European standard.

All cabins to have private WC/shower.

One lift for crew to be provided.

Full HVAC in accommodation.

Mechanical ventilation for all service rooms.

Meeting rooms, recreation and lounge

- Auditorium for 50 pax.
- Gym with space
- Sauna

Sanitary Systems etc.

The vessel shall have a combined fresh water and drinking water system and technical water system.

Toilet seats in cabin WCs to be vacuum type, wall mounted for easy cleaning.

Sewage treatment system.

An automatic biological sewage treatment plant with integrated vacuum generating unit is to be provided.

Waste management and handling system of ship generated garbage.

Miscellaneous

In order to not interfere with air quality measurements all ventilation outlet openings shall be arranged aft of the superstructure. Emissions from the funnels to be directed aft as well.

Machinery – electrical

General

The vessel has a diesel-electric power plant and propulsion system with medium-speed AC main diesel generators producing electricity for the propulsion units and other onboard consumers. In addition, there is one medium-speed harbor generator, and a separate emergency diesel generator. The vessel has also a battery energy storage system for emission free operation, spinning reserve and peak-shaving. The battery to be charged both from the diesel-electric power plant and from shore while moored at quay side. The power plant is designed to be redundant with the main generators, transformers, switchboards and other equipment divided into, at least, two separate engine rooms with dedicated pump rooms and auxiliary systems.

The propulsion system consists of two azimuthing thrusters with stainless steel fixed pitch propellers and one centerline propeller with a duct for increased propulsion efficiency especially in icebreaking operation.

Main Engines

Dual fuel main diesel engines are to be installed.

Propeller Plant

Two (2) azimuthing thrusters, each 11 MW. The propulsion units are strengthened for astern icebreaking operations.

One (1) stainless steel propeller with a duct at centerline, 12 MW.

The propulsors are driven by frequency-controlled AC electric motors.

Boilers

Exhaust gas boilers and two (2) oil fired water boilers.

Aux. Engines

One medium-speed harbor generator that can be used to produce electricity when the vessel is stationary with main propulsion offline.

Emergency Generator

One (1) emergency generator, diesel driven.

Battery Energy Storage System

The battery energy storage system to have a capacity sufficient for 6 hours emission free operation at zero speed in polar conditions or at least 5 MWh. The battery energy storage system to deliver spinning reserve and peak-shaving.

Non-interruptible power system

Central UPS-systems for scientific equipment

Electrical Shore Connection

Electrical shore connection to be arranged with shore connection cabinet and space for cables and cable drums.

Seawater Cooling System

The vessel to have two (2) high-capacity ice chests for sea water intake connected with a cross-over canal.

Seawater System for Science

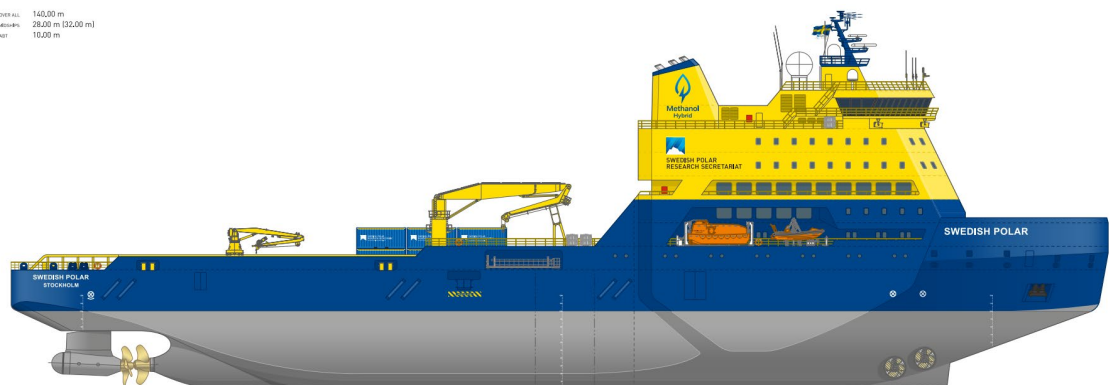
The vessel to have a separate ice sea chest for supply of water for science.

Minimum capacity: 100 liter/min. All infrastructure installed with easy access for maintenance. Sea water connections to all wetlabs adjacent to the moon pool.

Water Maker

One (1) fresh water generator. Capacity 20 ton / 24 hrs.

LENGTH OVER ALL 146,00 m
BREADTH MAXIMUM 28,00 m (32,00 m)
DRAUGHT AFT 10,00 m



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