



FISH TECH VESSEL DESIGN

STERN TRAWLERS, WELL BOATS AND MARINE RESEARCH VESSELS

WHY CHOOSE US?

Legacy

Ship design since 1937

We have been a leading independent consultancy providing a comprehensive range of design, engineering and project management services to shipyards and ship owners around for more than 85 years. Setting trends in design innovation, vessel efficiency, and ship operability is our hallmark.

The Maritime industry propels towards zero emissions by 2050, igniting innovation in efficiency, alternative fuels, lightweight structures, and advanced technologies.

Together with ship owners, shipyards, suppliers and industry partners, KNUD E. HANSEN forge the path to a low-emission shipping frontier. The integration of proven and groundbreaking solutions brings environmental gains without compromising efficiency or capacity.

KNUD E. HANSEN offers specialized consultancy and expertise for design of new builds, conversions, retrofit, modernization, project management, stability tests, structural modifications, HVAC engineering, surveys, and site inspections.

Since 1937 more than 850 vessels have been built and over 300 conversions carried out to our designs. In addition, over 450 hull lines have been developed as well as thousands of surveys, technical studies and engineering analyses.

The ocean of fish as we see it

KNUD E. HANSEN stand by owners and operators of vessels in the fishing and aquaculture industry, as well as marine research and scientific operations. Our role isn't limited to mere consultancy and support; we're pioneering the industry and operations for new designs and innovative solutions to meet international regulations and foresee world market demands.

Consumers' demand for sustainability labels in fishery and aquaculture products has been increasing in the last decades. Also, there is a growing interest from consumers to widen the sustainability concept to include the social and ethical information of the fishery and aquaculture industry. Not only to push for international policies and legislation, but in support to market driven incentives and industry's voluntary approach on the labeling of socio-ethical aspects on products.

We proudly offer a range of services to the commercial fishing and aquaculture sector as well as marine research and scientific institutions. From Concept to Basic Design for new vessels, including Interior Design, LCA modeling and VR modeling, our comprehensive approach shines.

As consumers' demands for sustainability and responsible fishery and aquaculture products is evident, we address the growing awareness and commercial needs with our clients to accommodate their customers today and foresee the future.

OUR SERVICES & VESSEL TYPES

■
Ship Design
& Consultancy

■
Live Fish
Carriers

■
Stern
Trawlers

■
Research
Vessels



Giant Well Boat



▲ ► BAKKAFOSSUR in operation outside Torshavn, Faroe Islands (September 2023)

Faroeese fish farming company, Bakkafrost took delivery in January 2023 of one of the largest Well Boats or Life Fish Carrier (LFC) in the global aquaculture industry. This significant state-of-the-delivery marked for KNUD E. HANSEN the culmination of 10 yrs. of development of Life Fish Carriers.

Working our way up since 2013 we have been supporting the aquaculture industry with design for future fleet and platforms, incl. consultancy, design, and technology development for the strategy on expansion of operations into offshore fish farming.

Our latest Bakkafrost project has been an immense journey bringing our team into the forefront for design and construction of LFC's. The KEH scope of work in this project included concept, tender, contract, and basic design, as well as owner's consultancy, design approval and onsite supervision.

In his speech at homecoming ceremony Bakkafrost CEO, Regin Jacobsen, stated:

"We need to see an increase in the supply of sustainable protein. Aquaculture and salmon farming in particular is regarded as one of the best solutions for sustainable food production when considering sustainability in the broadest sense. The Faroe Islands offer many opportunities – thus it is of vital importance that the will, skills and regulations facilitate the utilization of these opportunities. With Bakkafossur, we take a huge step towards both offshore farming and more sustainable operations.

Our vision for the Faroe Islands is to increase our production output significantly to increase the general supply of sustainable ocean food, contributing to the sustainable transformation of the world's food system."

State-of-the Art

At 109.2 metres long and 22.2 metres wide BAKKAFOSSUR is a giant in fish farming industry setting new standards for future operations. The vessel can carry up to 1,000 tonnes of live salmon.

BAKKAFLOSSUR is installed with capabilities covering a range of operations as the owner is preoccupied with meeting the complexity of objectives, incl. efficiency, volume, environment, animal welfare and decarbonization.

Most importantly the owner wants to reduce biological risk in operations and ensure a stable and healthy production. The specialized equipment for handling live salmon includes an advanced water treatment plant. The well boat is equipped with reverse osmosis technology for de-salination of water with a production capacity of 6,000 tonnes of freshwater a day.

Treating salmon with freshwater is an efficient way to de-lize salmon stock and rinse gills to protect against AGD (Amoebic Gill Disease). This on-board treatment ensures more robust and healthy growth of stock. Following the owner's sustainability strategy, the vessel is also installed with the FLS system for optimal efficiency and reduction of time for de-lizing.

The well boat is installed with four wells with a total tank capacity of 7,000m³ of sea water and freshwater tanks with capacity of 3,000m³ produced on board.

The four wells are equipped with water treatment systems consisting of, among other things, circulation pumps, filters, CO₂ stripping, oxygen injection, cooling, UV filters etc.

A dual (2 x 600mm hoses/pipes) vacuum loading system operates two cargo tanks at a time via 2 x 2 sea dewatering systems that pump the sea water back into the sea.

A sorting facility in the drainage systems ensures that cleaner fish, under-meters and other unwanted fish are sorted out for disposal or return to cages.

Designed for lifetime conversion

For one BAKKAFOSSUR is designed with a Diesel-Electric Hybrid propulsion, incl. a large battery storage system for peak shaving and optimal energy consumption. The vessel can optimize consumption supported by battery package, and store energy in the batteries when extra energy is produced from the ship's generators.

Secondly the five diesel-electric generators have been installed above the waterline on the shelter deck. This strategic placement of the diesel-electric generators is intended to ease any future conversions and replacement of machinery when more sustainable fuels and energy solutions are available on the market. Whereas the electrical propulsors, shaft-line and propellor all is intended to stay unaffected during lifetime, the generators can be replaced with less design implications.

KNUD E. HANSEN LFC References:

3000 m³ Life Fish Carrier/ Well Boat

4000 m³ Life Fish Carrier/ Well Boat

7000 m³ Life Fish Carrier/ Well Boat







Future Stern Trawlers

Why fix what is not broken?

An entirely new design for the factory stern trawler segment has been developed by KNUD E. HANSEN's Faroe Islands design team. From stem to stern this design redefines the classic trawler layout which has remained unchanged for decades.

A few years back our Faroese design team set out to “fix what's not broken” in order to release a future ready design platform for offshore and coastal stern trawler. The aim of this design project has been to foresee new standards for the next generation of stern trawlers, seeking innovation in all solutions and adaption of new technologies to the long-proven concept of stern trawlers.

The traditional ocean factory stern trawlers have grown bigger in size and capacity over the years but there has been very little innovation in recent designs and constructions. The traditional layout for a stern trawler known from its Norwegian design have hardly changed over the decades.

If you have sailed one, you have sailed them all.

Reviews of the original design, construction, components and technology led our Faroese design team to conclude that improvements can be made – and are indeed needed.

Groundbreaking trawler design

Simplicity, efficiency, functionality, and adaptability are key in this future ready trawler design.

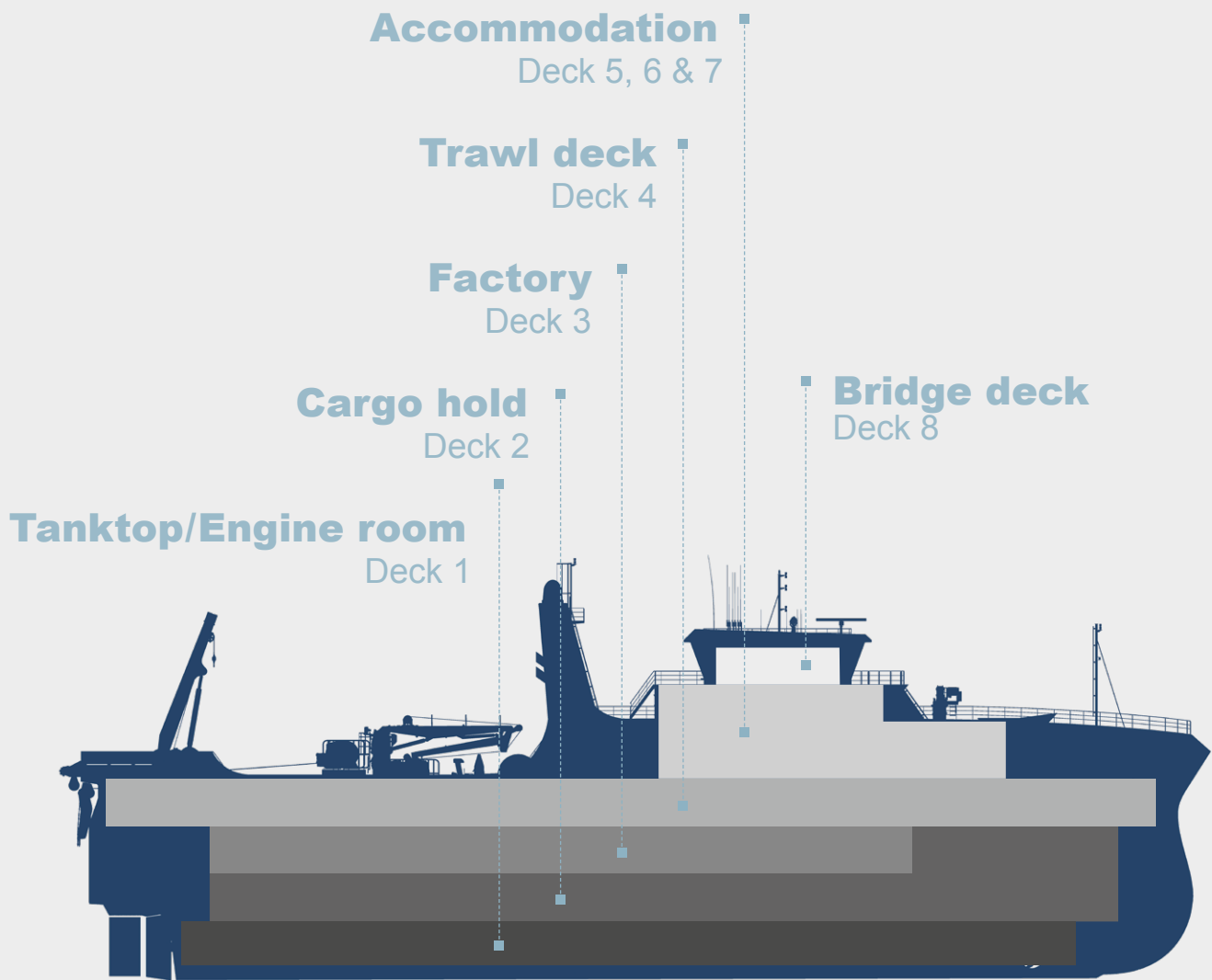
Not only does the KNUD E. HANSEN layout bring immediate improvements to vessel performance, production workflow, cargo handling and crew comforts but it offers some groundbreaking potentials for the lifetime conversions and transition towards zero emission.

Our design philosophy started replacing the main engine with Diesel-Electric Propulsion and creating the longitudinal deck layout. Having the cargo hold and engine room separated in the length of the vessel completely changes the potential for design improvements throughout the entire vessel.

Our team completely redesigned all main features, construction, and components. Improvements have been made to almost every aspect bringing out an entirely new functionality and simplicity.

Sideview of KNUD E. HANSEN's groundbreaking trawler design (82 m North Atlantic Stern Trawler). ▼





▲ Having the cargo hold and engine room separated in the length of the vessel completely changes the potential for design improvements throughout the entire vessel.

Seaworthiness: Optimized for rough seas

Our stern trawler design has been designed for rough seas based on more than 30 years of experience in the Faroe Islands designing and building fishing vessels for the North Atlantic. The high bulbous bow and hull lines gives a good flow to the two propellers. The design of the hull with the high bulbous bow and hull lines aft optimizes the flow to propellers and rudders. We have succeeded in designing a vessel without construction trim levelling less draught aft and increasing draught in the foreship. This reduces dragging and water resistance due to heavy heeling and prevent slamming in rough seas.

No ballast water is needed as an open ballast keel contains 150 tonnes of flow-through seawater ballast. Our design without ballast water and dragging of the vessel inefficiently

through the sea improve fuel consumption during transit voyages. Basically, this makes our trawler hull more fuel efficient, increase seaworthiness and make it more comfortably for crew. A better ship.

Designed for lifetime conversions

Our design is based on a Diesel-Electric propulsion philosophy ready for hybrid set-up with large battery powerbank and/ or future conversions for alternative fuels (i.e. Methanol, Ammonia). The DE propulsion set-up increase adaptability and ease any lifetime conversion of engine arrangements, including replacement of generators and increased need for tank capacity for future low-emission fuels. ►

Having the engine room arrangement laid out on lower deck in full length of the ship significantly improves the practical working conditions for the ocean factory trawler engineer. Also, the extension of the engine room in full length of the ship supports better weight distribution and moving of casing for exhaust and ventilation forward.

Workhorse: Maneuverability and bollard pull

The installed Diesel-Electric propulsion on twin shafted slow-rotating propellers (FPP or CPP) almost doubling the propeller disc area compared to a single propeller design.

For the basic arrangement the trawler is designed with 4 diesel medium-speed or high-speed generators and 2 electrical motors on two ducted FPP and double rudders. This combined with the installed powerbank and peak-shaving, the electrical shaftline generates high torque for bollard pull.

The twin shafted nozzled propellers indeed improve maneuverability and turning radius.

Factory Deck: An open playground

Our design philosophy aims to reduce the number of pillars on the factory deck to a minimum. This literally opens a playground for the factory processing engineers in the full length of the vessel to arrange for optimal production lines, incl. sorting areas, cookers, freezers, and elevators.

In the basic layout for our 82 m North Atlantic Stern Trawler the factory area covers 700 m² of open deck area, and in the 90 m Arctic Prawn Trawler version the factory deck covers 1100 m² with room for 5-6 production lines.

We have improved the flexibility and adaptability immensely when designing with a minimum of pillars supporting the upper deck structures. Changing catch and replacing on board production lines

Cargo handling: Ready to Ro-Ro

Re-arranging the traditional forward two-deck cargo hold with a cargo deck layout in full length of the vessel simple improves the philosophy of cargo handling – and leave open potential for new ways of fast unloading and handling of cargo via ramps and elevators.

Logistics will improve significant when handling can be done in the full deck length not having to stow pallets into the awkward bottom of the foreship.

This also gives a practical working height comparable to the height inside a refrigerated container, improving practical working conditions and safety during fishery and when unloading.

Traditional unloading with cranes and derricks is still a priority for fast and efficient simplicity, but the new layout is prepared for further development of elevators and Ro-Ro cargo handling.

Artist's impression for the release of KNUD E. HANSEN design of the 45 m Coastal Stern Trawler. ▼





Artist's impression for the release of KNUD E. HANSEN design of the 82 m North Atlantic Stern Trawler. ▲

Working areas: Trawl deck arrangements

We have increased working area aft and flexibility on trawldesk when moving casing forward. The increased working areas on the trawl-deck allow us to design improvements for the trawl arrangements and handling of winches and fishing gear.

In the new layout the traditional gallows and outhauls can be replaced with a single hydraulic A-frame aft. From the high position on the trawl deck an A-frame crane covers the entire working area on the aft deck and trawl lanes having an open upper deck over the trawl slipway.

Your home when away: Crew comforts

Our trawler design has been laid out to support the crew on the long stays at sea. Hence, the mess, galley and dayrooms are all on deck 5 with easy accessibility and priority placement for the crew to overlook the aft deck and great visibility to both sides of the vessel. The mess has the capacity to serve the entire crew at the same time and features good visibility through big windows.

Accommodation quarters are all placed forward on deck 5, 6 and 7. In our basic layout for the 82 m North Atlantic Stern Trawler the vessel accommodate 32 crew in single berth 15 m² cabins, incl. toilet and shower, with the officer's cabins being somewhat bigger.

The accommodation quarters, cabins, corridors, and stairwells are arranged so that starboard crew on watch doesn't need to disturb port crew off duty and vice versa.

Six stairwells in the ship improve all passage between decks to allow the crew to move easily throughout the vessel. The stairways are arranged on both side of the vessel with one stairway aft, on central stairway amidships and one stairway forward. The central stairways amidships are designed so crew from the engine room and crew from the fish factory do not meet on the stairway.

Further our new trawler layout is installed with three side doors to allow boarding when berthed from foreship, midship and aft ship without having to have all crew, service personnel and guests use the same gangway.

KNUD E. HANSEN Stern Trawlers references:

82 m North Atlantic Stern Trawler – Cargo 2250m³

90 m Arctic Offshore Stern Trawler – Cargo 3950m³

45 m Wet Fish Stern Trawler

45 m Coastal Stern Trawler

Research Vessels

In a league of their own

Research Vessels are in a league of their own when it comes to complexity and operational flexibility as they must be capable of adapting to a wide variety of challenging mission requirements. They have become increasingly important for scientific operations as well as monitoring of climate change and harvesting of resources in the world's oceans.

Research vessels are often required to operate in the most extreme conditions on earth, thousands of nautical miles from refuge and emergency support. Long-duration missions require these vessels to be entirely self-reliant for many months away from port.

The design of research vessels requires an inherent understanding of these requirements, along with the rules and regulations of the relevant flag authority and classification society, which aim to ensure the highest standard of safety for the vessel, its crew, and the surrounding environment.

With KNUD E. HANSEN as your design partner, you can be assured that we will consider all design possibilities to optimise the layout of the vessel and technological solutions for your

operations and scientists. The design is continuously evaluated and validated from the early, conceptual stage right through to completion to ensure the vessel delivered meets or exceeds all customer requirements.

KNUD E. HANSEN's involvement in the design of research vessels includes newbuilds, conversions, refits/ refurbishments, life extensions, as well as a variety of other engineering and non-engineering tasks such as owner representation, market analysis and feasibility studies.

KNUD E. HANSEN references include:

- 68m ICES209 Research Vessel (PC6)
- 54m DNV SilentR Research Vessel
- 35m Marine Research Vessel
- 68m Fishery Inspection Vessel
- 90m Southern Ocean Patrol Vessel
- 140m Heavy Polar Icebreaker (PC2)
- 160m Antarctic Resupply and Research Icebreaker (PC3)

RSV NUYINA

Our most outstanding example is the 160-metre icebreaking research and supply vessel 'RSV Nuyina' to serve in Antarctica. Australian Antarctic Division (AAD) took delivery of this world leading research vessel in October 2021. The vessel was constructed and built by DAMEN Naval Shipyards.

RSV Nuyina is a Polar Class 3 icebreaker (PC3). This has many design implications with respect to hull form, structure, propulsion, redundancy and maneuverability, as well as crew safety and survivability of the vessel. The vessel was also required to meet demanding low underwater radiated noise, a world first for such a powerful vessel.

RSV Nuyina is designed with a large cargo capacity for resupply of Australian Antarctic stations as well a highly advanced platform for multidisciplinary scientific research including meteorology, oceanography, seabed, under ice and marine biology. RSV Nuyina has an incredible range of sixteen thousand nautical miles with an endurance period of 90 days for 150 personnel.

The successful design of a vessel with such complex technical requirements is a testament to the experience and expertise of KNUD E. HANSEN.

Capabilities of RSV NUYINA include:

- Diesel-electric hybrid propulsion with Silent-R capability
- Cruising speed of 16 knots
- Icebreaking at 3 knots in 1.65m of ice with snowloading
- DP2 dynamic positioning in Beaufort 8
- Dry cargo capacity of 1200 tons, including 96 TEUs
- Two 55 ton & one 25 ton offshore knuckle-boom cranes
- Wet cargo of 2000 tons station fuel & fresh water
- Hangar and helideck with capacity of up to four aircrafts
- Amphibious LARC's & Haggalund tracked snow vehicles
- Large moonpool for sampling equipment & ROVs
- CTD hangar with moonpool & side deployment cranes
- Wet-well for krill & egg sampling
- Dual drop keels for sensitive acoustic instruments
- Multi-beam bathymetric sonars for seabed mapping
- Two multipurpose dry laboratories & two wet laboratories



Nuyina at 12 knots - Western Sahara © Pete Harmsen AAD



▲ Artist's impression of the 68 m multidisciplinary research vessel, RV DANA V.

Multidisciplinary research vessel DANA V

Dansk Dana Konsortium (DDK) set up by KNUD E. HANSEN and Odense Maritime Technology are developing the design for the 68 m multidisciplinary research vessel, R/V DANA V.

The vessel is being designed for the National Institute of Aquatic Resources (DTU Aqua).

This vessel will be replacing the aging workhorse R/V DANA IV that is currently serving the Danish Marine Sciences since 1981. DANA V will enter service for DTU Aqua in 2027.

DANA V will be designed for operations in polar waters. The vessel will be classed to Polar Code B, PC 6 and comply with high standards for low level underwater noise during scientific operations.

The vessel will have marine research capabilities which include the equipment and installation for fish stock monitoring, hydro-acoustic surveys, biological, chemical and physical oceanography.

Additionally, the vessel will be used for ice edge research, geological research, seismic surveys, microbiology, bathymetric surveys, meteorology observation of sea birds and mammals, and a flexdeck for the handling of ROV's, AUV's, buoys, anchors and more.

DANA V will be designed with the operational efficiency of the modern trawler combined with state-of-the-art multidisciplinary science operations capabilities for marine research. This includes efficient fishing gear configuration and several laboratories. Also, the vessel will be designed for drop keel installation with a large hydro-acoustic sensor suite.

On the multi-flex aft deck, a large hydraulic A-frame will be designed for handling various equipment and fishing gear. Smaller cranes will be operating from the side of the vessel. These cranes will handle smaller nets and sampling equipment.

Apart from being the future flagship of DTU Aqua's operations, DANA V will serve as a research and testing platform available to scientific disciplines and research programs from other universities. The vessel will be equipped with teaching and conference facilities, and there will be separate network and satellite communication for students on board.

Littoral water marine research vessel

KNUD E. HANSEN developed an advanced littoral marine research vessel for Australian Institute of Marine Science (AIMS) for tropical coastal environments.

The vessel is designed for safer and more flexible operations. Lowering operational costs and reducing carbon emissions were also primary requirements of the new vessel. The trimaran hull provides the vessel with a larger working deck area compared to similar size monohull vessels.

The design is prepared for fitting of modularised laboratories (i.e. seismic surveys) or special purpose equipment (i.e. ROV). Modularising the science equipment allows reduced preparation time in port and improved vessel utilisation.



The vessel is designed for operation of UAV's and deployment of larger and heavier scientific bouys than the current AIMS vessels.

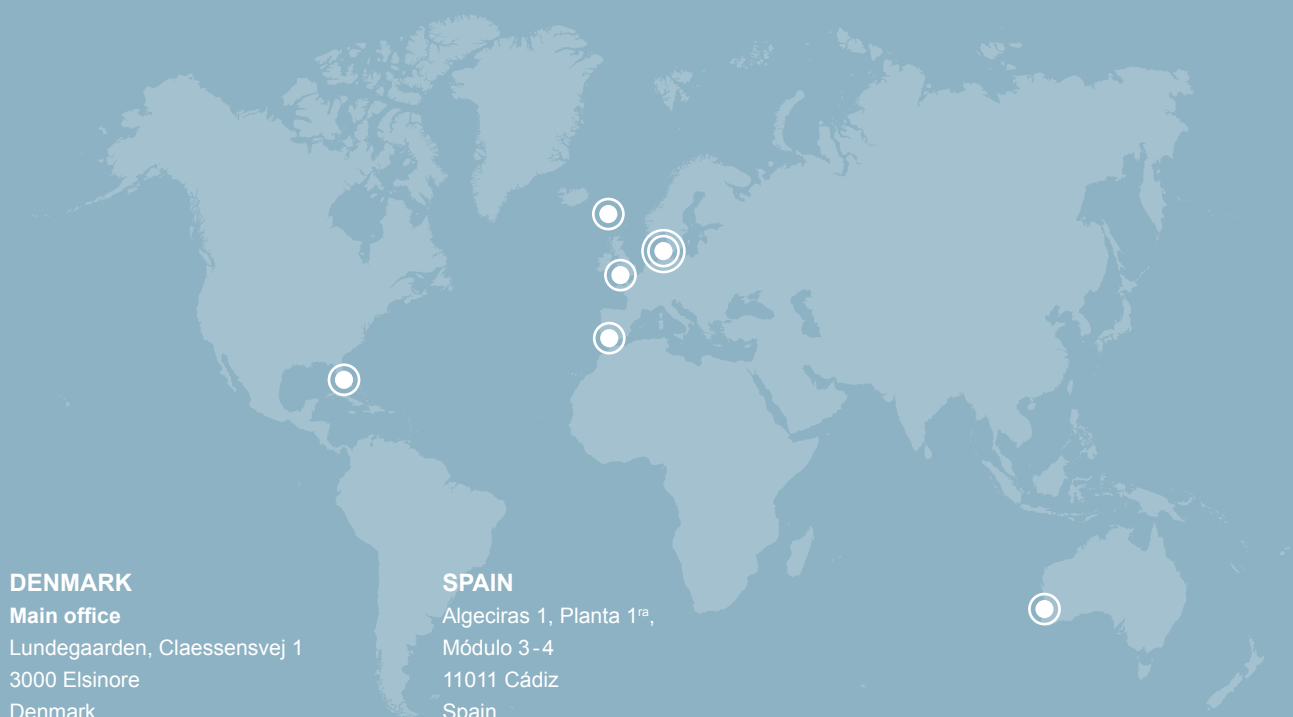
Technologies applied to this design to reduce carbon emission include a diesel-electric hybrid propulsion system. Installed batteries can be re-charged from shaft generators while cruising or by the gensets when at anchor. This ensures that the gensets can be always loaded efficiently and cycle off when running on battery to reduce engine running hours and maintenance costs.

The vessel concept deploys 40 kWe of solar photovoltaic fixed and flexible panels to significantly reduce the ships electrical generator load while also reducing the air conditioning load through the shading effect of the panel array.

A kite sail system was specified for assisted propulsion. The sail can reduce propeller power requirements by up to 200 kW in favourable wind conditions and is sufficient to fully propel the vessel during slow speed trolling operations.

◀ ▼ Artist's impression of 35 m AIMS Research Vessel





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WE DESIGN SHIPS We are a leading independent consultancy providing a comprehensive range of design, engineering and project management services to shipyards and ship owners around the world. Our innovative, customized solutions cover areas ranging from concept, tender/contract & basic design, to supporting the building and conversion process of all types of maritime vessels and offshore structures, to energy optimization and services for the offshore wind industry. Since 1937, over 800 vessels have been built and over 400 conversions carried out to our designs.

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