



Presentation at ERVO annual meeting 2022

Training of maritime engineers in the new build process

DANA IV

Only oceangoing research vessel in Danmark

- From 1981, global range and high ice-klasse (1A*)
- Robust, reliable (so far) but outdate technical, environmental and in research offerings
- Has contributed significantly to the high ranking of Danish marine research



Dana i is-fyldt farvand



Dana ud for hjemhavnen Hirtshals



... i Sargassohavet på jagt efter løsning af ålevandringernes gåde

Main activities today

1. **Fisheries research and monitoring** *in european and north atlantic waters for the Food Ministry - obligations towards EU*
2. **Marine research** *supporting Danish research communities coordinated by Danish Center for Marine Research (DCH) incl. contributions to GIOS - Greenland Integrated Observing System*
3. **International research collaboration** *DTU Aqua coordinate EU H2020/HEU- projects – e.g. Mission Atlantic and EcoTip*
4. **Environmental research and monitoring** *in european waters for the Environment Ministry – e.g. in support of MSFD*

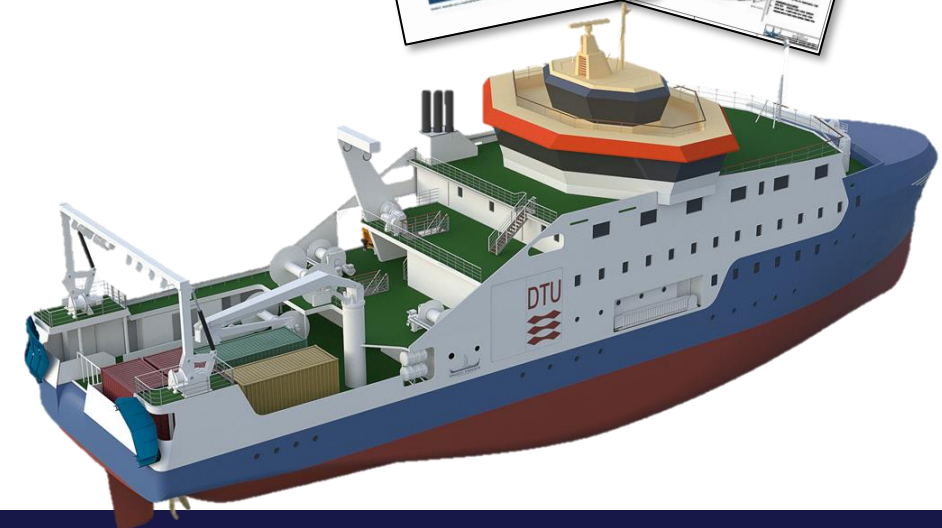
New research vessel - financing

The Danish parliament has in the budget 2021 reserved (€22,8 mio) **170 mio. kr.** for co-financing of a new ocean and arctic-going research vessel. The parliament agreement stated that:

... A new research vessel should, besides research, perform the monitoring for the Food ministry and do research activities in the Arctic area.

... The construction of the vessel should contribute to teaching about ship design for arctic conditions.

????



Applying private foundations

- (✓) • DTU applied APM for (€6,8 mio) 50 mio. kr. for the remaining costs towards the KEH design
 - Precise terms and conditions needed clarification ...



Skroget på det nye havforskningskib skal forstærkes, så fartøjet kan sejle i farvande med isdannelse på op til én meter (Illustration: DTU)

Med en donation fra A.P. Møller Fonden på 50 millioner kroner kommer et nyt forskningskib et skridt nærmere på at blive en realitet. Men sammen med donationen følger et krav om grøn fremdriftsteknologi, som der ikke var budgetteret med.









Af [Frederik Marcher Hansen](#) 26. apr 2021 kl. 09:45

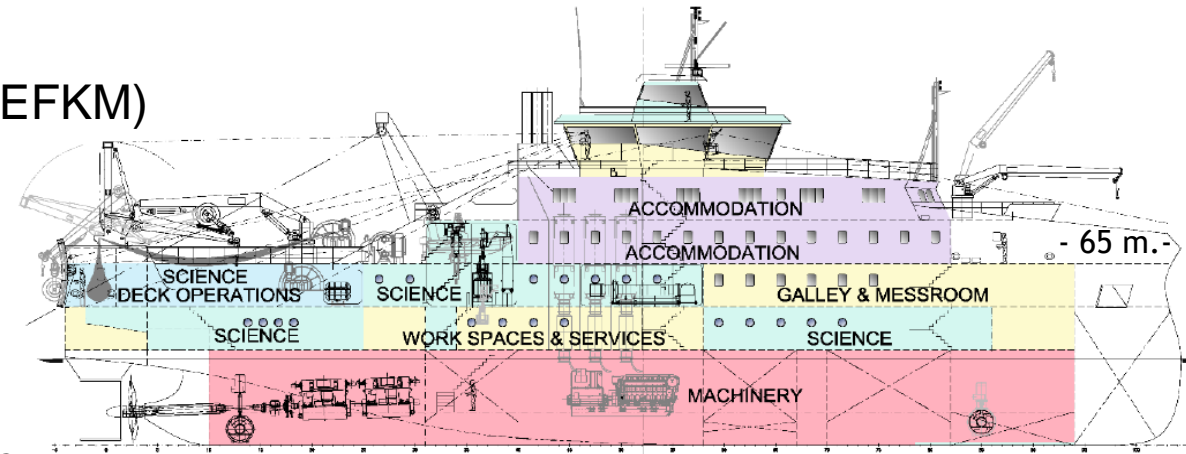
Danmarks Tekniske Universitets (DTU) drømme om et nyt havforskningskib, der skal erstatte det udslidte Dana IV, har skulpet rundt på usikkert farvand, men ser nu ud til at kunne komme i havn, efter at A.P. Møller Fonden har doneret 50 millioner kroner til projektet.

Læs også: [Aftale om nyt havforskningskib sparkes til hjørne](#)

Den finansielle støtte fra fonden supplerer DTU's og statens investeringer på henholdsvis 100 og 170 millioner kroner, men med donationen følger også kravet om, at det nye topmoderne, oceangående forskningskib skal kunne drives af grøn

New research vessel: **KEH design optimised for marin research**

-  Multidisciplinary design, fishery, climate, biodiversity, environment, geology (interest of UFM, FVM, MIM, EFKM)
-  Regular work, marine research and monitoring (EU obligations)
-  Silent ship (diesel elektrik), that allow avanced hydro-acustic work
-  Space for researchers (18-20)
-  Winches, netdrums, wire and cranes for over the side operations of heavy, stationary/pulled and other technologies
-  Prepared for (lab)contains
-  Relative high ice class (PC6), 1A, range: Baltic to Arctic
-  Sustainable operational costs



- *Important platform for collaboration in the Kingdom. Contributing to the arctic strategy and compliment new builds in Greenland and Faroe Islands*
- ***There is a potential to contribute to maritime research including maritime engineering education and serve as a platform for innovation, tests and demonstration for the maritime industry.***

... and a wish

Applying private foundations

- (✓) • DTU applied APM for (€6,8 mio) 50 mio. kr. for the remaining costs towards the KEH design
 - Precise terms and conditions need clarification

- (✓) • DTU applied another foundation for (€6,8 mio) 50 mio. kr to create a platform for education of engineers. Focus on learning and broad understanding of green solutions – e.g. in relation to optimisation, life cycle analysis, clean emissions and water, noise and vibrations – and as a platform for innovation, tests and demonstration.



Broadening of the project include

- Increase of the total costs to approx (€50 mio) 370 mio. kr.

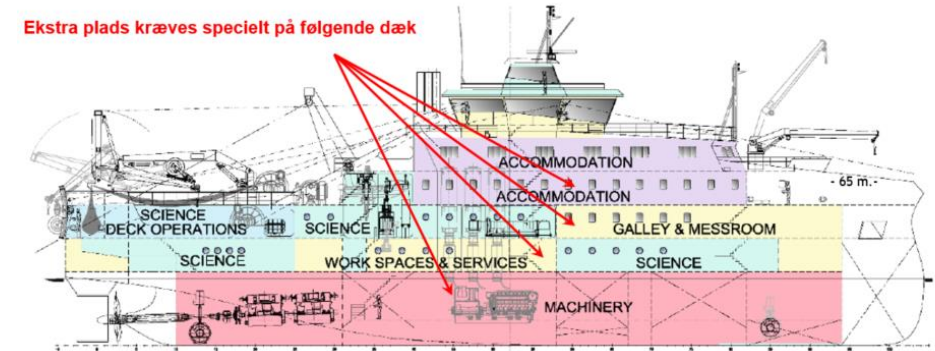
Applied for:

- Extention of the ships with about 3 meters, which will provide 200m² ekstra space for berths (4), teaching space and facilities and innovations/test activities
 - E.g. separate network and Sat-com for students,
 - Labs- and test facilities for maritime research, to run in parallel with primary research assignments and operations

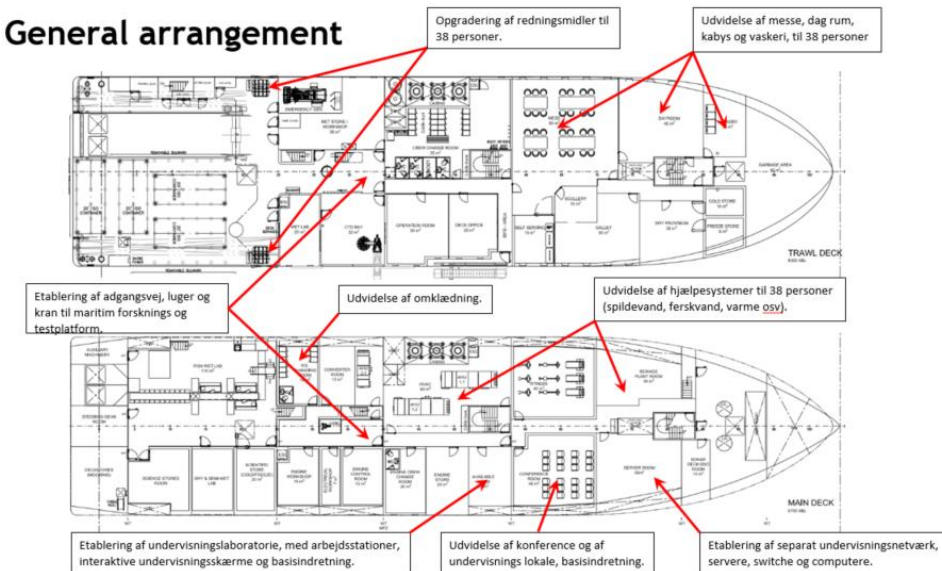
For activities running alongside normal operations

General arrangement

De 3 m forlængelse vil ikke være en separat blok der bliver isat, men en generel forlængelse af skibet, således at kvadratmeterne bliver benyttet i forskellige områder på hvert dæk



General arrangement



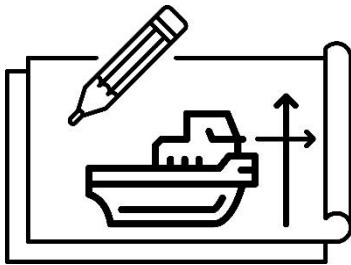
Education of maritime engineers in the new build process and operations

2021

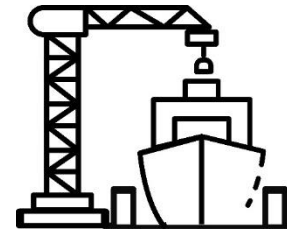


2026/7

DESIGN



BUILD



OPERATION



Education in the design- og build process

- **Special purpose vessels, strengths and stability**
Design and building of vessels, strengths, stability, CFD modelling, waves, digitalisation, arctic operations
- **Optimal energy configuration**
Propeller, engine, optimisation, noise, hydrodynamic modelling, arctic conditions and requirements
- **Sustainability in the maritime sector**
LCA, materials, new fuels, circular economy
- **Maritime sensortechnology and digitalisation**
Digitalisation in operations, autonomy and sensors
- **Include training in tenders**
Requirements for underpinning training aspects in technical project management, design and build contracts
- **Safety at sea**
Further development of the basic sea safety course for researchers, students and others onboard carrying out work. Development of material, videos and e-learning material.
- **3D shipmodelling**
Use of 3D modelling in design-processes and workflow

Preparation of maritime training in the operations phase

- **New ingeneering courses onboard Dana in parallel to monitoring**
To be developed from 2025

Consolidation and continuation

Requirements in the design tender

”as part of the design tender DTU wish to integrate and utilise the possibility of teaching and courses, e.g. by using the design material including drawings, calculations, and models developed by the the contractor.

DTU expects that the contractor include actions that accommodates training aspects.

DTU wish to integrate and utilise the design and the knowledge acquired through training, guest lectures and presentations.”

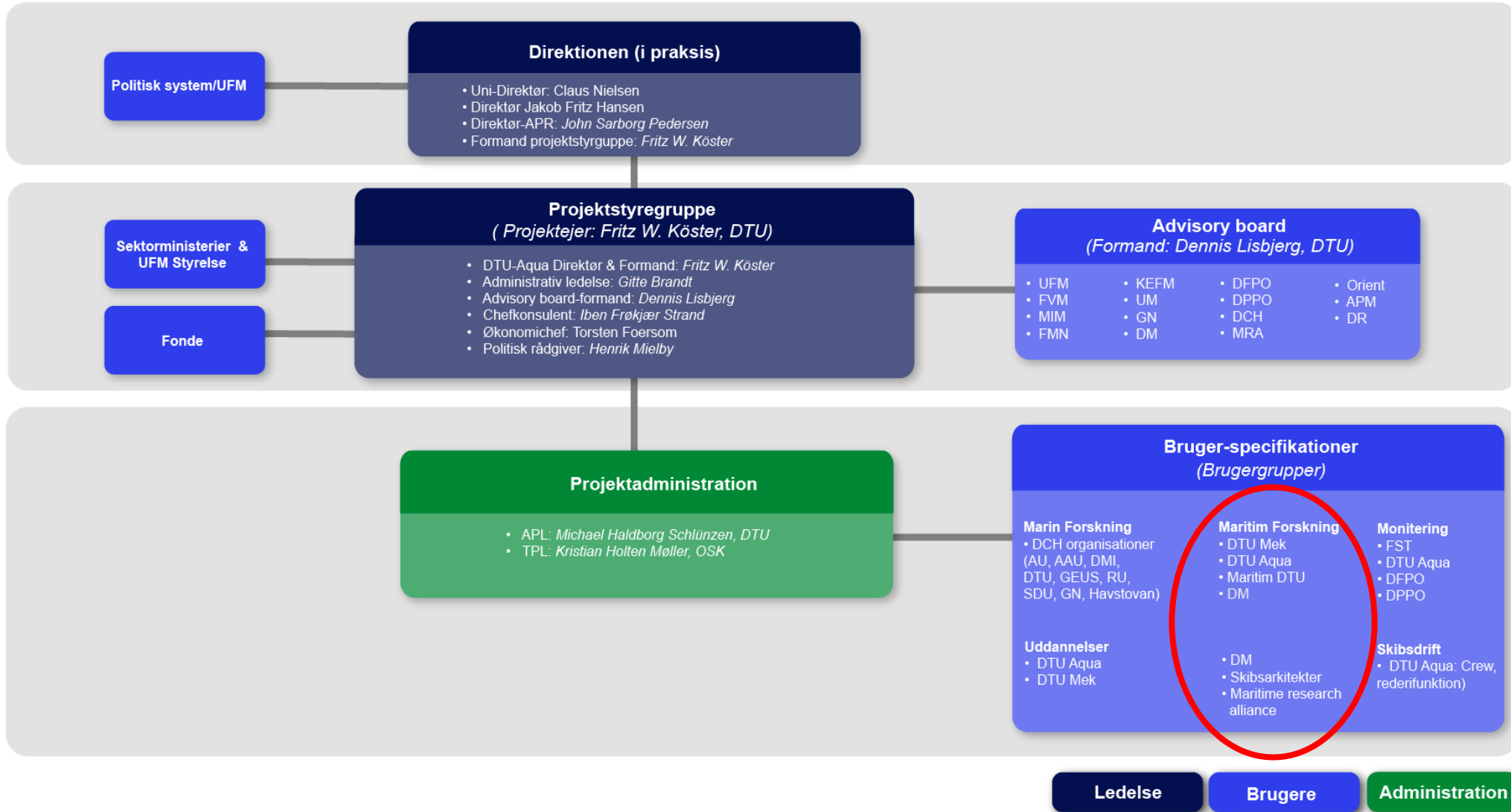
”DTU should have unlimited rights for utilising the material, including editing and distribution rights.”

”The contractor should deliver calculation models, including CFD, stability and database, FE-models, visualisations and VR-models in accessible exportable formats ...”

(own translation)



Project Organisation – External Structure



Working group on education and training

Maritime DTU – center across DTU institutes to develop new courses

Maritime research alliance (MRA) - across Danish institutes

- My question: How to educate and organise the crew???



Administrative project manager Michael Haldborg Schlünzen mih@aquadtu.dk
/Dennis Lisbjerg deli@aquadtu.dk

DTU



EXTRA MATERIAL

Lidt skibstekniske specifikationer

Arbejdsklassenotation: DNVGL 1A SPS E0 Dynpos PC6

Skrog optimeret til silent-R / ICES 209

Hoved dimensioner

- *Længde 68 meter*
- *Bredde 15,6 meter*
- *Dybgang 5,2 meter*

Plads til 38 personer – 18 i en-personers kamre og 10 i dobbelt kamre

Sænkekøl plasteret med censorer 😊

Uddannelses faciliteter

Diesel elektrisk fremdrivning.

- *2x1450kw*
- *1x1050kw*

Servicefart 12 knob

En skrueaksel – FPP

Pæletræk 25 ton ved 5 knob



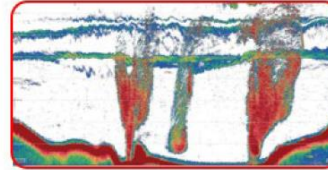
yderligere

CFD analyse gennemført af Force og viste et behov for sænkekøl til akustiske sensorer.

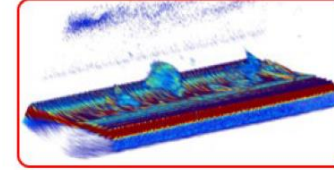
En **teknisk arbejdsgruppe** bestående af eksperter fra Mærsk Fleet Management & Technology, Mærsk Supply, Center for Zero Carbon Shipping samt DTU konkluderede at biodiesel (HVO) og en batteripakke er realistiske muligheder for at gøre skibets fremdriftssystem mere miljøvenligt.

I det nuværende grunddesign er der gjort plads til en batteripakke til "peak-shaving" og til strømforsyning i havn.

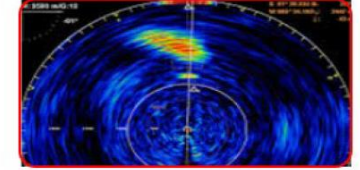
- ADCP dybt vand, f.eks. RDI Teledyne Ocean Surveyor
- ADCP lavt vand, f.eks. RDI Teledyne Workhorse Mariner
- Multi Beam dybt vand, f.eks. Kongsberg EM 304
- Multi Beam lavt vand, f.eks. Kongsberg EM2040-04
- Multi Beam (biomasse estimat), f.eks. Simrad ME70
- Sub Bottom Profiler, f.eks. Kongsberg Topas
- Fiskeri sonar, f.eks. SIMRAD SX90



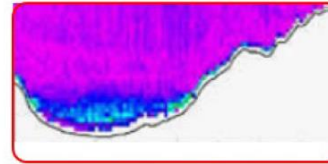
6 Biomass Echo Sounder Transducers
Simrad EK 80 (6 freq. 18 – 333 kHz)



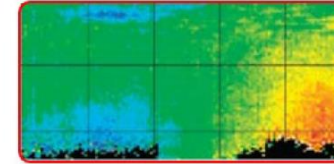
Multi Beam Echo Sounder (MBES),
Biomass Estimates - Simrad ME70



Fishery Sonar
Simrad SX90



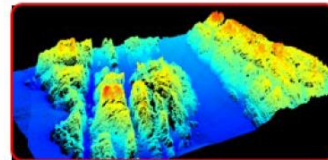
Acoustic Doppler Current Profiler (ADCP),
Shallow Water - RDI Teledyne Workhorse Mariner



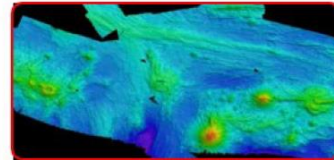
Acoustic Doppler Current Profiler (ADCP),
Deep Water - RDI Teledyne Ocean Surveyor



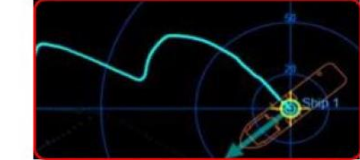
Hydrophone for trawl sensors



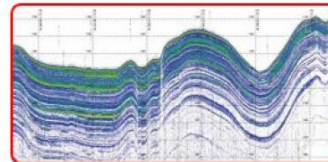
Multi Beam Echo Sounder (MBES),
Shallow Water - Kongsberg EM2040-04



Multi Beam Echo Sounder (MBES),
Deep Water - Kongsberg EM 304



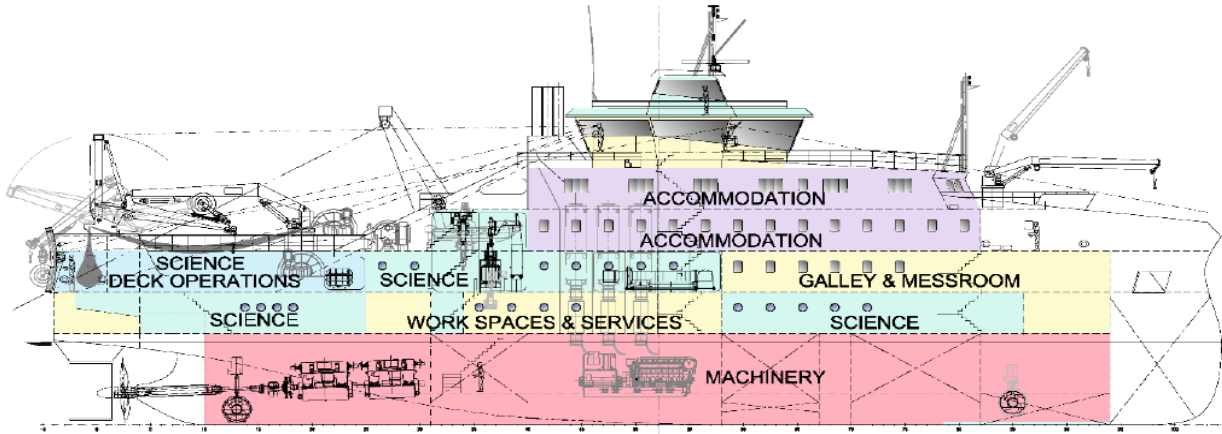
USBL with Sonardyne Type 7950
deployment machine



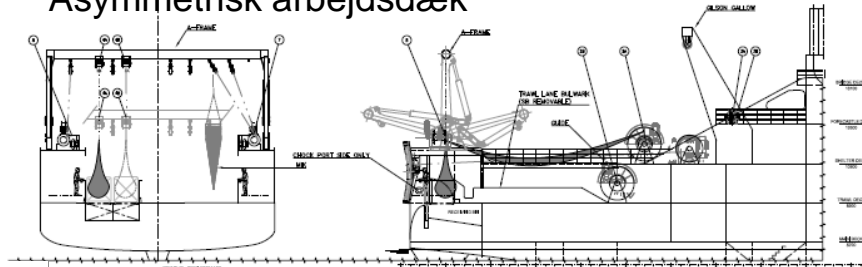
Sub Bottom Profiler
Kongsberg Topas

Dana V - general arrangement

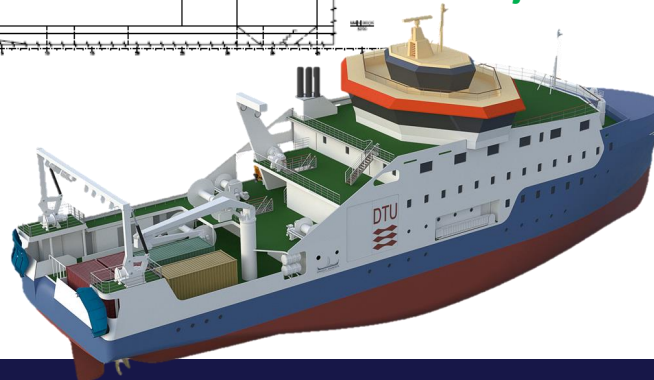
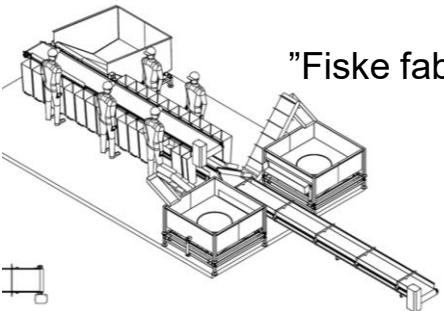
Design til optimeret løsning (ved Knud E. Hansen)



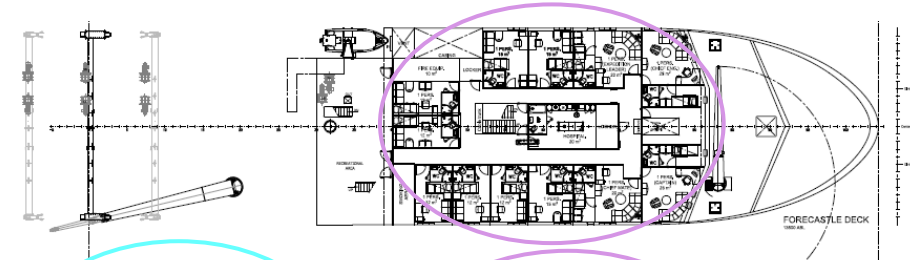
Asymmetrisk arbejdsdæk



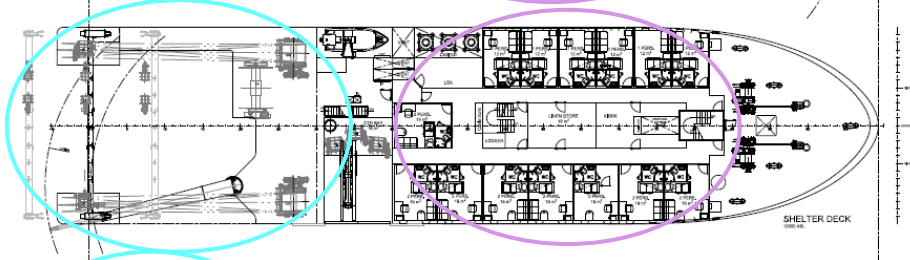
"Fiske fabrik" på Main Deck



Aptering

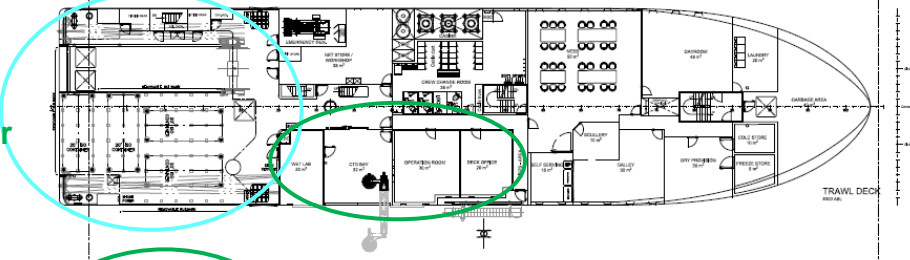


Spil, net-tromle, kraner væk fra arbejdsdæk

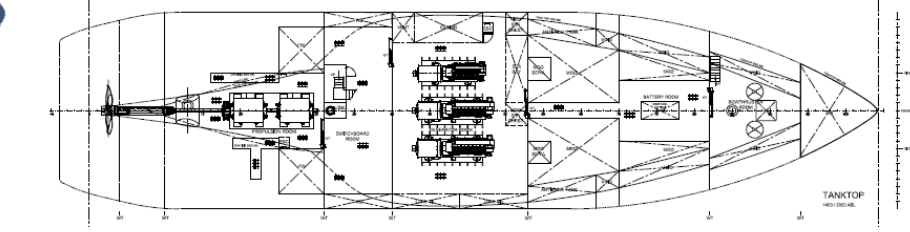
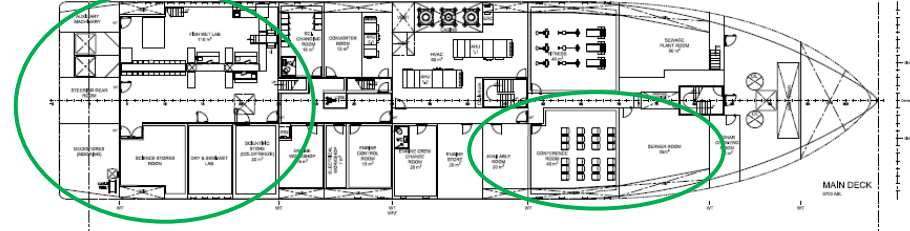


Multipurpose arbejdsdæk

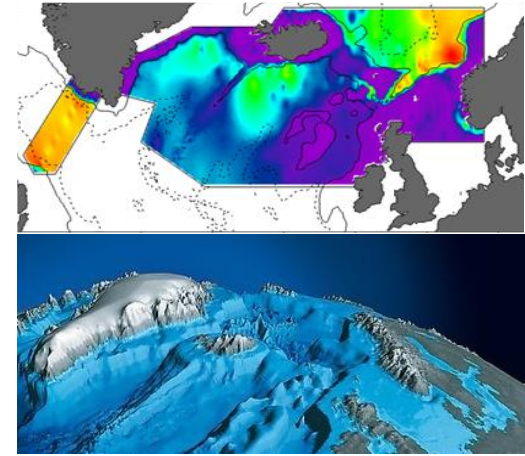
Stor hangar for udsætning over siden



Vådlabs under arbejdsdæk



Nyt forskningsskib: Opgaver i Arktis



Et nyt forskningsskib - opgaver og interesser i Arktis

- **Styrke havforskning og videnopbygning i Arktis**
 - Klima, biodiversitet, havmiljø, fiskeri, geologi
- **Platform for samarbejde i Rigsfællesskabet (Grønlands Naturinstitut og Havstovan/Færøerne)**
 - Avancerede hydroakustisk, opgaver i isfyldt farvand, herunder geologi
- **Civil tilstedeværelse, lavspændingsområde**
- **Evt. bidrage til Forsvarets opgaver i Arktis**
 - Rednings- og eftersøgningstjeneste, logistik, miljømonitoring, opmåling og overvågning

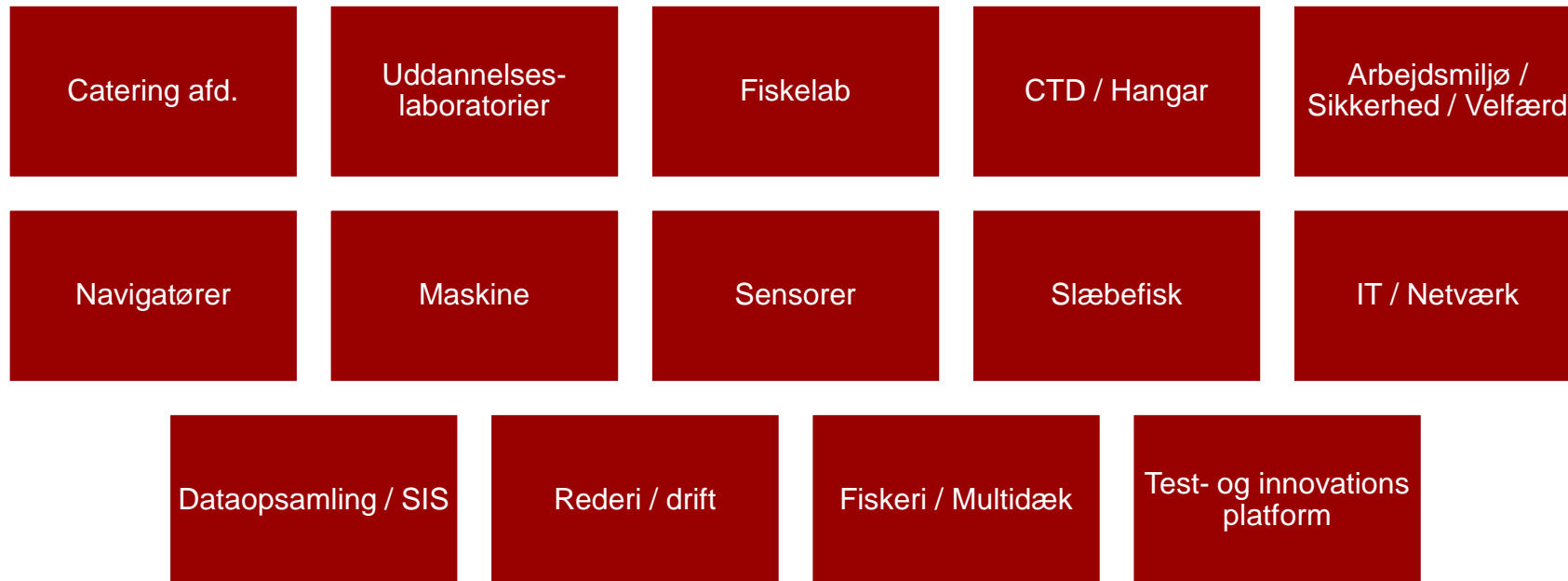
Udviddelse:

- **Marine og maritime uddannelses platform**

Faste brugergrupper

Skibet inddeles i områder, hvor der nedsættes faste brugergrupper, som konsulteres i forbindelse med design og indretning af områderne.

Hver gruppe består af 2-4 medlemmer, der kan konsultere faggrupper eller erhvervene omkring design eller specifikke løsninger.



Dana V - Konceptdesign

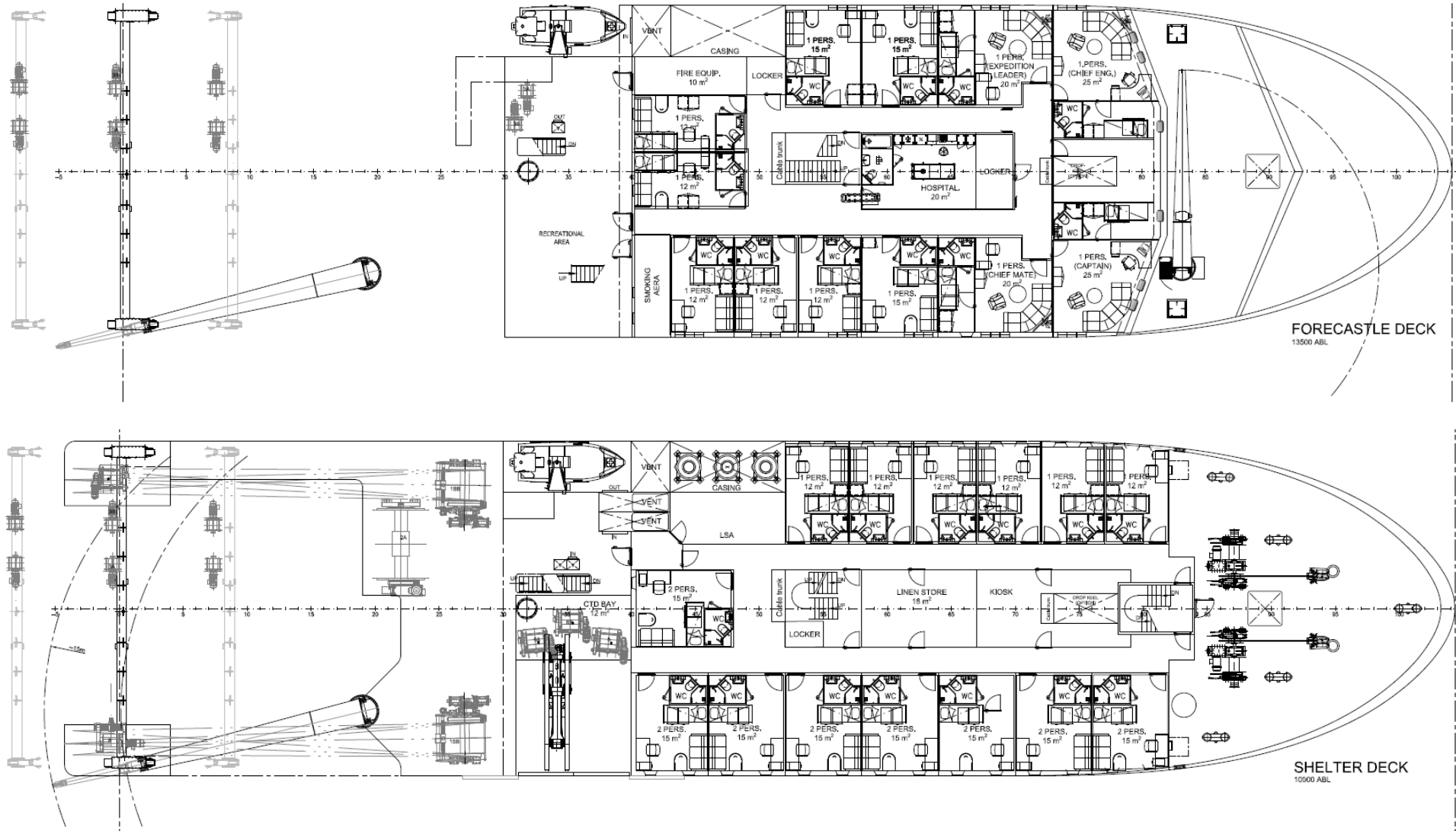
DTU og Knud E. Hansen har udarbejdet et design til optimeret løsning af opgaver i hele riget og nord-europæiske farvande

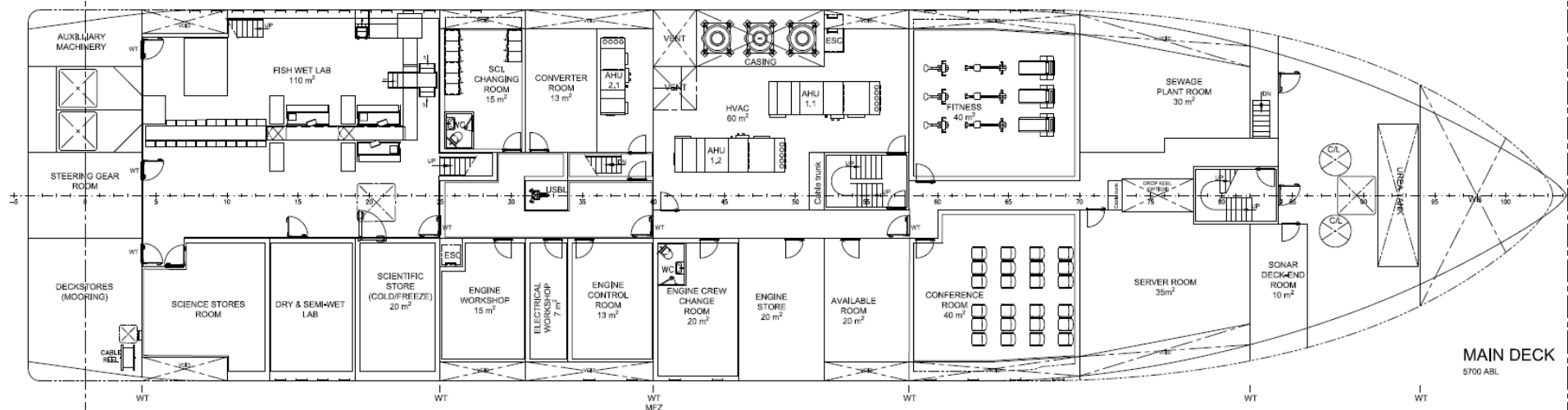
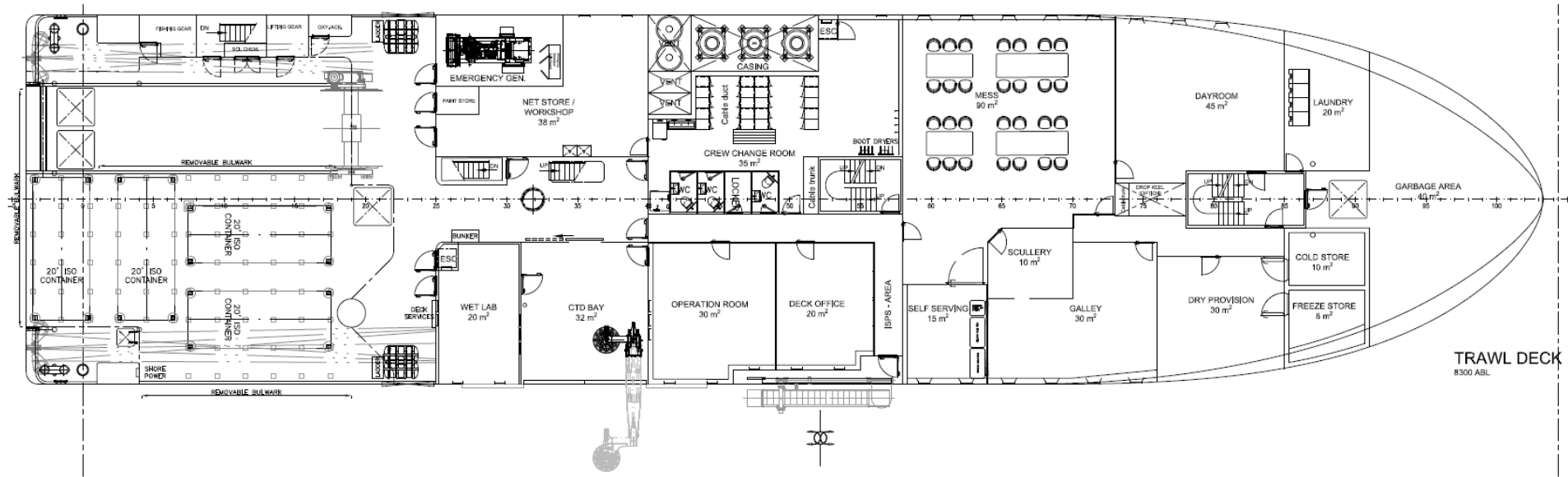
- Multidisciplinært design, fiskeri, klima, biodiversitet, havmiljø, geologi
- Bundne opgaver, forskning og monitoring iht. DK's forpligtelser overfor EU
- Støjsvag fremdrift, der ikke påvirker sensorer til avancerede hydro-akustiske opgaver
- Plads til 34 personer, dvs. 18-20 forskere
- Udrustet til tunge instrumenter, særlige laboratorier, container-baseret udstyr m.m.
- Høj is-klasse, operationsområde fra Østersøen til Arktis
- Neutral færden i alle territoriale/demilitariserede farvande
- Bæredygtig driftsøkonomi



- **Klima- og biodiversitetsforskning**
fx bidrag til *Treaty on Marine Biodiversity beyond National Jurisdiction*
- **Undersøgelser af levende og geologiske ressourcer**
fx bidrag til *FN's agenda 2030 og Havets årti 2021-2030, den europæiske Fælles fiskeripolitik*
- **Miljørelateret havforskning**
fx bidrag til *Havstrategi-direktivet, Regionale Havkonventioner*
- **Platform for samarbejde i Rigsfællesskabet**
fx bidrag til *Agreement to prevent Unregulated High Seas Fisheries in the Central Arctic Ocean*

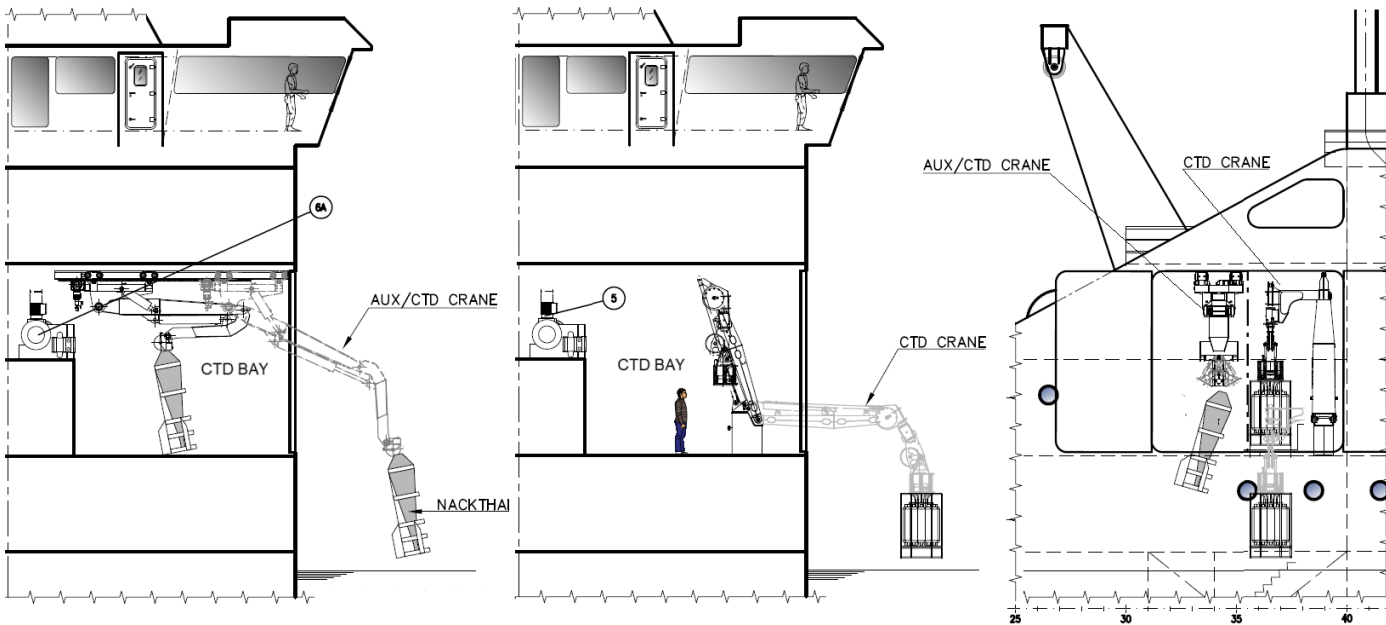


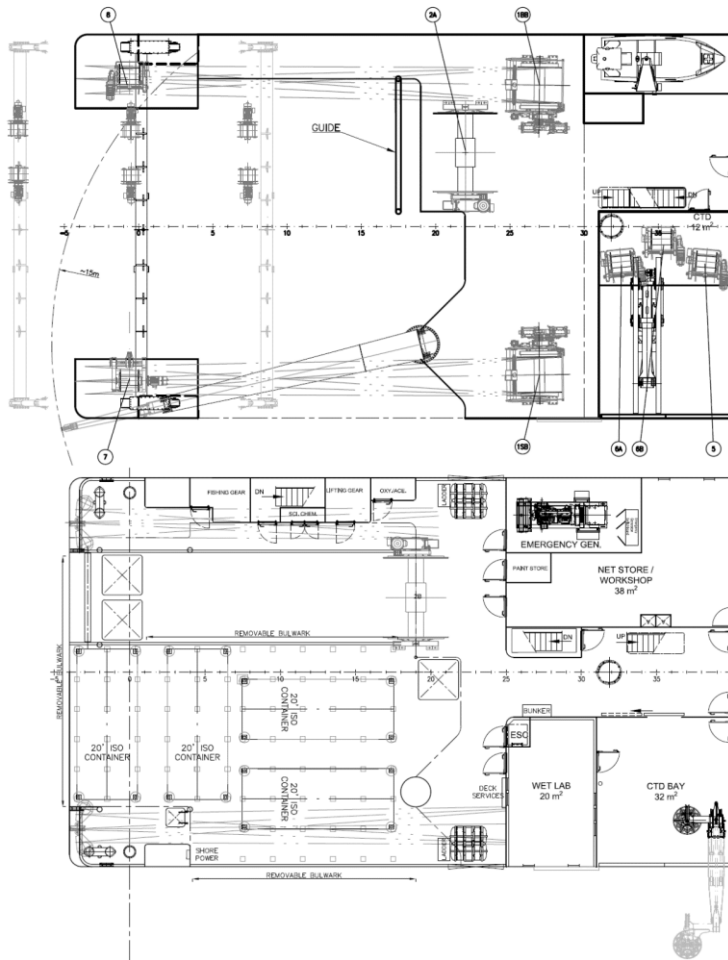




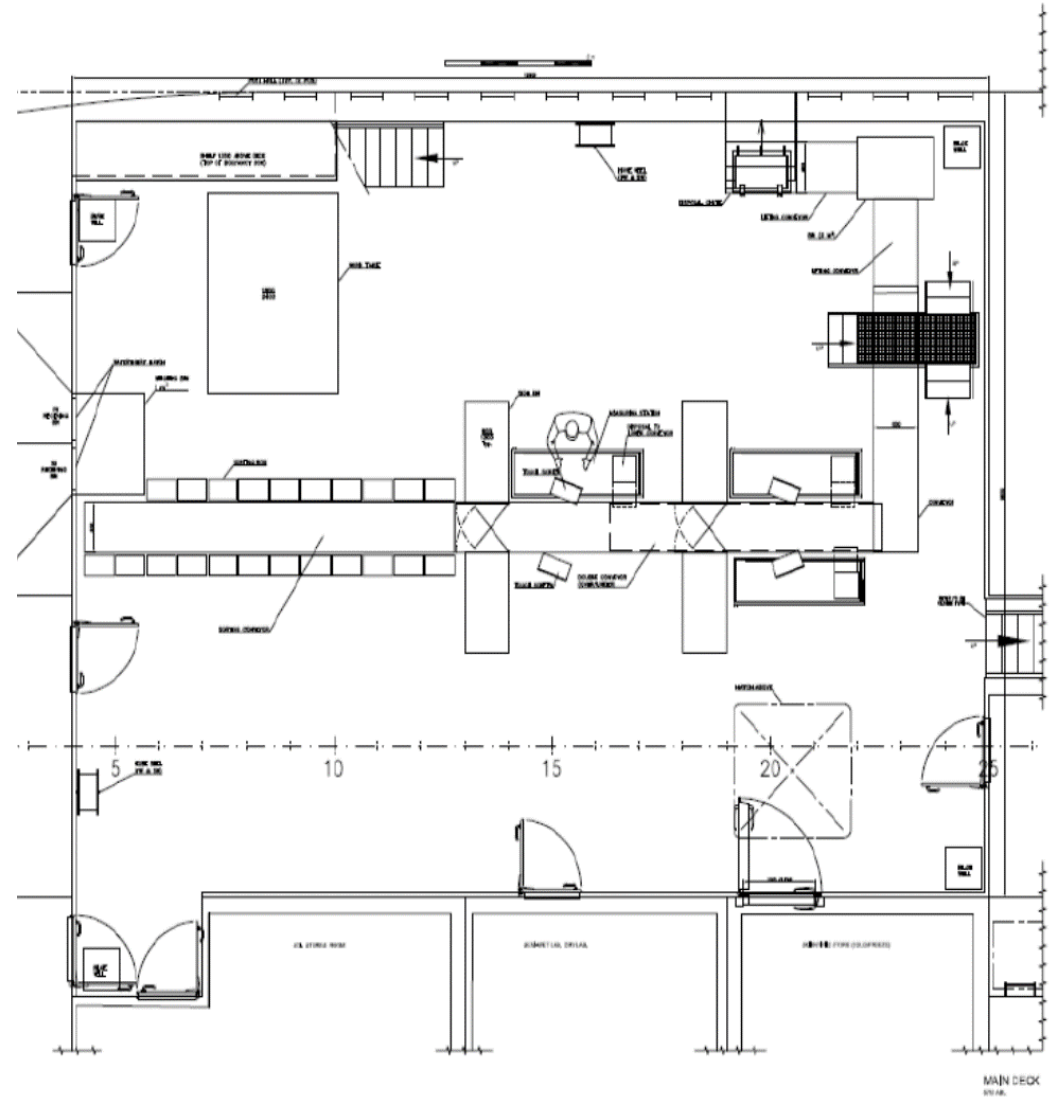
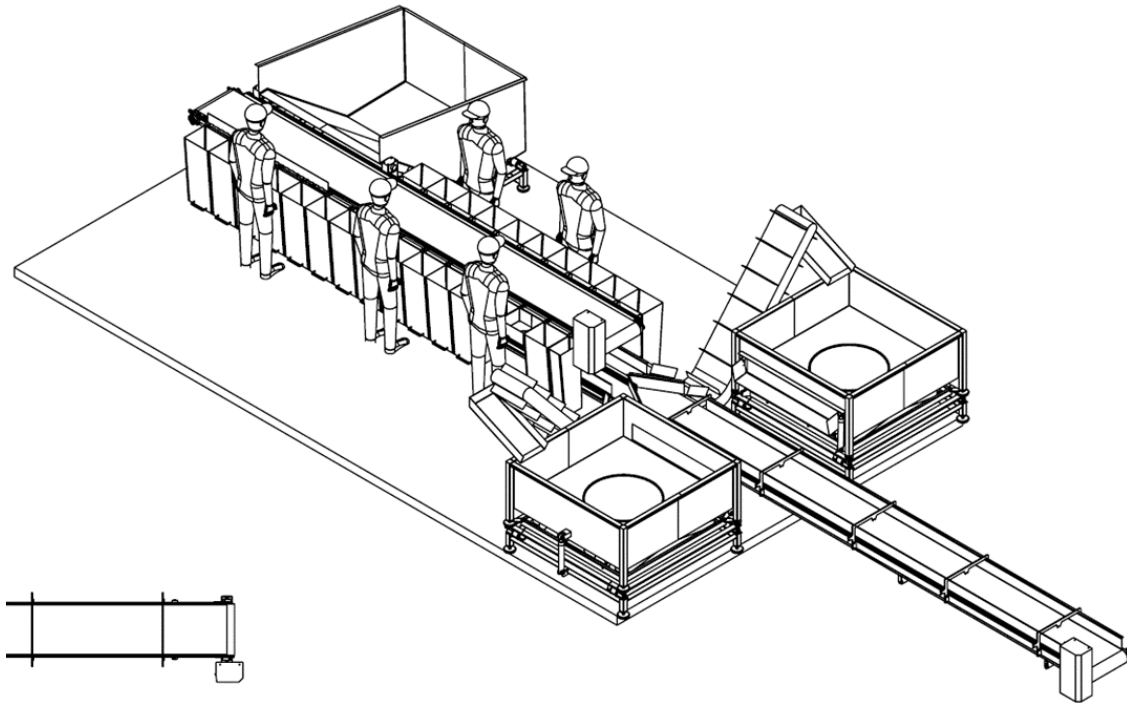
CTD Hangar-installationen omfatter:

CTD crane	Single-man operation. 2-t SWL sea state 5 over board lifts. Hydraulic operated. Articulating boom with CTD capture mechanism. Min. outreach 3 m from ship side and 1 m below deck level. Landing on 0.5 m high CTD cradle.
CTD winch including coax cable	1 pc. (Pos. 5), 3500 m Ø8.18mm coax cable
CTD auxiliary derrick	Knuckle boom derrick type, to avoid pendular effect. Towing force 20 kN. 2-t SWL at sea state 5 overboard lifts.
CTD winch / auxiliary winch including coax cable and rope.	1 pc. (Pos. 6A & 6B) combined unit with 2 drums, 1000 m Ø8. 18mm coax, 3000 m 10-mm Dyneema®





Winches	Requirements
Trawl winch SB including rope	1 pc. (Pos. 1SB), 30 ton, 120 m/min., 15 t last layer, 3000 m Ø20-mm Dyneema® SK75 rope
Trawl winch PS including rope	1 pc. (Pos. 1PS), 30 ton, 120 m/min., 15 t last layer, 3000 m Ø20-mm Dyneema® SK75 rope
Net drums	2 pcs. (Pos. 2A & 2B), 30 ton, 10 m ³
Gilson winch	2 pcs. (Pos. 3A & 3B), 12 ton
Dumping winch (Cod-end winch) including rope	2 pcs. (Pos. 4A & 4B), 5 tons, 75 m Dyneema® rope
Aux. winch (small gear) including rope.	1 pc. (Pos. 7), 5 ton, equipped for wire metering, 3000 m 14-mm Dynlce® Dux rope
Trawl Sonar Winch including data cable.	1 pc. (Pos. 8), 2 tons, 3000 m 13.6-mm Dynex® data



DTU

