Protechting people and planet

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Kongsberg Ship Design

IRSO 2023, 19th October, Brugge
Einar Vegsund, Director – Ship Design Solutions

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Our story at a glance

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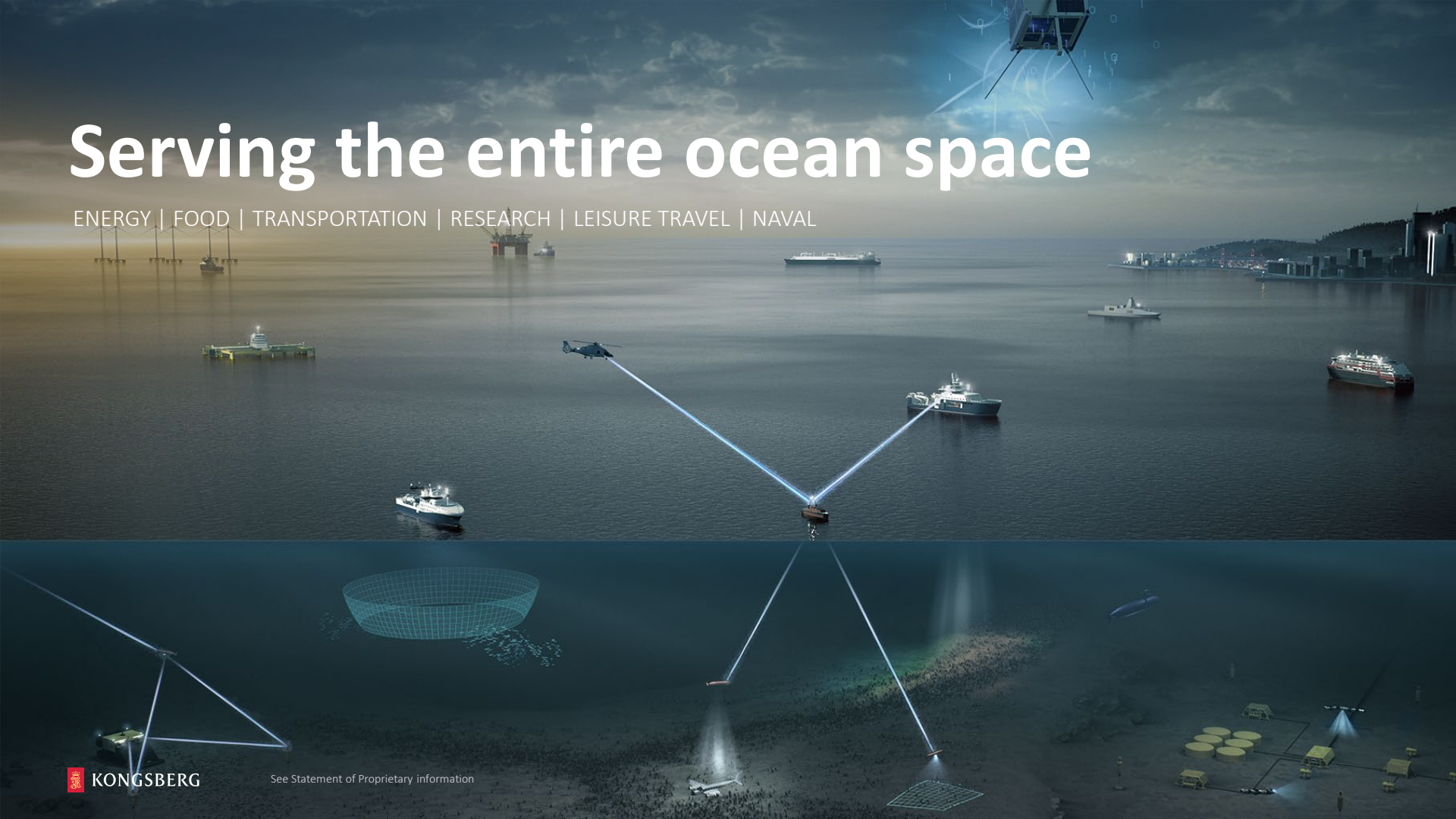
Serving the entire ocean space

ENERGY | FOOD | TRANSPORTATION | RESEARCH | LEISURE TRAVEL | NAVAL



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IRSO 2023

Topics for the day

RV BELGICA

As the designer of the vessel we would like to share information from the design process and lessons learned

GREEN FUEL INITIATIVES

There is no ‘silver bullet’ solving the decarbonisation.

A flavour of some of the initiatives Kongsberg is involved in for Green energy

DISRUPTIVE APPROACH

Sometimes a disruptive approach is the best solution to meet budget, safety and environmental requirements.

USV’s are example of this and examples from one of our ground-breaking projects will be presented

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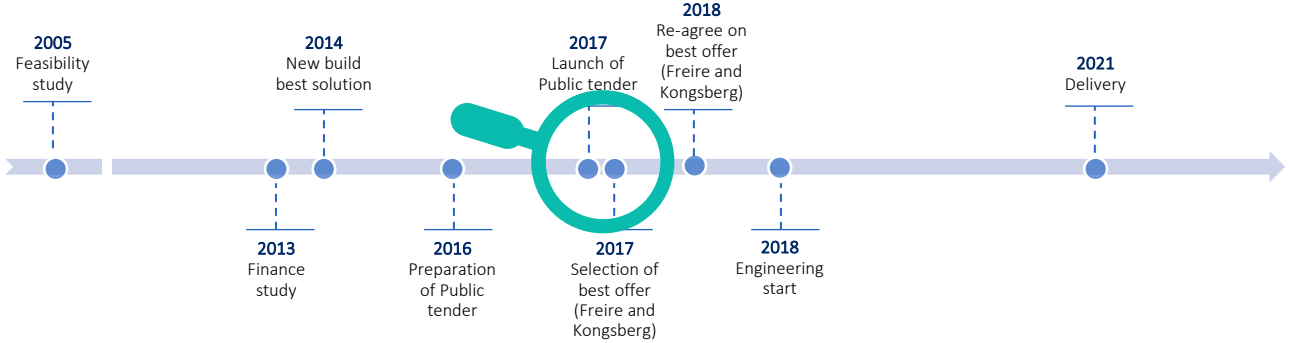
The Design process

RV BELGICA

Picture: Freire



In a period of 7 weeks all major development work was carried out and project ready for commitment.

…based on documentation in French and Dutch

How do we do this?

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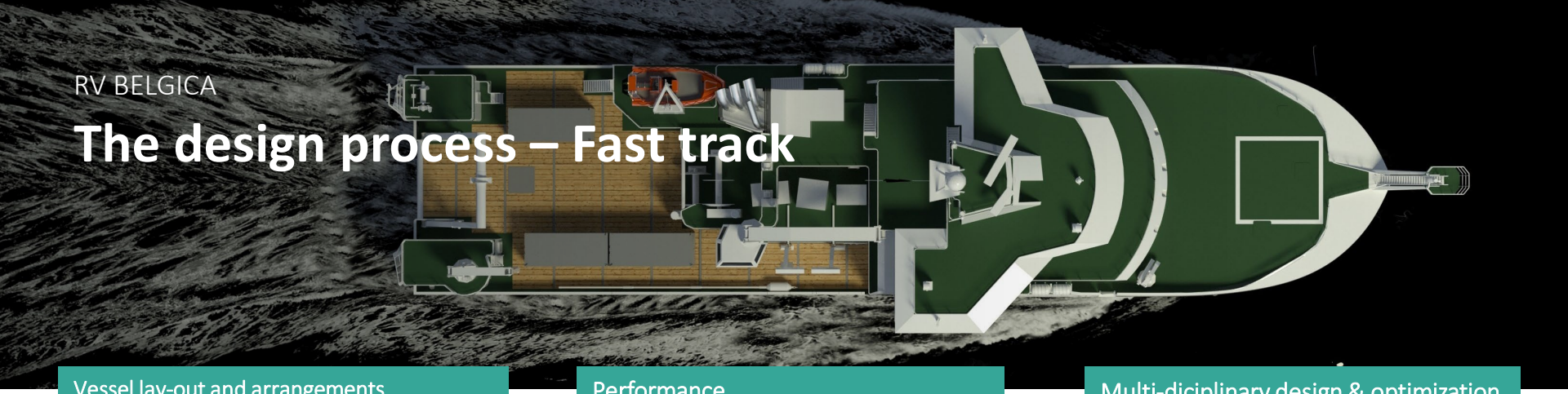
RV BELGICA

The design process – Fast track



Vessel lay-out and arrangements

- Tender criteria and score system
- Cost – benefit evaluations
- Logistics
- Space reservations
- Safety aspects
- Rules and Regulations (SPS)
- View from operation stations - 3D viz
- Noise and vibration
- URN
- Air bubble sweep down
- Launch and recovery systems
- Makers list
- ++

Performance

- Speed
- BP
- Fuel calculations
- SPS code
- Draught limitations
- URN
- 3D steel weight model
- Detailed weight and CoG calculations
- Propeller/thruster configuration
- Machinery system configuration
- ++

Multi-diciplinary design & optimization

- Weight
- Seakeeping
- Station keeping
- Propulsion system alternatives
- Advanced full scale CFD for
  - Hull design
  - Speed & Power calculations
  - Fuel consumption
  - Appendix design - URN
  - Manoeuvring simulations
- ++

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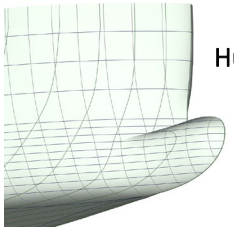
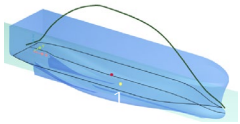
From design spiral to holistic approach

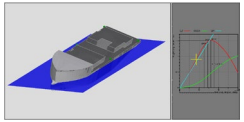
Multi-Diciplinary Design & Optimization

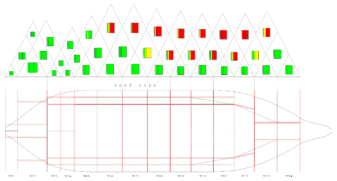


Hull design

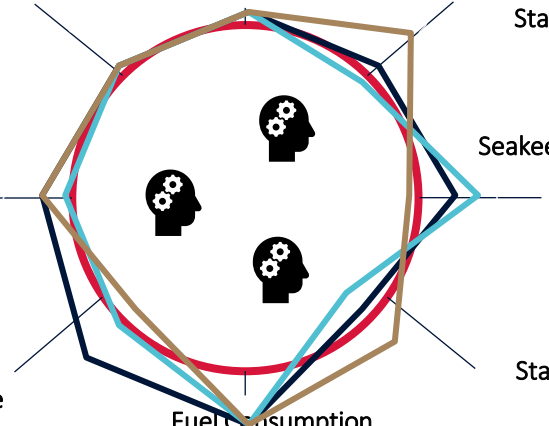


Hydrostatics

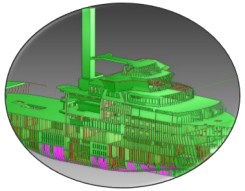




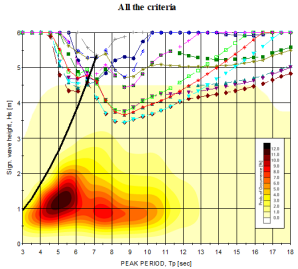
Intact + Damage Stability



Weight Estimations

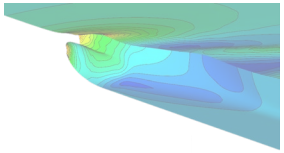


Seakeeping

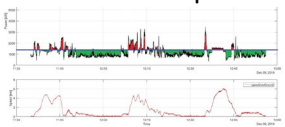


Vessel A
Vessel B
Vessel C

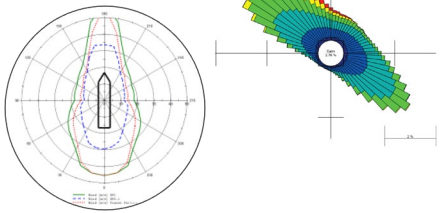
Resistance



Fuel Consumption



Station-Keeping



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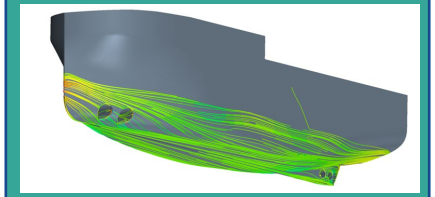
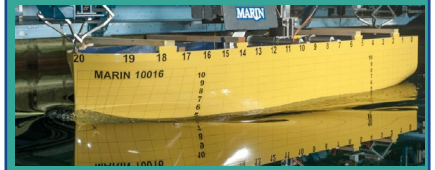
Performance calculations and verifications

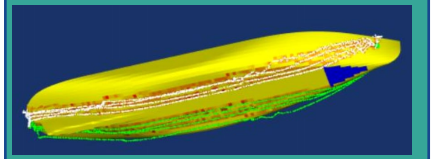
SPEED & POWER

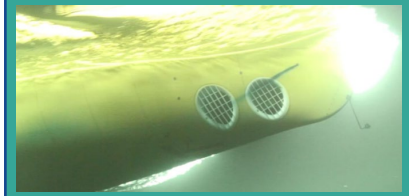


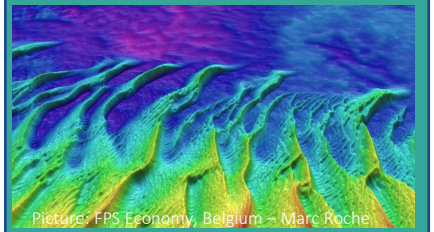


Picture: Freire

AIR BUBBLE SWEEPDOWN

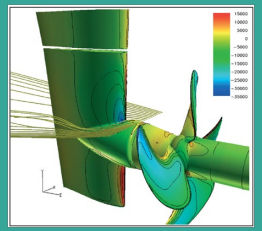


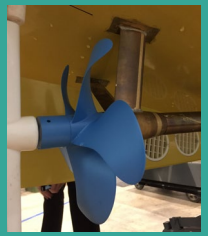




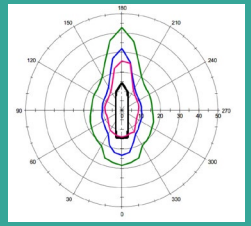
Picture: FPS Economy, Belgium – Marc Roche

URN





DP-SEAKEEPING-MANEUV



Picture: Naturalscience.be

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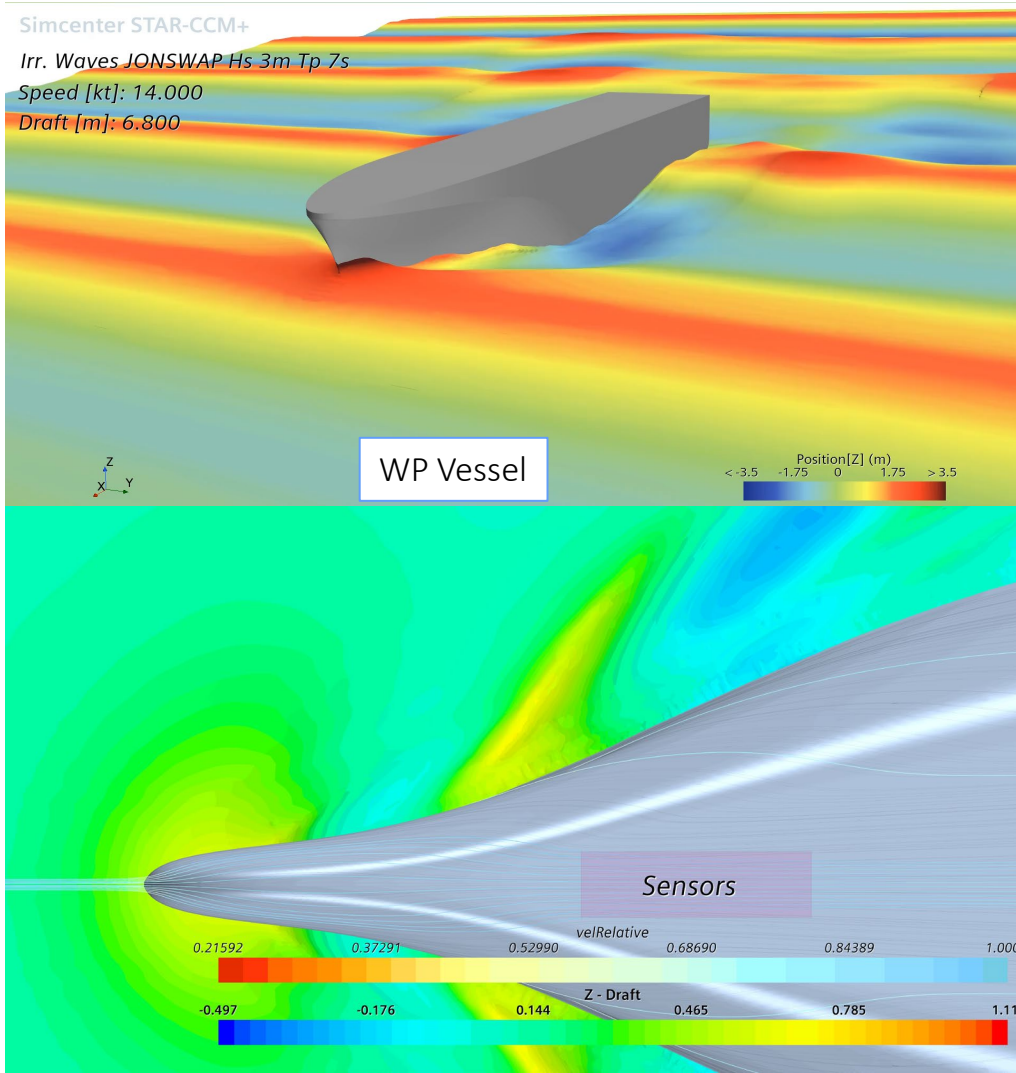
Advanced Simulations

Sailing in a Seaway

- Full-Scale CFD
  - Self-Propulsion
- Added Wave Resistance Estimation
  - Irregular sea states
- Accurate Power Prediction
  - Validated with Model Tests
- Optimization Capability
  - Relative comparison between designs
- Alternative for Model Tests
  - Reduced design iteration time



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UT 844
Research Vessel

KONGSBERG

DESIGN AND INTEGRATED SYSTEMS

UT 844 «RV BELGICA»

70 m Research vessel

The UT 844 “RV BELGICA” features strict limitation of Underwater Radiated Noise (URN), 40 berths, facilities for VERTREP operations, sufficient endurance to run cruises of 30 days without resupply of fuel.

Main features/duties

- Geology and sedimentology
- Fisheries science
- Marine Biology
- Chemistry, geochemistry and biochemistry
- Oceanography
- Meteorology
- Hydrography
- ROV and AUV operations
- Seismic operations
- VERTREP operations

Highest industry standard

- Extreme low Under water Radiated Noise, DNV Silent(R)
- Dynamic Positioning Class 2
- High Comfort Class (COMF(V2))
- SPS code
- Ice Class (DNV ICE(1C))
- Large Accommodation
- Large flexible work platform

DESIGN AND INTEGRATED SYSTEMS

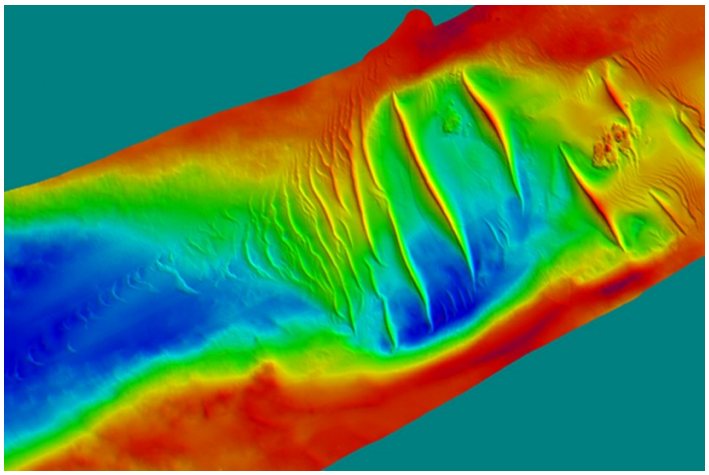
Kongsberg Ship Design provides an integrated system package solution for:

- Ship Design
- Subsea sensors
- Propeller systems
- Dynamic Positioning
- Power Electrics
- Automation
- Deck machinery
- Bridge systems

Subsea sensors

KONGSBERG provides and/or integrates the following subsea sensors (mounted in the hull or one of the 2 drop keels)

- EM 304 1x1 Deep water Multi-beam echosounder
- EM 2040-04 Shallow water Multi-beam echosounder mounted in the port side drop keel
- TOPAS PS18 Sub-Bottom Profiler
- Simrad EK 80 Scientific Split Beam Wideband echo sounder-mounted in the starboard side drop keel
- ADCP 75/600
- Simrad ME 70 Scientific Multi-beam echo sounder mounted in the starboard side drop keel
- Simrad SU 90 Omni-directional acoustic fish finding sonar mounted in the starboard side drop keel
- Noise monitoring system
- HiPAP 502 hydro acoustic reference system with deployment device
- Sound Velocity Profiler sounder
- K-Sync Synchronizing unit
- MDM 500 data management system
- Simrad Trawl and catch monitoring system



Scientific winches and handling equipment

The following scientific winches and handling systems from Ibercisa are installed:

Scientific winches:

- 2 x CTD winch (5500 m)
- Multi functional winch (5500 m)
- Hydrographical winch (5500 m)

Fishery winches:

- 2 x Trawl winch
- 2 x Net drum winches (one split-drum)
- Net sounding winch
- 2 x Gilson winches

Handling equipment:

- A-frame aft
- 2 x T-frames starboard side
- CTD boom
- Coring system (up to 15 m corers)
- Towing booms

The vessel is also equipped with a moonpool (0,8 x 0,8 m) with bottom door

Laboratories

The vessel is equipped with the following laboratories and scientific spaces:

- Operational centre with good view on the operations
- Science hangar
- CTD hangar
- Wet laboratory
- Two general laboratories
- Clean labratory
- Wet fisheries laboratory
- Dry fisheries laboratory
- Aerosol laboratory
- Autonomous Underway Measurement System (AUMS) room
- Different stores, freezers and science hold
- Scientific offices

The vessel is prepared for installation of many different science spreads:

- Corer
- Rock drill
- MeBo rig
- AUV handling
- ROV handling
- Seismic operations
- Moorings
- Etc.

Kongsberg Hugin AUV

Automation systems

KONGSBERG provides and/or integrates the following automation systems:

- K-Bridge integrated bridge system with navigation & communication
- K-Chief integrated automation system
- K-Gauge tank tender system
- K-Load loading computer
- K-POS Class II dynamic positioning system including:
  - High performance GNSS systems
  - HiPAP hydro-acoustic reference system

Vessel Insight performance monitoring system enhancing awareness for informed operational efficiency.

- Improving vessel and fleet performance
- Onboard system helping crew optimize operations
- Supporting regulatory compliance
- Integration with Equipment Health Management

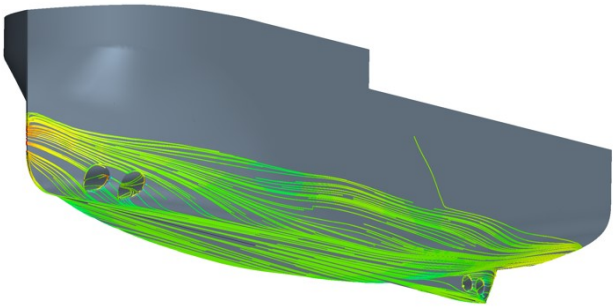
Energy saving

Optimized hull design by using CFD:

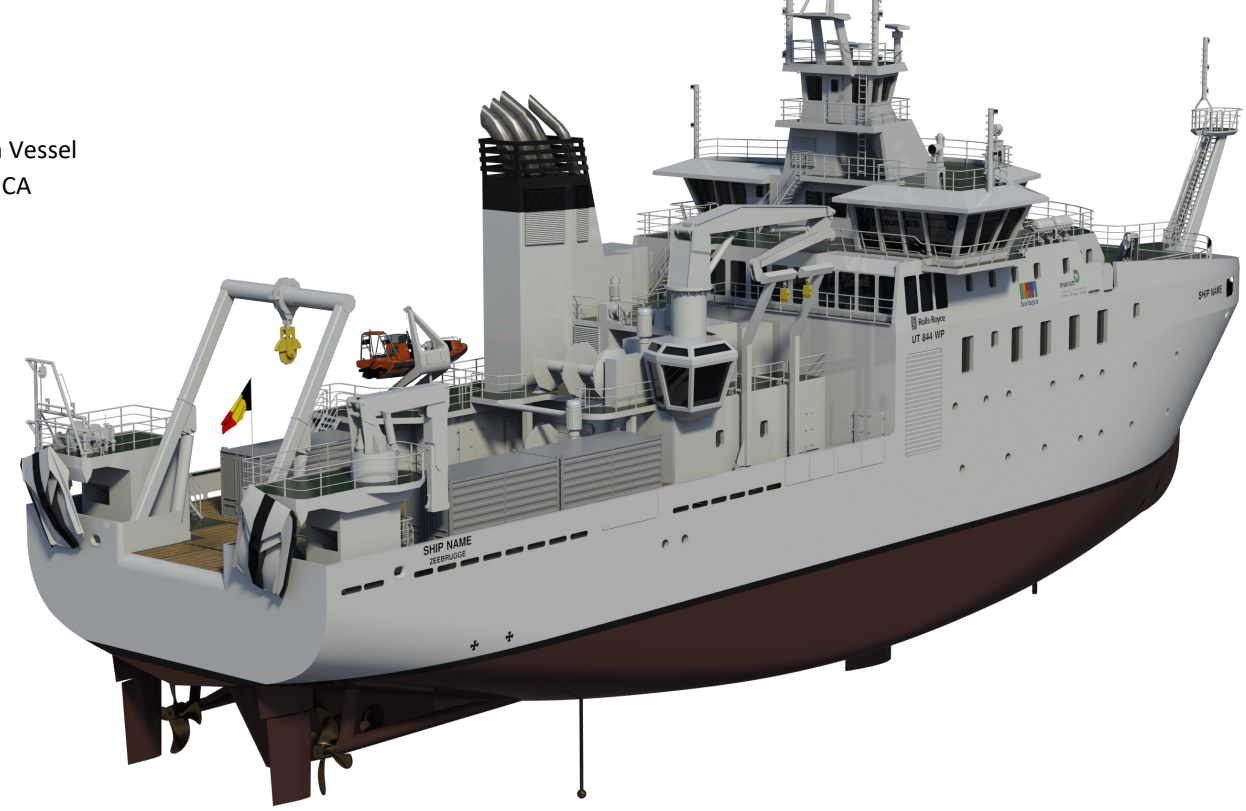
- Hull lines designed for low fuel consumption
- Bow optimized for minimum Bubble Sweep Down
- Stern and appendages optimized for low Under water Radiated Noise (URN)

Waste heat recovery:

- Economizers installed in the exhaust system



UT 844
Research Vessel
RV BELGICA



MAIN DIMENSIONS

• Length overall	71.4	m
• Breadth mld.	16.8	m
• Depth main deck	6.3	m
• Design draught	4.7	m

CAPACITIES (PRELIMINARY)

• Water Ballast	615	m^3
• Fuel Oil	273	m^3
• Potable Water	53	m^3
• Urea	25	m^3
• Deadweight at T_{design}	450	ton
• Work deck area	260	m^2

PERFORMANCE

• Trial speed at T_{design}	13+	kn
• Economic & survey speed	11	kn
• Bollard Pull	30	t

ACCOMMODATION

The vessel has accommodation for 40 persons (12 crew and 28 scientists) in 27 cabins.

PROPULSION AND MANOEUVRING SYSTEMS

- 2 x Kongsberg Main propulsion ice class, Promas 5-bladed fixed pitch propellers
- 2 x Kongsberg Promas rudders
- 2 x Kongsberg Steering gears
- 2 x Kongsberg Bow thrusters
- 2 x Kongsberg Stern Thrusters

POWER SYSTEM

- 3 x Medium speed ABC generator sets with SCR's (2 sets double resiliently mounted for low URN)
- 1 x Emergency/Harbour generator set
- Kongsberg Power generation and Electric distribution system with drives and PMS.

Sea Keeping

- The vessel is equipped with a Hoppe roll-reduction tank (U-type)

OTHER PARTICULARS

Mooring equipment

- 1 x Anchor windlasses
- 2 x Capstans

Cranes:

- Multi functional crane aft (8 t @16 m)
- Multi functional crane SB (4 t @ 16 m)
- Multi functional / stores crane fwd. (1,5 t @ 16 m)

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Decarbonisation challenge

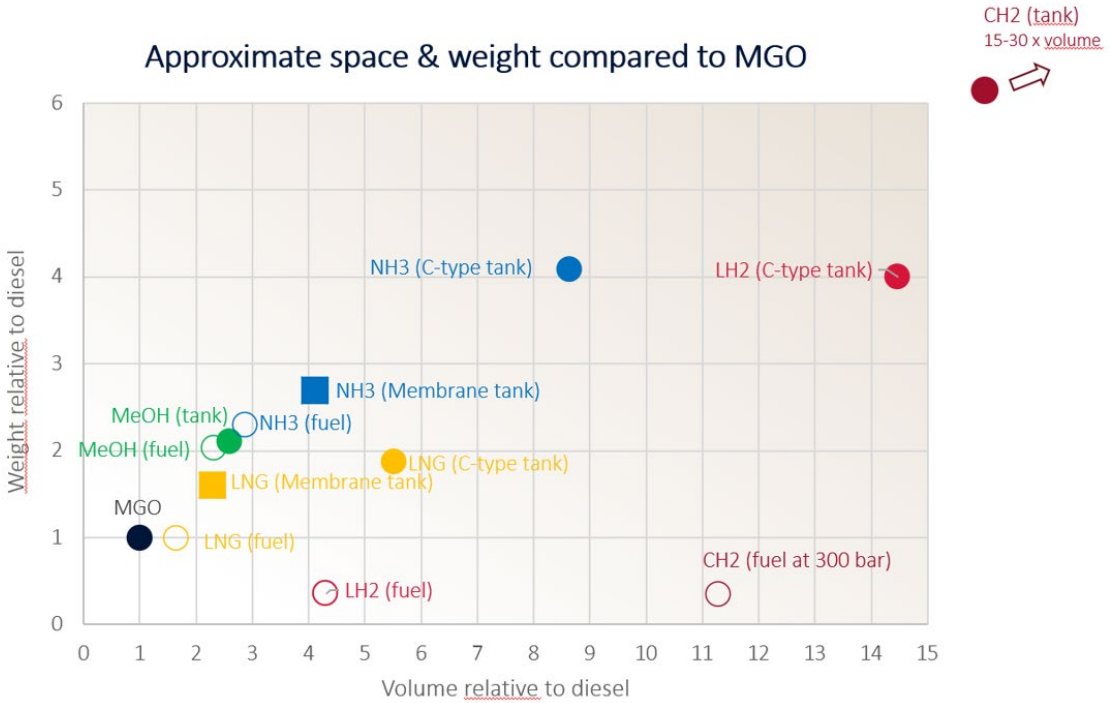
Developing new solutions

Fuel transition

Decarbonisation challenge

Space and weight

- All alternative fuels require more space onboard than MGO
- This is emphasised when the fuel containment systems are included into the calculation
- The alt fuels are also heavier than MGO when the weight of the tanks are included
- This introduces a challenge for the naval architect and might impact endurance, payload capacity or main dimensions of the ship



Note: Space for C-type tank is assumed to be the entire tank compartment

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Decarbonisation examples

Our way towards green shipping

Wind assisted propulsion

Three vessels in order for Tärntank based on a third generation award winning design. Now including wind assisted propulsion and methanol engines.

Wind assist technology is expected to reduce emissions up to 19 %

NH3- Ammonia

Building contracts for the two first vessels in a series is under negotiation.
Approval in Principle granted from DNV and BV.
NH3 bunkering system is part of the business case

80%-100% reduction in CO2 emissions

Methanol

2 + 4 vessels under construction based on methanol fuelled notation. ICE technology.

Approx 70% reduction in CO2 emissions

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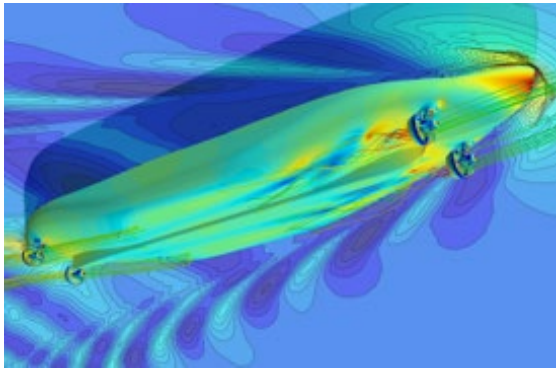
Decarbonisation examples

Our way towards green shipping

Offshore charging

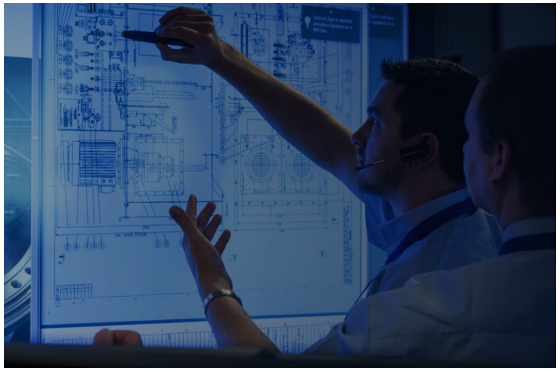
Development program on-going for offshore charging station and PHEV vessel design.

Operational efficiency



6 off CSOV vessels under construction with double ended propulsion set-up and battery hybrid machinery.
Large amounts of operational data used as basis for new design – The full picture

Retrofit



Several FEED studies for, upgrades, conversions, hull modifications and new fuels.

Significant potential for energy savings estimated and verified at completion (25%-30%)

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Disruptive Solutions

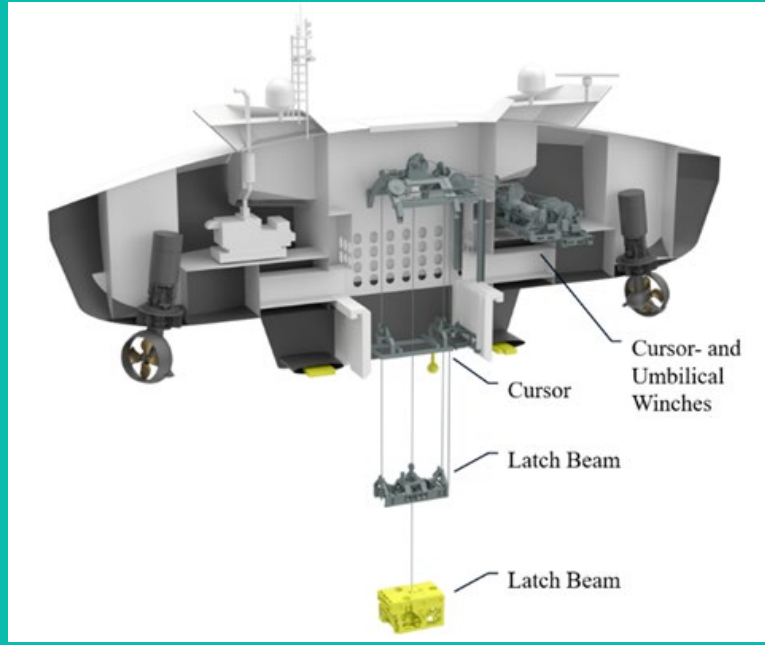
Pushing limits

Reducing emissions and cost through innovation

Unmanned Surface vessels

It all started with a few ideas and questions raised:

- Traditional ROV operations primarily operated and controlled from large, multi-functional subsea vessels
- For many ROV duties, there is limited- or no value added from the extensive capabilities of such vessels
- The innovation concept was based on the idea of a small-scale, un-manned, self-propelled, Remote and Autonomous (R&A) controlled mother vessel from which an ROV may be operated
- Extensive test and verification program



The project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement N°815012.

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Reducing emissions and cost through innovation:

Changing complex ROV operations

- **Vessel size 24.9 m x 8 m**
- **New Design** developed acc to alternative design process
- **Delivery** of first two unmanned surface vessels in **2024**
- **Gamechanger** for the industry
  - Low-emissions - 90% reduction in daily CO2 emissions
  - Cost-effective
  - Remotely operated
  - Safe work environment
- **KM is the prime contractor:** deliver complete vessels to the customer Reach Remote.
- **Massterly ROC** in Horten to control the vessels
- **ROV** controlled from Haugesund

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UT 5208 - Capability

Survey

Reach Remote will be able to perform all kinds of traditional survey tasks like seabed mapping, pipeline inspection, UXO surveys etc. Moreover, Reach Remote will have number of advantages versus traditional vessels and survey spreads.

- Sub bottom profiler – Kongsberg Maritime TOPAS 120
- Multibeam echosounder – Kongsberg Maritime EM2040
- USBL – HIPAP 502
- Navigation – Seapath 380 and iPS4

ROV based survey

Reach Remote will be capable of performing the same way as traditional ROV based survey. In addition, automated functions will increase speed and efficiency of the survey tasks. E-ROV can be equipped with full package of survey sensors.

Reducing emissions and cost through innovation:

Changing complex ROV operations

Technologies at work:

- Secure connectivity
- Safe navigation
- Automated vessel
- Hybrid battery powered
- Remote operation
- Underwater survey
- Launch & Recovery

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Thank you

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