



KONGSBERG

Kongsberg Maritime

SEISMIC

OPTIMIZING SEISMIC OPERATIONS

MAXIMIZING PERFORMANCE BY PROVIDING

THE FULL PICTURE

Our mission

We shall earn the respect and recognition for our dedication to provide innovative and reliable marine electronics that ensure optimal operation at sea. By utilising and integrating our technology, experience and competencies in positioning, hydroacoustics, communication, control, navigation, simulation, and automation, we aim to give our customers The Full Picture. The Full Picture yields professional solutions and global services that make a difference enabling you to stay ahead of the competition.

Our philosophy

Our success depends on the success of our customers. Actively listening to our customers and truly understanding their needs, and then translating these needs into successful products and solutions is central to achieving our goal. Our people are the key to our success and we empower them to achieve. Working together in a global network of knowledge, guided by our values, engenders innovation and world class performance. Every day we have to think a little differently, because every client is unique. We aspire to translate the imagination and dedication of our staff into successful technologies and solutions. Our commitment is to add value to your operations by providing you with The Full Picture.

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PROVIDING THE FULL PICTURE

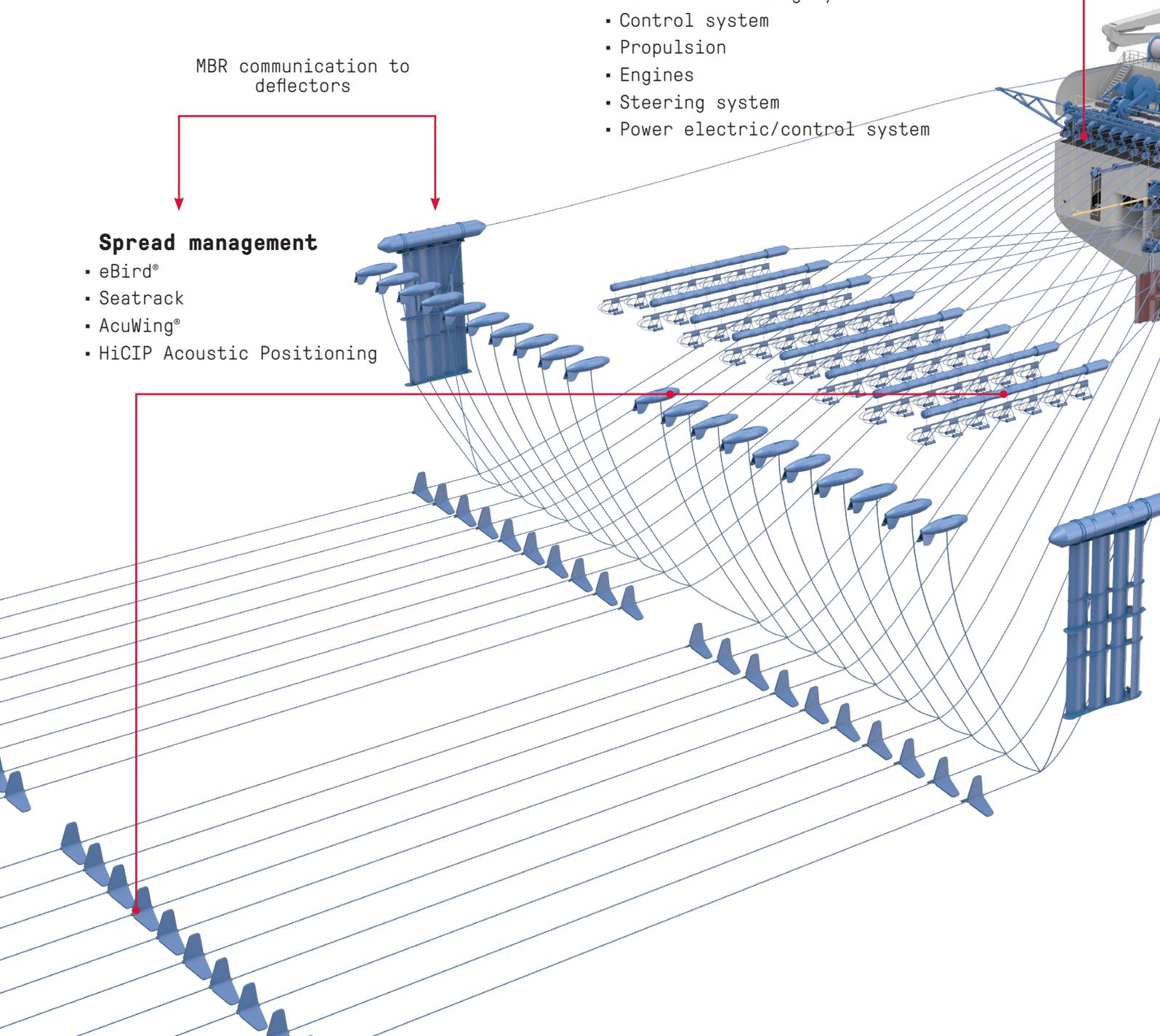
Backdeck solutions

- Streamer handling systems
- Gun handling system
- Wide tow handling system
- Control system
- Propulsion
- Engines
- Steering system
- Power electric/control system

MBR communication to
deflectors

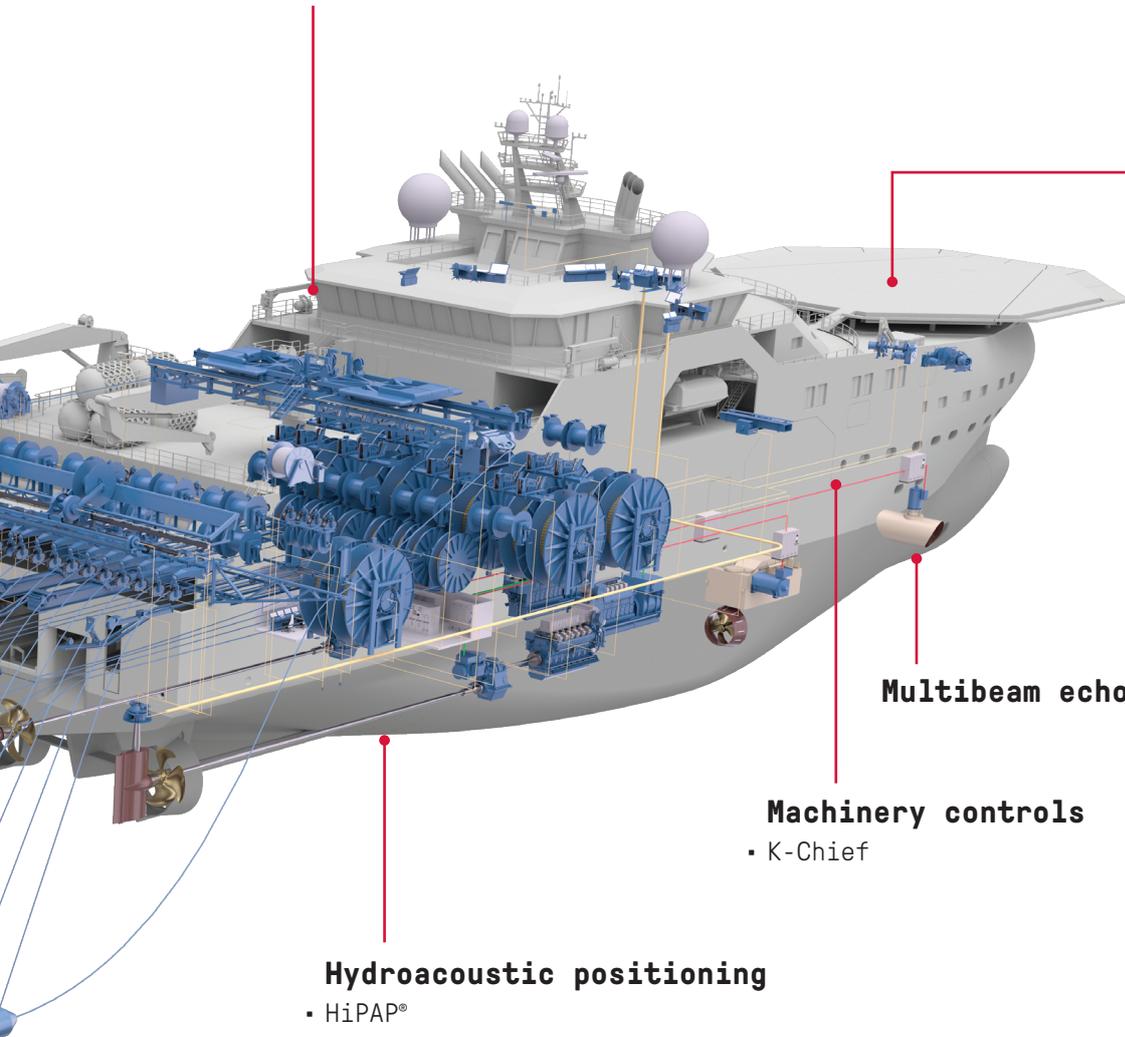
Spread management

- eBird®
- Seatrack
- AcuWing®
- HiCIP Acoustic Positioning



Transport and marine operation

- K-Master
- K-Thrust
- Seapath®
- Vessel Motion Monitor
- AIS for seismic operation
- Navigation



Helideck monitoring

- Helideck Monitoring System
- Motion Reference Unit

Multibeam echosounder

Machinery controls

- K-Chief

Hydroacoustic positioning

- HiPAP®
- HAIN

Solutions for all types of marine seismic activity

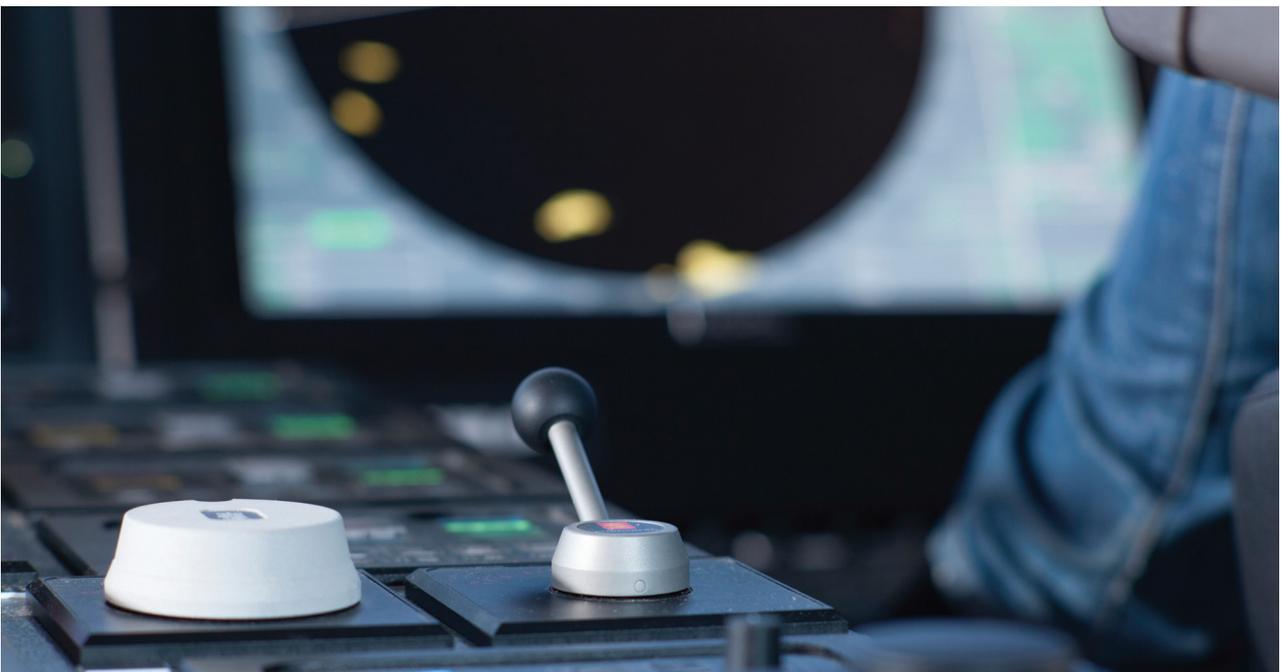
All types of seismic operations can benefit from Kongsberg Maritimes technology base and know-how.

Close cooperation with customers in development and long experience with marine operations with a wide range of applications in all environments gives an unmatched blend of high fidelity solutions for any kind of seismic operation.

Kongsberg Maritime provide operational solutions for:

- Towing seismic
- Electromagnetic seismic
- Seabed node seismic
- Ocean bottom seismic

where the aim always is to create efficient solution for the customer.



DYNAMIC POSITIONING

in seismic operation

In addition to the standard DP functionalities provided for, the seismic track mode function provides a number of seismic specific functionalities. The seismic track control is based on an interface with external seismic computer and thus provides;

- Operator specified cross track offsetting
- Operator selected cross track control gain
- Operator specified crab angle limits
- Operator specified crab angle warning and alarm limits
- Operator specified crab angle
- Cross speed limitation according to information from seismic computer
- Rate of turn limitation according to information from seismic computer
- Vessel speed information from seismic computer, doppler log or GPS receiver
- Cross track error filter

In addition, automatic speed control is available, including;

- Speed control with bumpless transfer from joystick/lever control
- Operator selectable speed deadband
- Operator selectable speed setpoint, or speed setpoint from seismic computer



High precision acoustic positioning - HiPAP®

KONGSBERG provides a FULL PICTURE suite of integrated acoustic and inertial positioning solutions. We have addressed the challenge of extending the operational limits of Super Short Baseline (SSBL) positioning, providing higher accuracy over long horizontal ranges and in deep water, reducing the requirement of reverting to full Long Baseline (LBL) positioning solutions. This affords extremely efficient use of vessel time and offers real operational cost savings.

HiPAP®

The HiPAP systems cover all water depths and a range of vessel types from large ocean research vessels to small vessels of opportunity. All HiPAP systems are able to send and receive acoustic data telemetry to and from autonomous underwater vehicles and transponders, autonomously logging data from environmental sensors.

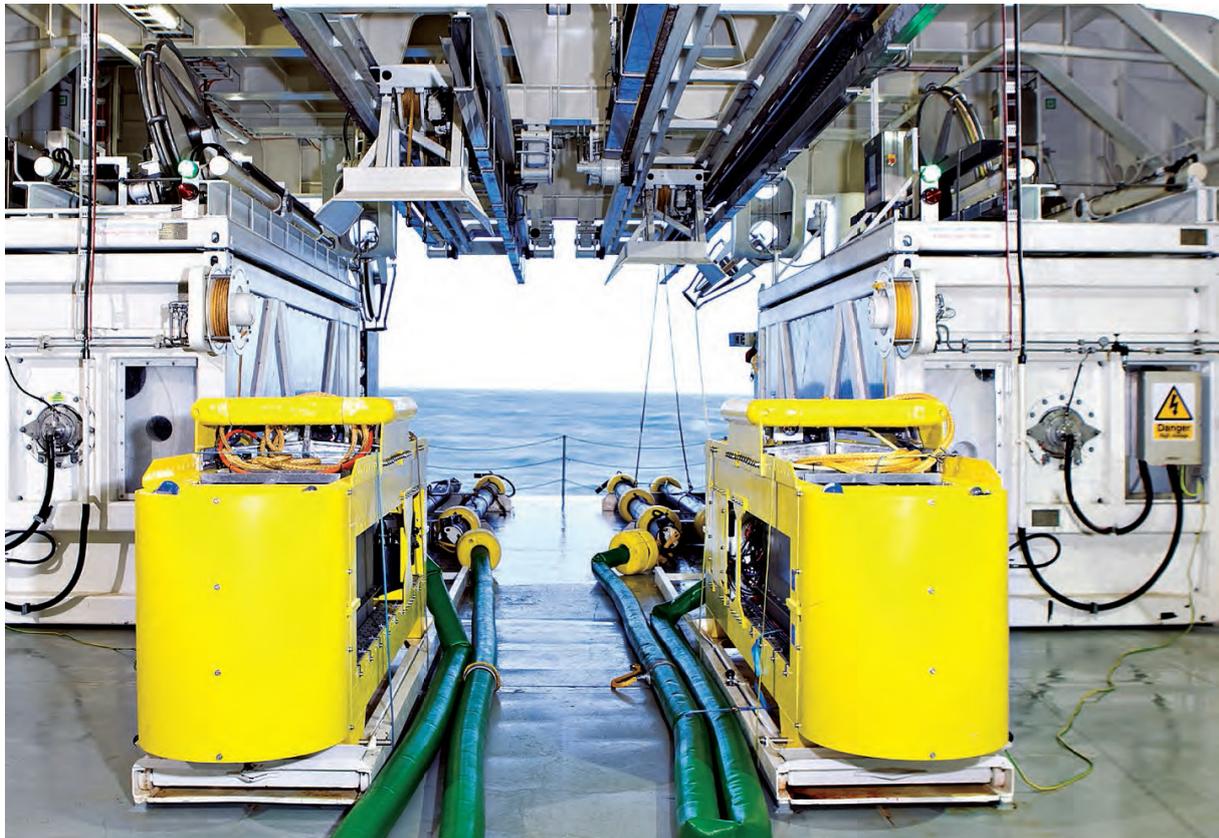
The system provides a comprehensive view of transponder positions along with sensor data and can handle several hundred targets.

CYMBAL®

All HiPAP models operate the latest acoustic protocol for positioning and communication, Cymbal.

The Cymbal protocol transmits more energy into the water, and together with the uniqueness, coding offers new filtering and acoustic processing techniques.

All new generation HiPAP models are compatible with earlier generations of transponders.





HiPAP® 502

With its impressive transducer array of 241 computer controlled elements assembled in a sphere, no other system beats its performance. Accuracy is always dependent on the beam width, and the active area of a transducer gives HiPAP 502 the best accuracy in the market. The HiPAP 502's spherical transducer allows the system to form narrow listening beams of 10° for reception of signals from the transponder.



HAIN Subsea

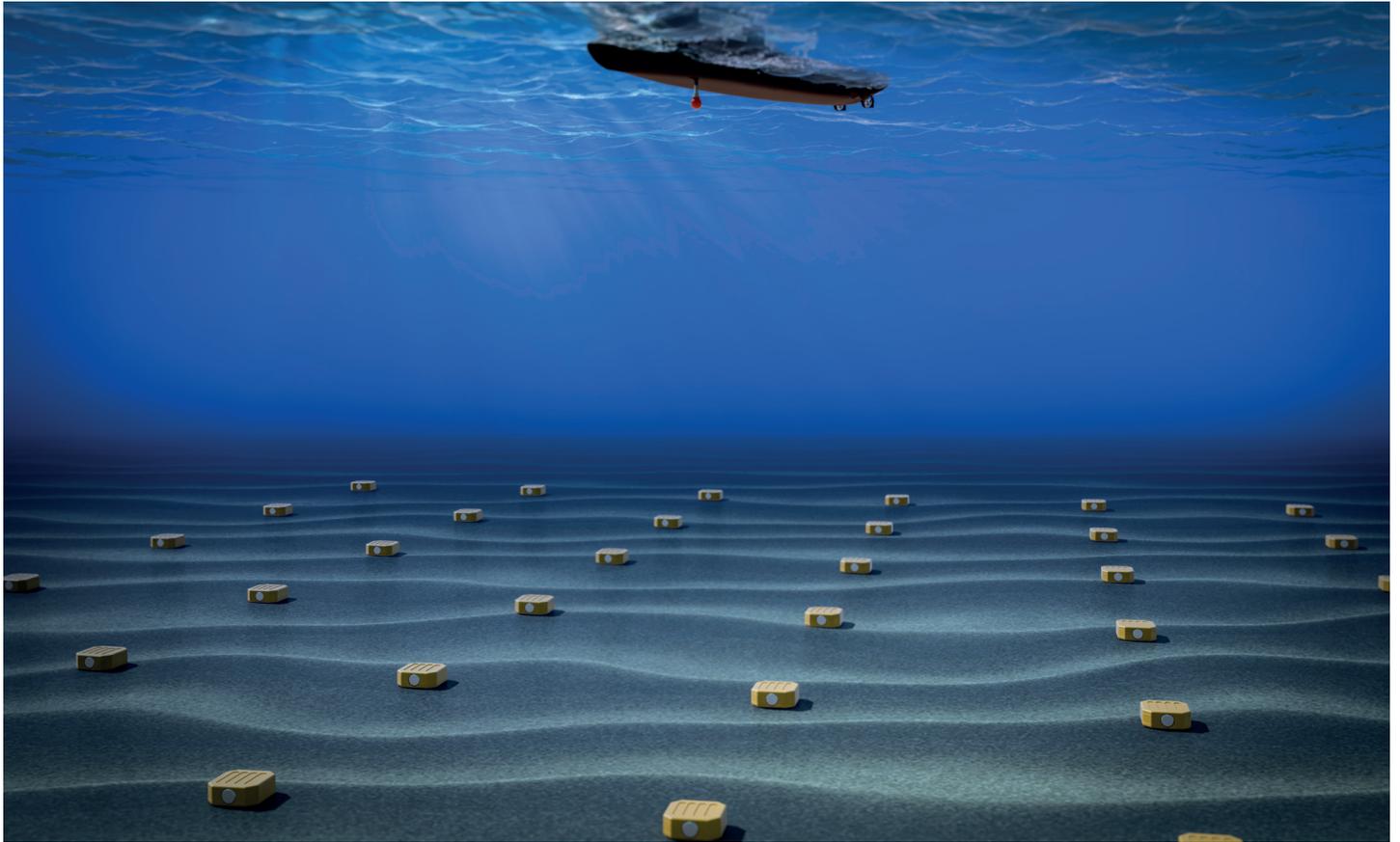
HAIN Subsea combines in an optimum way the HiPAP® acoustic measurements and the readings from the IMU (Inertial Motion Unit) and additional sensors onboard the ROV and/or towed body. The navigation equations update the ROV and/or towed body position, velocity, heading and attitude almost continuously. The topside software corrects these values when new acoustic positions and readings from the other sensors are available. This gives improved position accuracy compared to the acoustic measurements and higher update rates.

cNODE®

Transponders for HiPAP®

The various transponder models have different depth rating, source level, lifetime, beam pattern, size and functions. The transponders can be used for both positioning and data telemetry purposes. The acoustic telemetry can typically be values from internal or external sensors, or even function as transparent modem with data from external serial lines. Hundreds of unique transponder channels are available. The transponder technology can also be delivered as OEM modules for in-built in customers design.



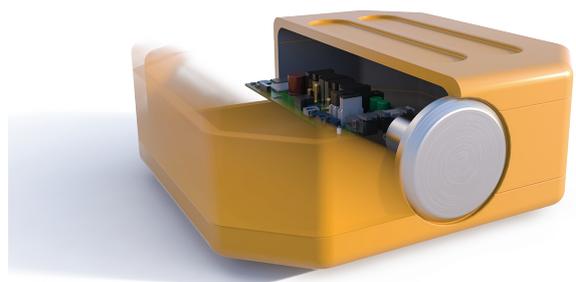


cNODE[®] transponder technology from KONGSBERG for positioning of your seismic seabed nodes

The well proven cNODE technology is supported by the industry standard HiPAP[®] underwater positioning system delivered by KONGSBERG.

Several hundred sailing vessels in the offshore fleet have the HiPAP system installed onboard. By choosing the cNODE transponder technology from Kongsberg Maritime, you will be able to select from a large pool of vessels which support positioning of, and communication to, your nodes.

Not only does the HiPAP / cNODE combination provide WORLD CLASS positioning accuracy, but it also supports the hydroacoustic modem functionality. This allows for you to communicate and interact with your nodes as well as collecting samples of your survey data while the equipment is deployed.



EA 600

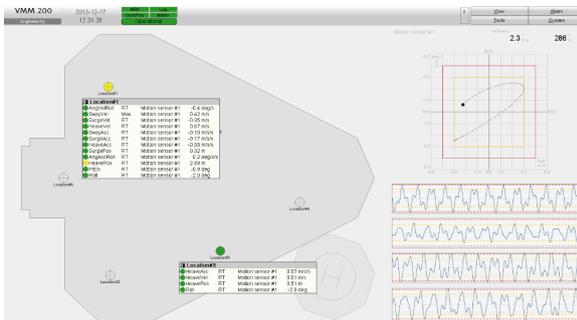
- single-beam echosounder



For safe navigation and as a true reference when processing gathered seismic data correct depth is essential. The operation of four frequencies simultaneously, combined with the installation of transceivers close to the transducers results in an improved performance. Available frequencies span from 10 to 500 kHz. FM pulses now allows for high resolution soundings even at long ranges. A variety of highly efficient transducers is available to suit all operational needs from very shallow water to a depth of 11.000 meters.

VMM 200

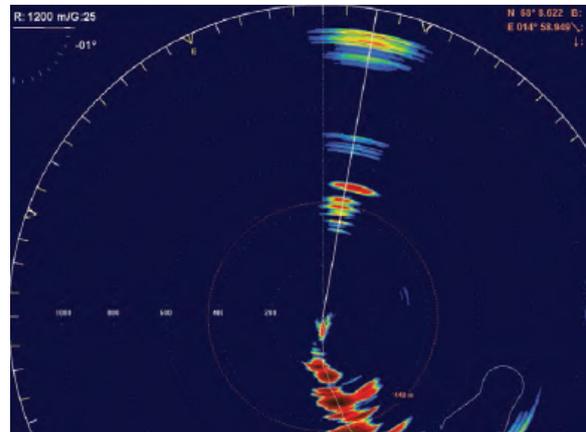
- Vessel Motion Monitor



The Vessel Motion Monitor is a novel and sophisticated vessel motion monitoring solution from KONGSBERG, set to improve the safety and efficiency of operations where accurate vessel motion data is critical. This unique attitude determination solution is the first of its kind and is made possible through decades of experience from demanding offshore marine operations. The VMM 200 is a decision support tool for marine operation like light well intervention, offshore crane operations, module handling on deck, and launch & recovery operations.

Marine mammal activity

Mitigation measures for the protection of marine mammals is in many areas mandatory for seismic operation. By utilizing the Whale Sonar from Kongsberg Maritime, the vessel will meet local restrictions and requirements. The sonar offer long range performance using advance wide band transducer design combined with digital transmitting and receiving technology. A frequency modulated (FM) transceiver with special filters enhances fish/whale detection and definition under difficult conditions, while extending the detection range.



Positioning

Vital in 3D and 4D seismic is the ability to have accurate positioning of the vessel. With a roll/pitch accuracy of 0.01°, utilisation of available GNSS infrastructure and PFreeHeave™, the Seapath® family offers a unique solution for operations in challenging environments. The possibility to use all available GNSS (GPS/GLONASS/Galileo/Beidou) significantly increases system availability, provides robust integrity monitoring and result in more precise solutions, particularly in heavily obstructed areas.



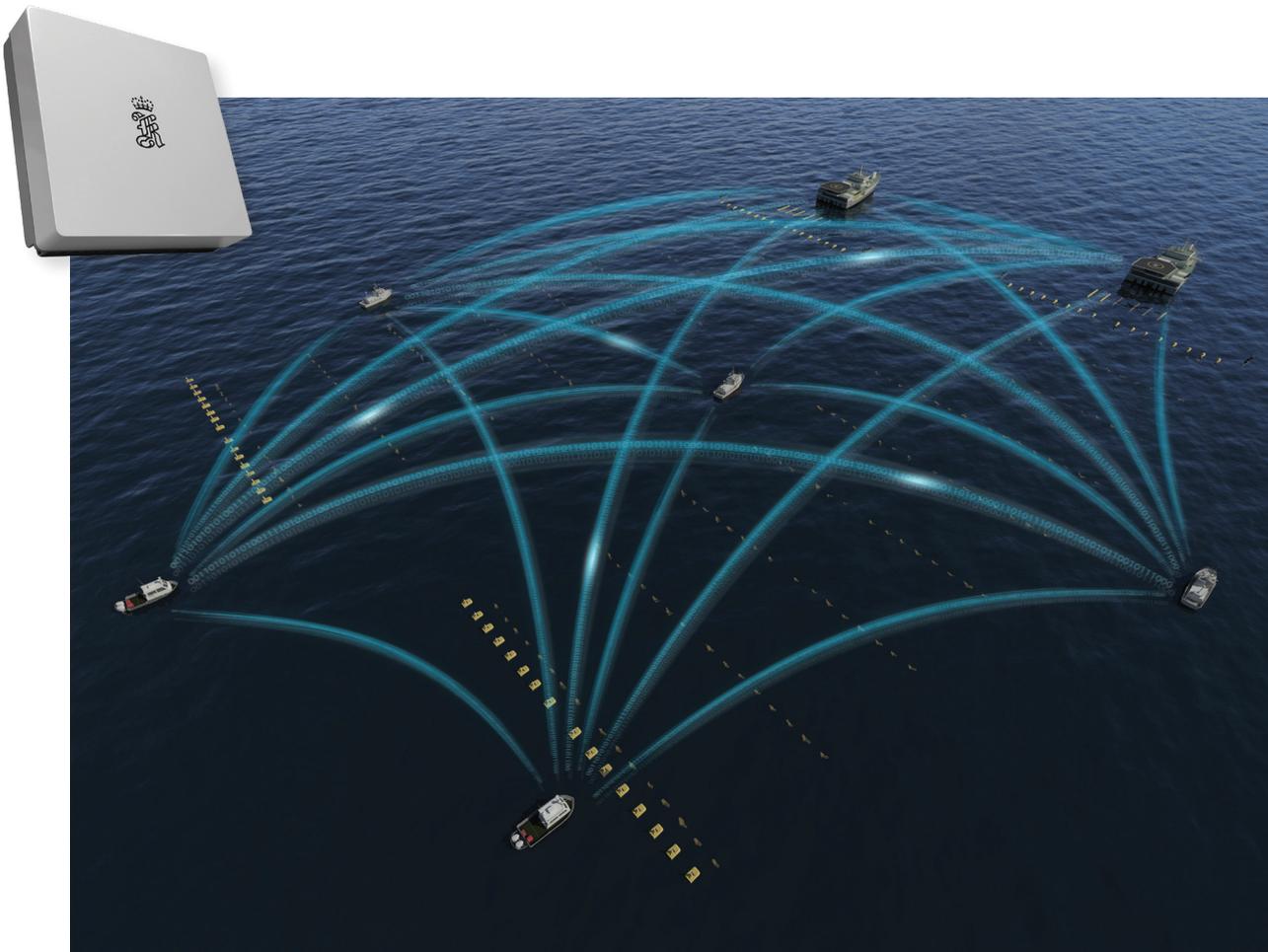


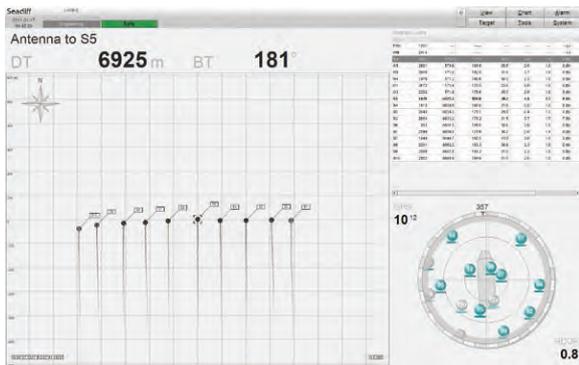
Helideck monitoring

The Helideck Monitoring System is used to monitor motion and meteorological conditions on the helideck to improve safety in hostile weather conditions. The HMS monitors attitude and vertical velocity, wind speed and direction, air temperature and barometric pressure as well as humidity to indicate landing conditions. The HMS is typically used offshore on floating production and storage vessels (FPSO) and seismic vessels, and meets all prevailing regulations from civil air traffic authorities.

Connecting seismic operations

A seismic vessel needs to communicate with its workboat for safety and operational reasons and the Maritime Broadband Radio (MBR) will provide a broadband data link for use to different sources/applications for everyday use. Large wide- and multi-azimuth operations will also benefit from the robust broadband communication channel. Unlike satellite, Wi-Fi or mobile network platforms, MBR requires no extra infrastructure or equipment beyond the units on participating vessels/assets. This makes it a simple to use and maintain solution for enhancing overall project efficiency in seismic operations.





Seadiff tracking for Seatrack

An unlimited number of GPS pods can be tracked simultaneously by utilizing the TDMA (Time Division Multiple Access) protocol. The Seadiff soft- and hardware package receives data via the VCU from the GPS pods and calculates position for each pod.



Efficient spread handling and control

KONGSBERG offers a wide range of proven applications and solutions to secure effective spread management.

eBIRD® - REDEFINING LATERAL CONTROL

eBird is unique in seismic operations with its ability to control lateral position of the streamer in addition to vertical position and roll orientation. eBird is a bird for lateral, vertical and roll streamer control in marine seismic acquisition. This enables the surveyor to have positive control of streamer roll orientation, depth and separation during the whole operation, including deployment and retrieval.

The increased accuracy of the streamer shape will enhance acquisition of data and even give the possibility to replicate streamer shape for later survey of the same area for better to compare data. Survey is less limited of weather conditions when it comes to currents and streamer aspect angles. The time to turn the seismic surveyor may be reduced and conducted in a safer way. These elements results in a safer and more cost-effective operation.

NOVEL TECHNOLOGY

The eBird is equipped with robust and advanced steering devices ensuring continuous operation for all types of streaming cables. The innovative implementation of technology with no connector between body and wings makes the eBird robust for all operational conditions.

EASY DEPLOYMENT AND RETRIEVAL

The eBird is made of titanium to gain high tensile strength as well as extraordinary corrosion resistance. The wings are easy to connect and disconnect for an efficient deployment and retrieval of the seismic cable. The eBird body is short and slender to avoid any damage when winding up and off the streamer drum.

ACUWING®

AcuWing represents a novel approach to streamer positioning by adopting the latest and proven technology within hydroacoustics to interchangeable eBird wings. eBird's elegant connector-less solution enables AcuWing to quickly and easily replace any wing on a standard eBird and utilize the same power and communication lines.

By adapting the eBird design, the AcuWing yield minimal hydroacoustic noise during operation.

The number of acoustic nodes are selectable and flexible, and the AcuWing forms a total position reference solution together with the acoustic nodes on tailbuoys, deflectors and source.

HYDROACOUSTIC POSITIONING FOR MARINE SEISMIC STREAMER CONTROL

KONGSBERG has developed several new products for placement onto desired locations within a seismic streamer spread, for accurate and reliable positioning of source-arrays, deflectors, front and tail buoys. In combination with the well proven eBird and AcuWing, this provides an even clearer picture of a seismic spread from onboard the vessel. The calculated positions and shape of the spread is displayed on the SPOS (Streamer Positioning Operator Station) computer which also can forward the information to external equipment.

SEATRACK FOR TAILBUOY POSITIONING

Seatrack has over the years evolved to be the de-facto standard solution for tailbuoy positioning and tracking. Thousands of Seatracks has been deployed world-wide, and has proven its excellence as vital tool in seismic streamer positioning.

By utilizing GNSS infrastructure, sub-meter accuracy can be obtained in high-precision mode. Also all development of Seatrack is backward compatible making it easy to upgrade Seatrack units when necessary.

The environment on a seismic source is extremely challenging for all types of electronics. Repeated firing of the air guns may cause high-energy shocks of more than 50G with 10 ms duration. The Seatrack solution from KONGSBERG is specially designed to with-stand this harsh environment.

Mechanical protection is not enough. Shocks of more than 20G will normally cause temporarily loss of lock of the GNSS satellites. This ruins position accuracy especially when using carrier phase measurements of RTK. A damping method reducing the high-energy shock exposure of the GNSS antenna and receiver by more than factor of 2.5 has been developed. This enables the Seatrack GNSS receiver to continuously maintain track, even during firing of the air guns.



Automatic handling system for seismic vessels

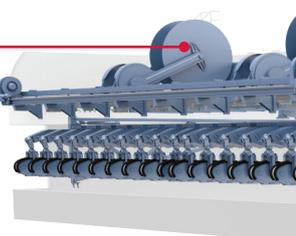
KONGSBERG's innovative, automated handling systems for seismic vessels are the most reliable on the market. Over the years, these handling systems have continuously improved the efficiency and safety of seismic operations and have become industry standards.

We have widened the operational window, reducing time lost due to rough weather conditions and boosting profitability significantly. Our equipment simply works when you need it. This is part of our focus on providing reliability for our customers.

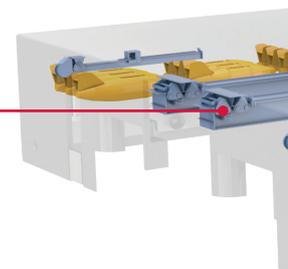
We are involved throughout the value chain of seismic systems and are engaged early in the design of seismic handling systems. We collaborate closely with customers to design the ship's entire aft deck, developing comprehensive solutions to the specified needs of each vessel.

Our automated handling concepts are made up of unique components, all of which are designed and delivered by Kongsberg Maritime. Hydraulic and electric streamer winches provide gentle and sensitive handling of streamers, with drum capacities to cover all length requirements. These are complemented by source and deflector handling systems, fairleads and the wide tow system. The result is cutting-edge solutions that strengthen the efficiency of the vessel – and create a safer ship for the crew. For example, our control system – a result of decades of experience in developing such systems – allows operators to direct and synchronize all winches, streamers and auxiliary equipment by remote control. This user-friendly system, which features automated spooling, reduces the need for risky manual handling on the aft deck.

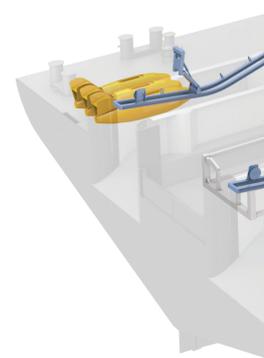
As well as streamer and source handling systems for 2D and 3D seismic survey, we provide handling systems for ocean bottom seismic vessels, both cable and node technology. In addition also solutions for electromagnetic surveys.

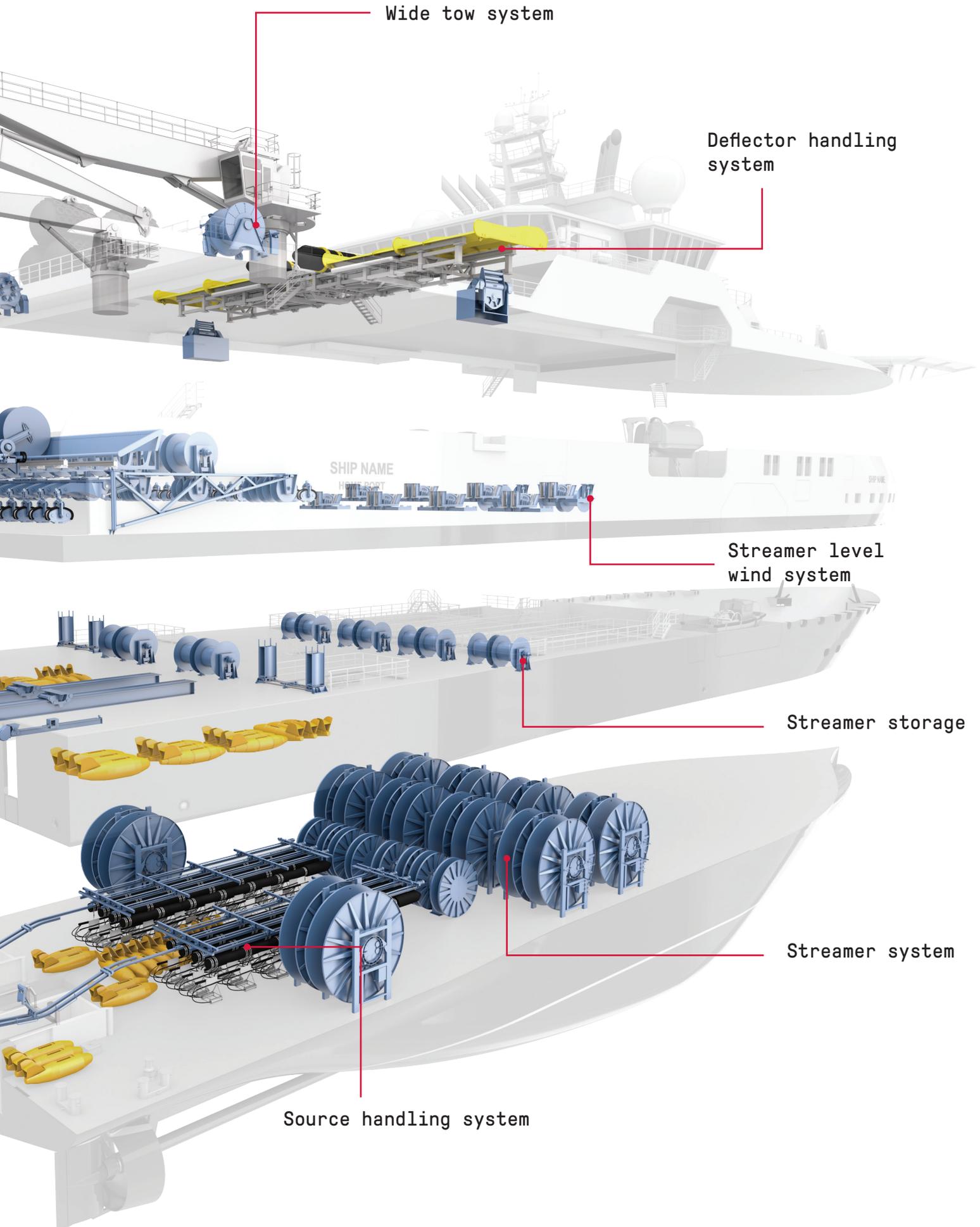


Transverse storage system



Work boat LARS





Wide tow system

Deflector handling system

Streamer level wind system

Streamer storage

Streamer system

Source handling system



Seismic vessel design

The UT range of seismic vessels provides fuel efficient designs for the whole range with excellent seakeeping capabilities and optimized arrangements.

KONGSBERG MARITIME PROVIDE SHIP DESIGN FOR:

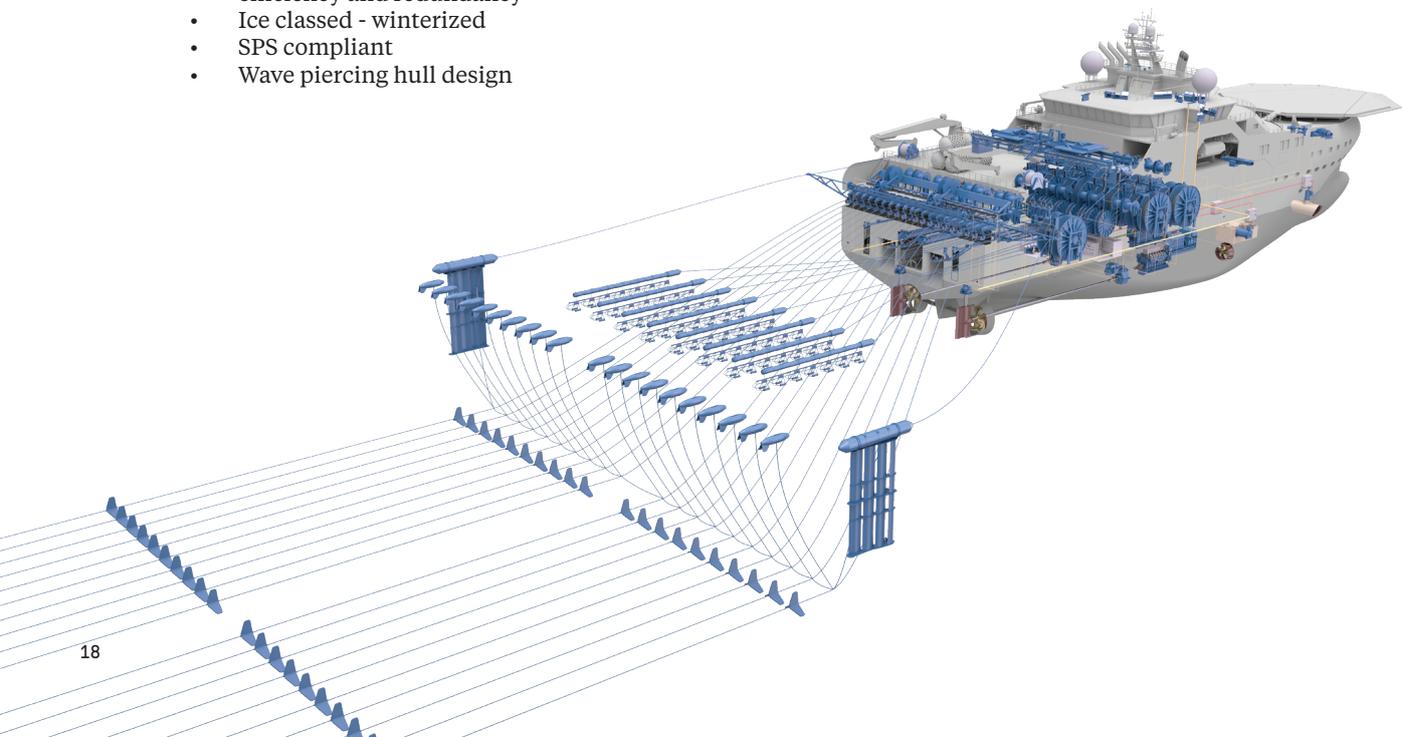
- Towing seismic - 2D and 3D streamer vessels
- Electromagnetic seismic vessels
- Seabed node seismic vessels
- Ocean bottom seismic vessels
- Seismic Support Vessels

UT 833 WP

Length: 110.00 m
Breadth: 26 m/28 m
Capacity: 20 streamers

WITH THE FOLLOWING CAPABILITIES:

- Underwater radiated noise acc to DNV Silent-S
- Hybrid propulsion systems - for optimum fuel efficiency and redundancy
- Ice classed - winterized
- SPS compliant
- Wave piercing hull design



MACHINERY CONTROL

MACHINERY PLANT WATCH-KEEPING

The K-Chief automation system improves watch-keeping of the machinery plant. From operator stations in the engine control room the engineer on watch has excellent overview of the power plant, propulsion machinery and other auxiliary machinery systems.

OUTSTANDING RELIABILITY

The distributed and redundant technology provides outstanding system reliability and availability for both the machinery and the power plant. Unique operational functionalities enable optimum operation of the machinery and therefore reduced fuel consumption. By combining the distributed technology and the unique functionalities - safety, efficiency and lower operational costs are provided for.

SAFE POWER GENERATION

K-Chief power management system is a complete switchboard and generator control system. It handles various configurations of generators driven by diesel engine, steam turbine and main engine in combination with switchboards of various complexities.

The K-Chief power management system ensures that the power capacity is in line with demand at any time, avoiding black-outs and minimizing fuel consumption. K-Chief power management system provides high redundancy and segregation, as well as blackout prevention features yielding stable power supply without interruption.

OPTIMIZING VESSEL PERFORMANCE

Tools for data recording, trending, reporting and analysis are available. The engineers may combine historic data from machinery systems and compare different operational conditions to analyze power consumption and fuel optimisation.



PROPULSION AND THRUSTER CONTROL

The K-Thrust propulsion and thruster control provides remote control of electrical and mechanical propulsion systems, azimuth and side thrusters. Each propeller is controlled by an autonomous control system, either as a stand-alone solution or integrated to our K-Pos dynamic positioning and K-Chief alarm, monitoring & control system:

- Non-follow up by pushbuttons
- Follow-up by levers or steering-wheel
- Manual lever control – individual or synchronised operation
- Joystick interface
- Autopilot interface
- Integrated to DP



EASE OF OPERATION

Thruster command levers and thruster control systems provide status indication. They are combined with buttons for emergency stop and manual command override capabilities.

- Ergonomic shape for tactile orientation
- Command indication displays
- Immediate access to safety and override functions

Touch sensitive displays for easier user interaction, used to manage information presented on the workstation displays.

- The new design replaces individual control panels for separate sub-systems
- There are two panels, both for redundancy and for simultaneous access to multiple sub-systems
- User interaction is simplified as there is no need for a pointing device

NAVIGATION - DESIGNED FOR EFFICIENCY AND SAFETY

Kongsberg Maritime has a long and distinguished pedigree in the design of bridge systems that at all times meet and surpass the latest maritime safety standards. Our experience gained down the years has shown us the importance of functional integration and the arrangement of controls and monitoring systems for vessel machinery, navigation and maneuvering.

We recognize that the user interface and an intuitive and harmonized style, look and feel, across sub-systems and functions provide significant advantages for safe vessel operation, all qualities provide for by Kongsberg Maritime.

K-MASTER - A COMPLETE WORKING ENVIRONMENT

With the K-Master bridge solution, Kongsberg Maritime sets a new standard in the integration of navigation, control and maneuvering functions - designed to meet strict bridge ergonomic considerations for the arrangement of working places, instrumentation and the operability of the equipment.

The true integration between the sub-systems makes it possible to provide functions across the sub-system boundaries, such as system wide mode control tailored to the vessel's different types of operation, accessible through a condition based user interface. K-Master provides for a common user interface for all functions accessible, including interactive interfaces for: DP, independent DP joystick, manual thrust control, monitoring and control system, central bridge alarm system, chart radar, conning display and communication devices.

The common user interface is highly intuitive and logical, supported by high-quality graphics and user-centric design, providing effective cues to the functionality and operation of the system and its applications. K-Master is designed to comply with the latest standards and regulations and supports the important work undertaken by the industry to improve safety of operation.





WORLDWIDE OPERATIONS

KONGSBERG is an international corporation with strong Norwegian roots. Collaboration with our customers, partners and suppliers, and a commitment to understand the context where our technology is applied, are important driving forces beyond the corporation's international development and growth.





KONGSBERG

