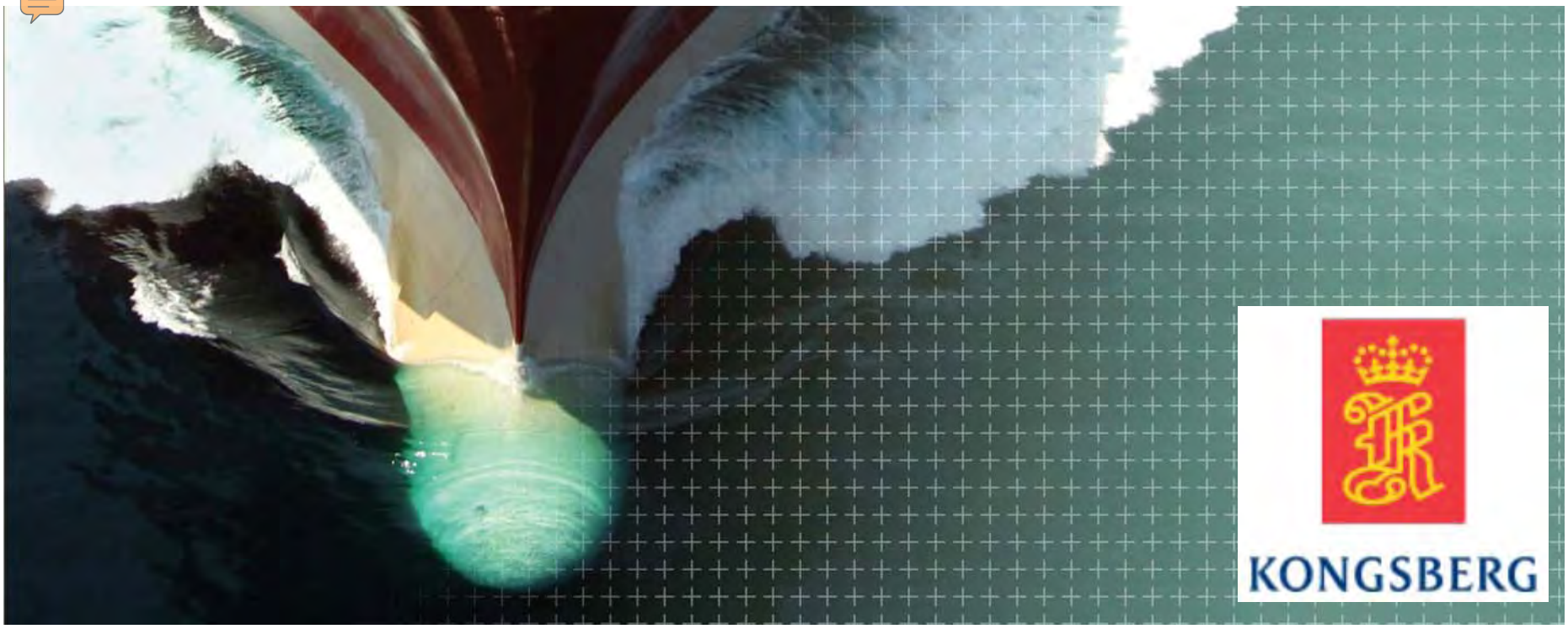


Kongsberg Maritime

"Green Ship" paper at Mari-Tech 2010

Montreal 11 June 2010

Kongsberg Gruppen

Kongsberg Gruppen (KONGSBERG) is an international, knowledge-based group that supplies high-technology systems and solutions to customers engaged in the oil and gas industry, the merchant marine, and the defence and aerospace industries.

Year 2009

Revenue US$2,300,000,000

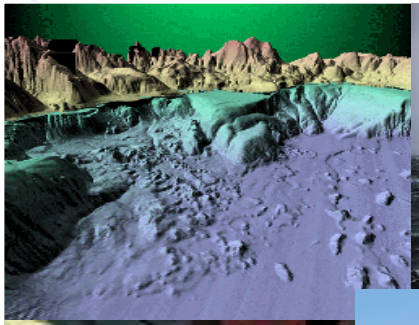
Backlog US$3,300,000,000

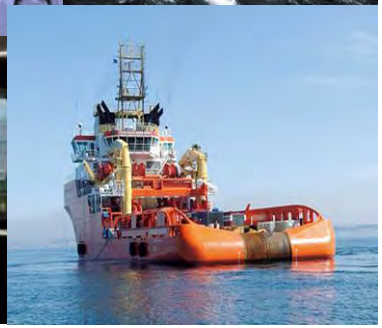
Employees ~ 5,400

Kongsberg Gruppen

Kongsberg Gruppen ASA

Kongsberg Maritime





Kongsberg Oil & Gas*

Kongsberg Defence Systems

Kongsberg Protech Systems

Briefly about **Kongsberg Maritime**

- ~ 3500 employees in 25 countries
- 60 years marine experience (Norcontrol, Autronica, Simrad & Albatross)
- Marine Automation
- Dynamic Positioning
- Navigation
- Cargo Monitoring & Control
- Maritime Training Simulators
- Position Reference Systems
- Hydroacoustics & Sub Sea systems

Dynamic Positioning

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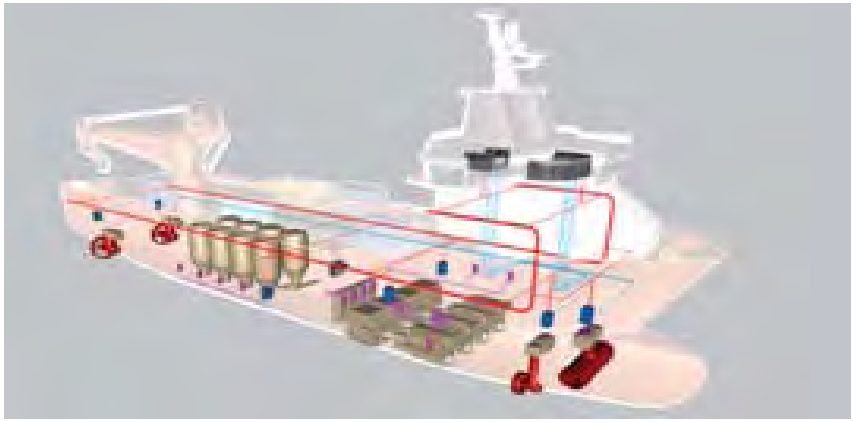

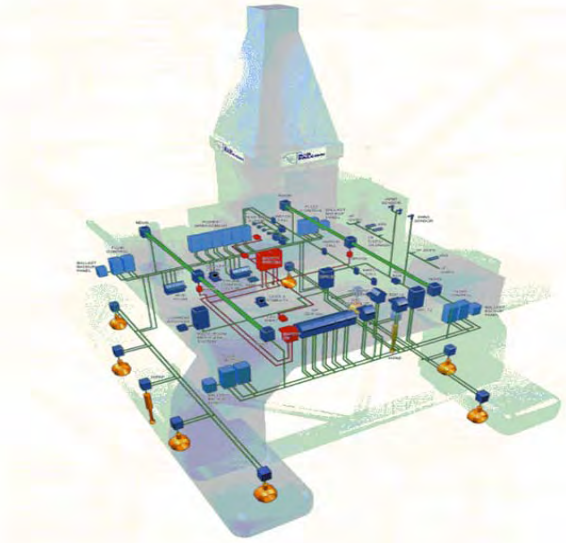

Monitoring & Control

Machinery & Propulsion

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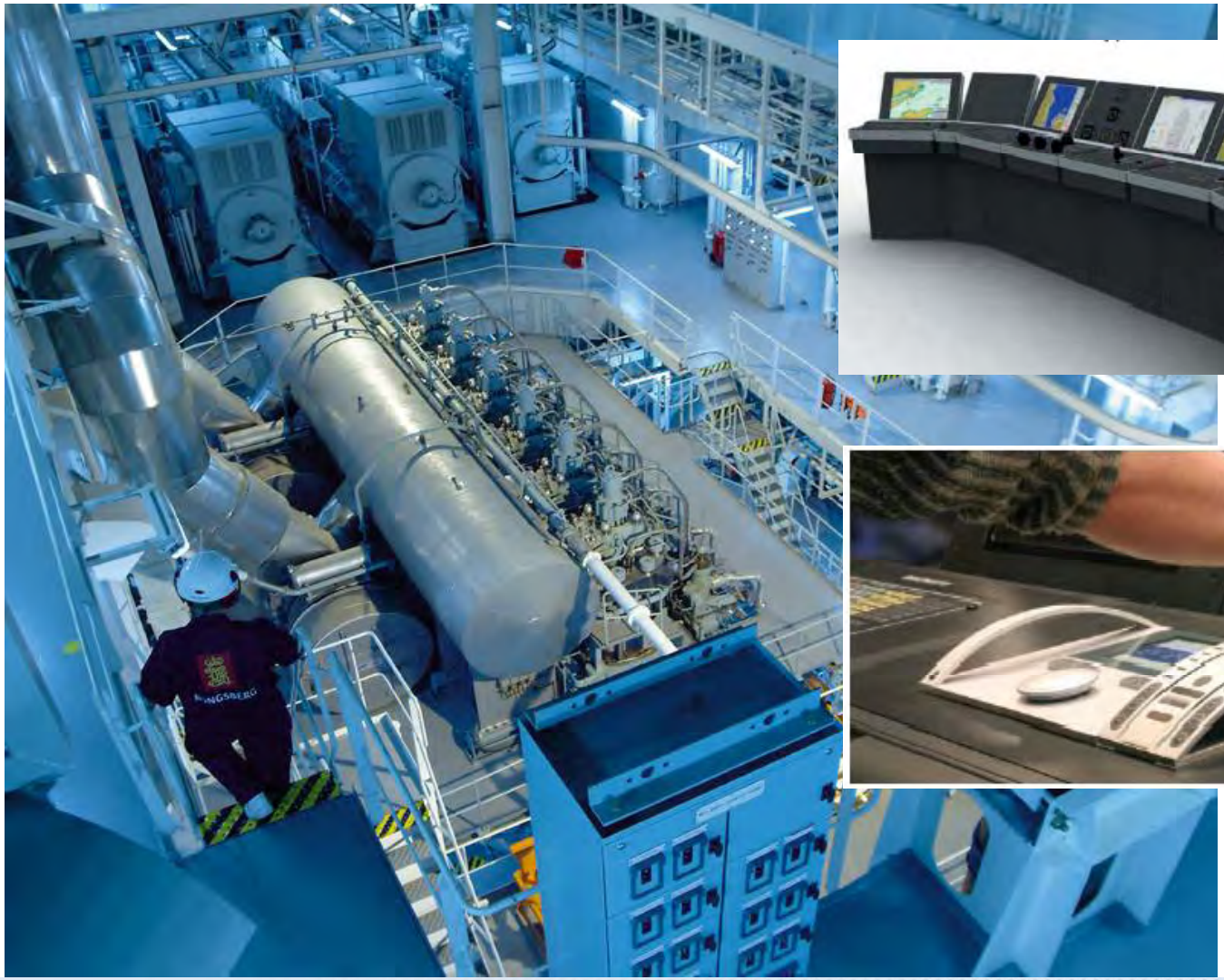
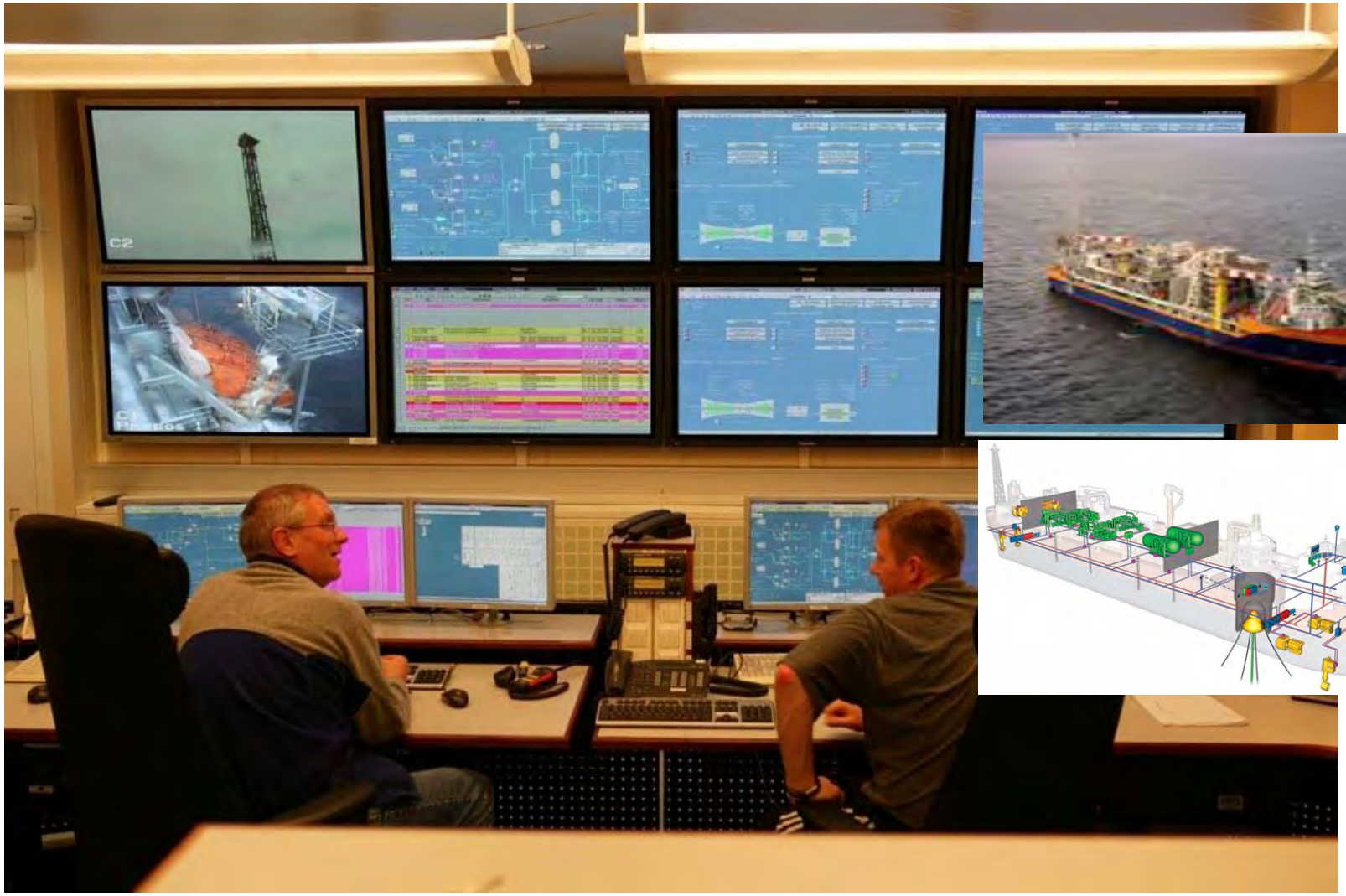


Process automation

KONGSBERG



Ship Simulation

KONGSBERG

Hydroacoustics

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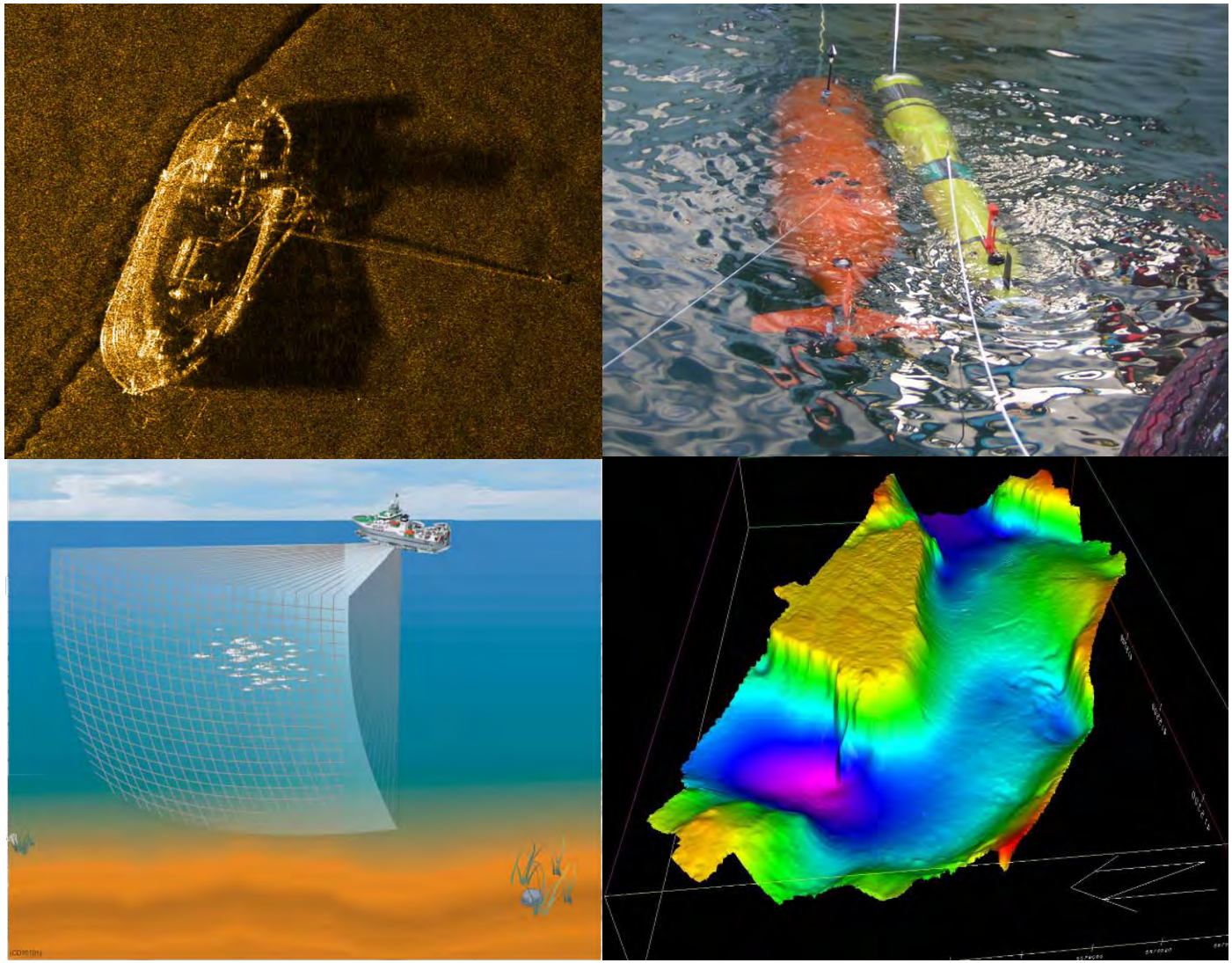


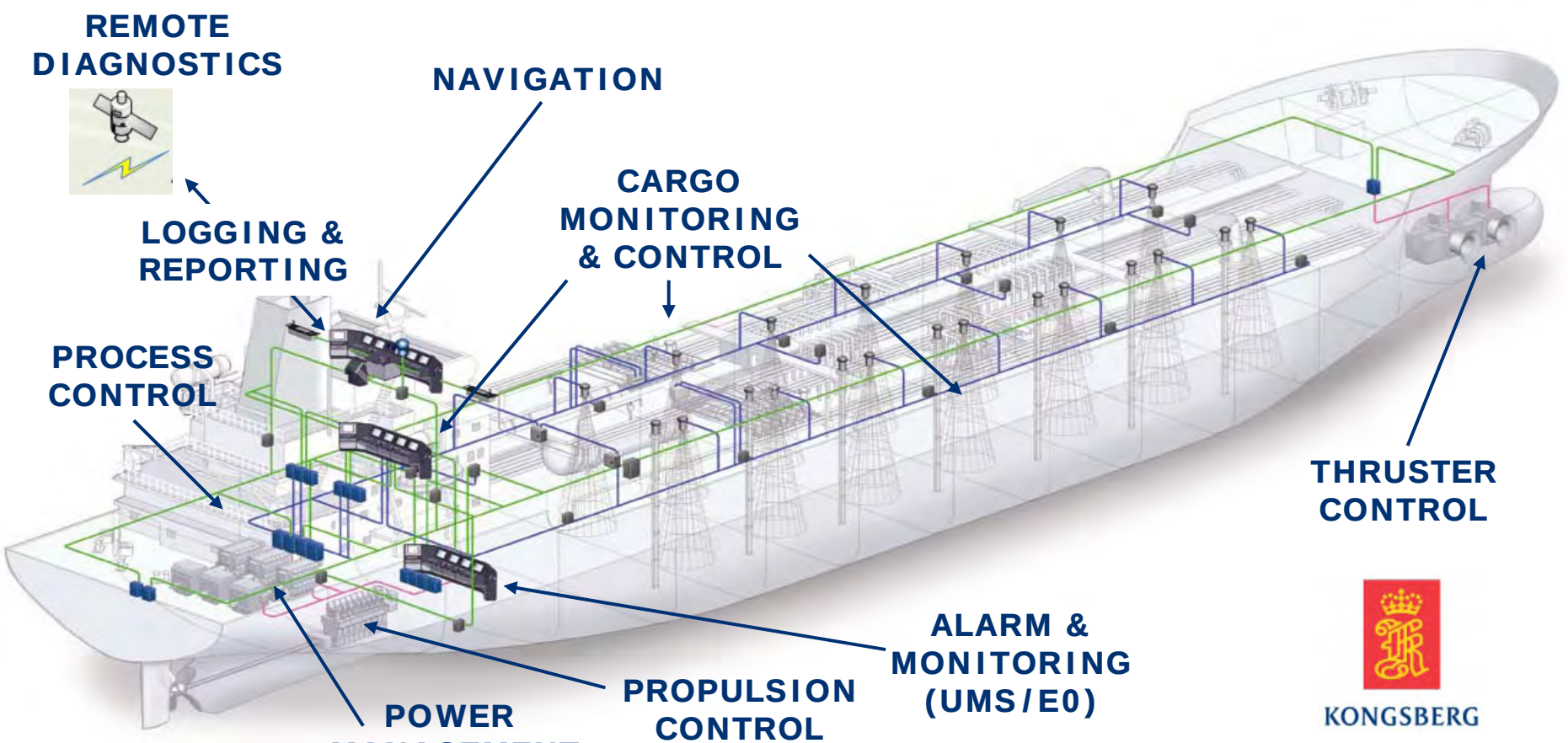
Kongsberg Maritime

- World Wide Customer Support

More than 15 000 Ships

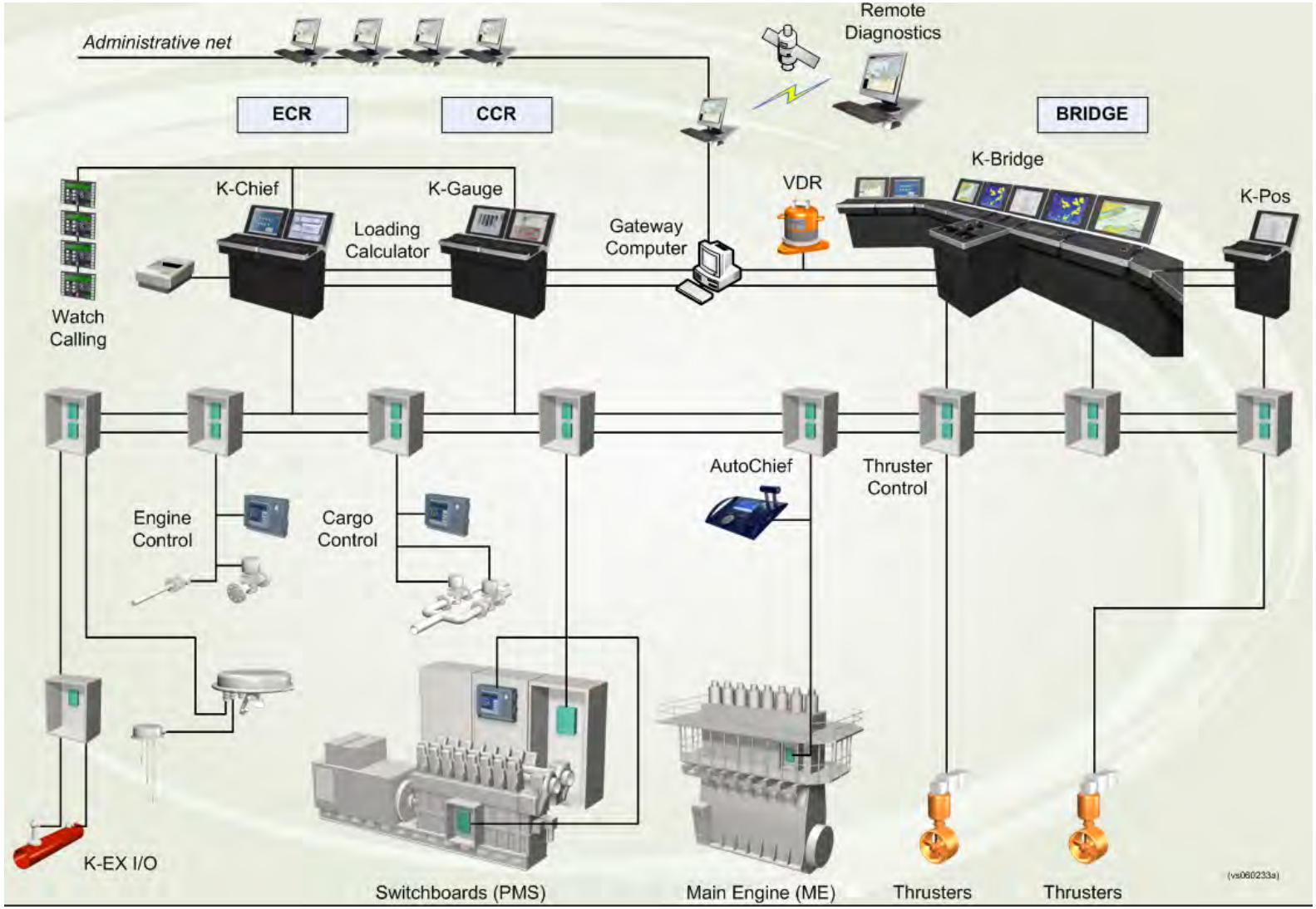
Maximizing marine performance by providing

the Full Picture



KONGSBERG

Maximizing performance by providing the Full Picture



How can Kongsberg contribute to a greener shipping environment?

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the Full Picture

in a Green perspective

- Organizing Control/Monitoring > integrated system
- Operator has **full picture** of onboard machinery condition.
- We cannot revolutionize ship/engine. We can ensure **optimal performance** so vessel is operated in most environmentally friendly way.
- ***Optimize*** directly through automation & indirectly by giving crew tools to control.
- We develop/deliver sensors and systems to give operator in-depth knowledge of machinery condition
- Achieve ***optimization*** with minimal maintenance cost.

the Full Picture

in a Green perspective

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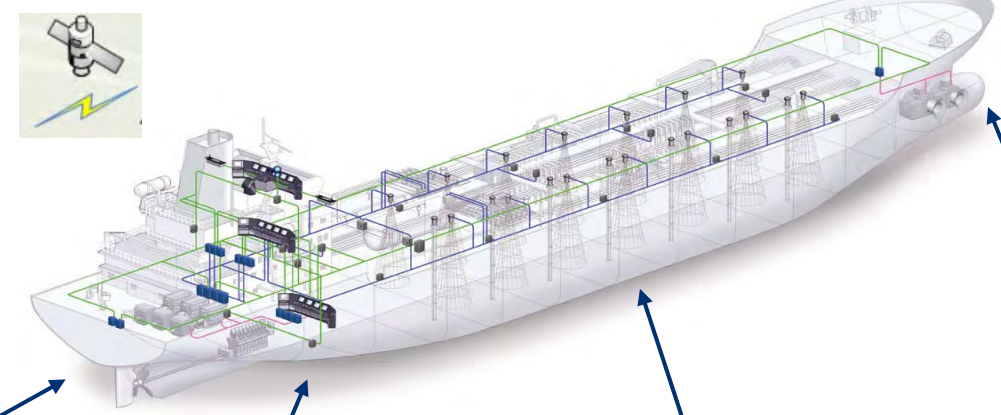
FLEET MANAGEMENT



ENGINE PERFORMANCE

ENERGY PERFORMANCE

HULL PERFORMANCE

NAUTICAL PERFORMANCE

Kongsberg Maritime
Vessel Performance System

- Integrates Kongsberg Maritime products + selected 3rd party applications
- Gives crew & owner “the full green picture” of vessel & onboard machinery
- Modern, future-oriented 3rd party integration = flexible system, adapts to each vessel
- Key elements:

  - ✓ Engine optimization
  - ✓ Fuel oil monitoring
  - ✓ Efficiency monitoring
  - ✓ Power monitoring
  - ✓ Draft monitoring
  - ✓ Trim monitoring
  - ✓ Voyage planning
  - ✓ Reporting

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Engine Performance and Optimisation

Engine Performance and Optimization

- Measuring points

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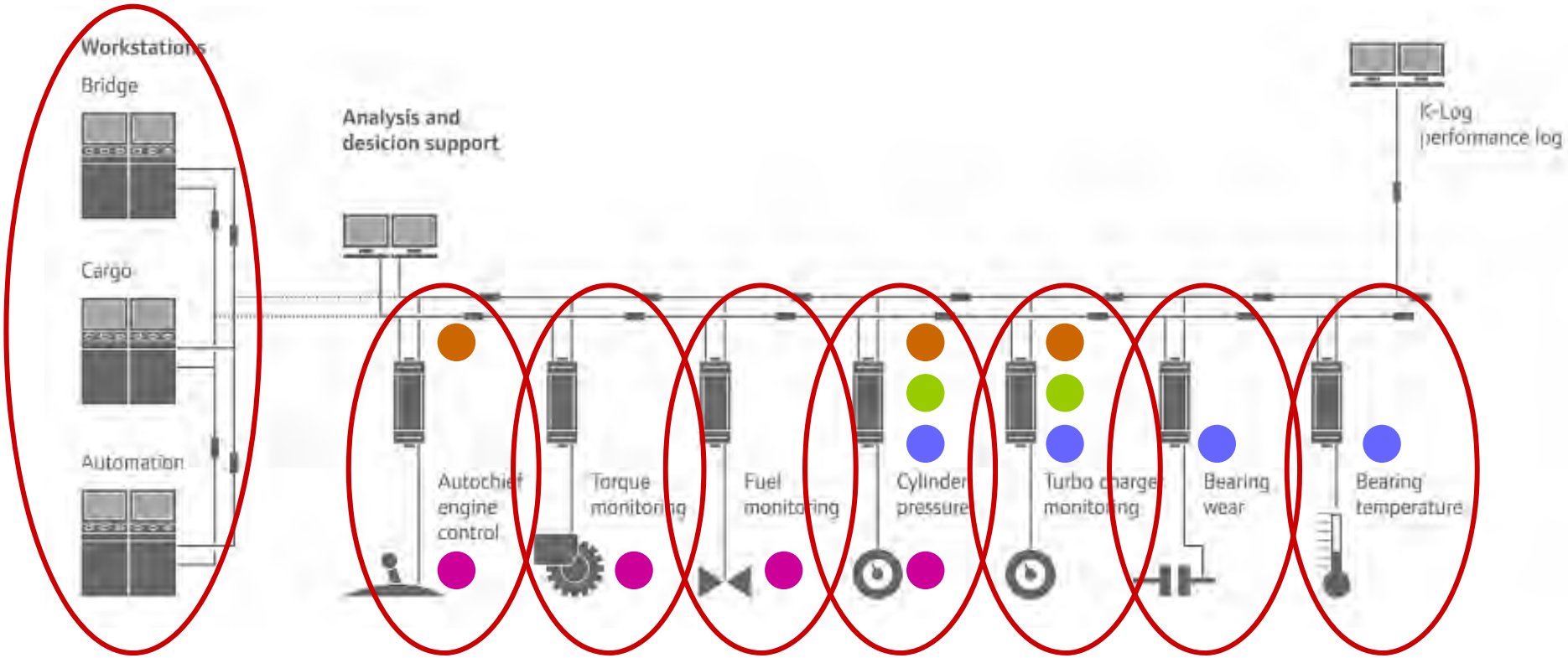
- Fuel efficiency
- Reduced emission
- Condition monitoring for predictive maintenance
- Data for performance calculation

Optimization guidance



Engine Performance and Optimization

- Performance Monitoring Display (K-Chief 600)

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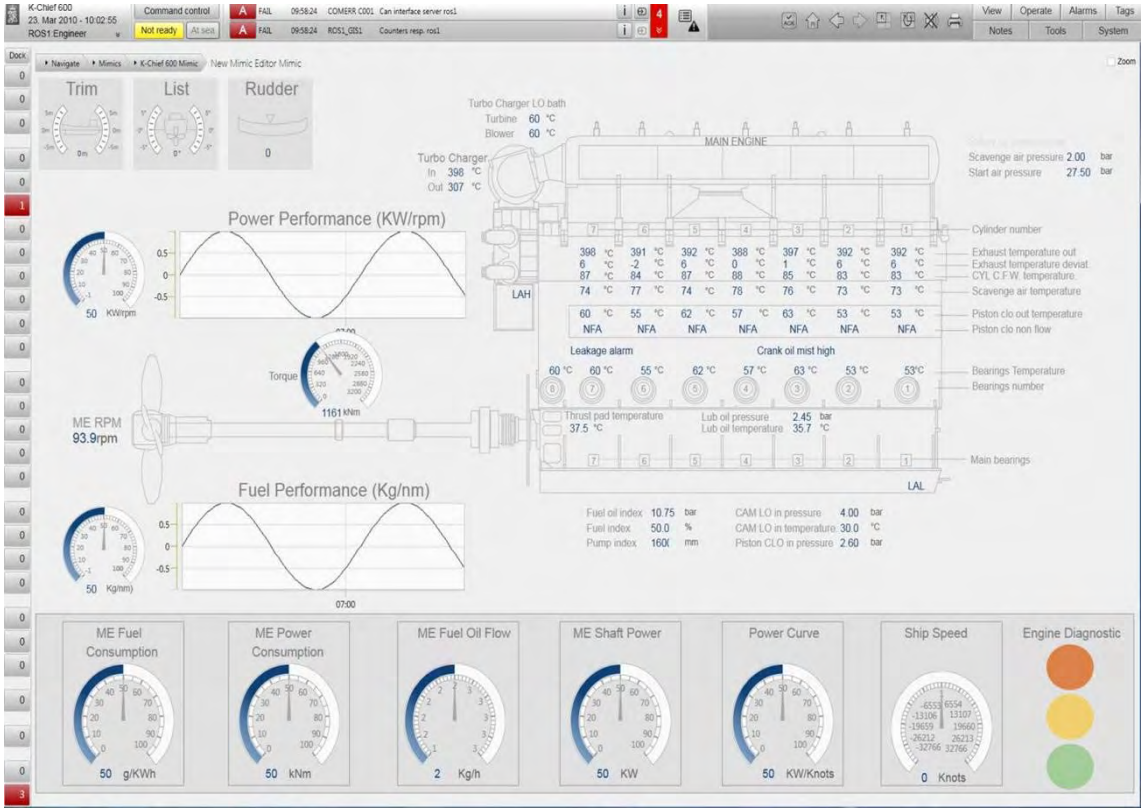
- ✓ Power Performance (kW/rpm)
- ✓ Fuel Performance (kg/nm)
- ✓ Fuel Consumption (g/kWh)
- ✓ Power Consumption (kNm)
- ✓ Fuel Oil Flow (kg/h)
- ✓ Shaft Power (kW)
- ✓ Power curve (kW/knots)
- ✓ Aux engine Fuel Oil Flow(kg/h)
- ✓ Cylinder Lub oil Flow (kg/h)
- ✓ Propeller slip (%)
- ✓ Other information (on request)



Engine Performance and Optimization

- Flexible and informative user views (K-Chief 600)

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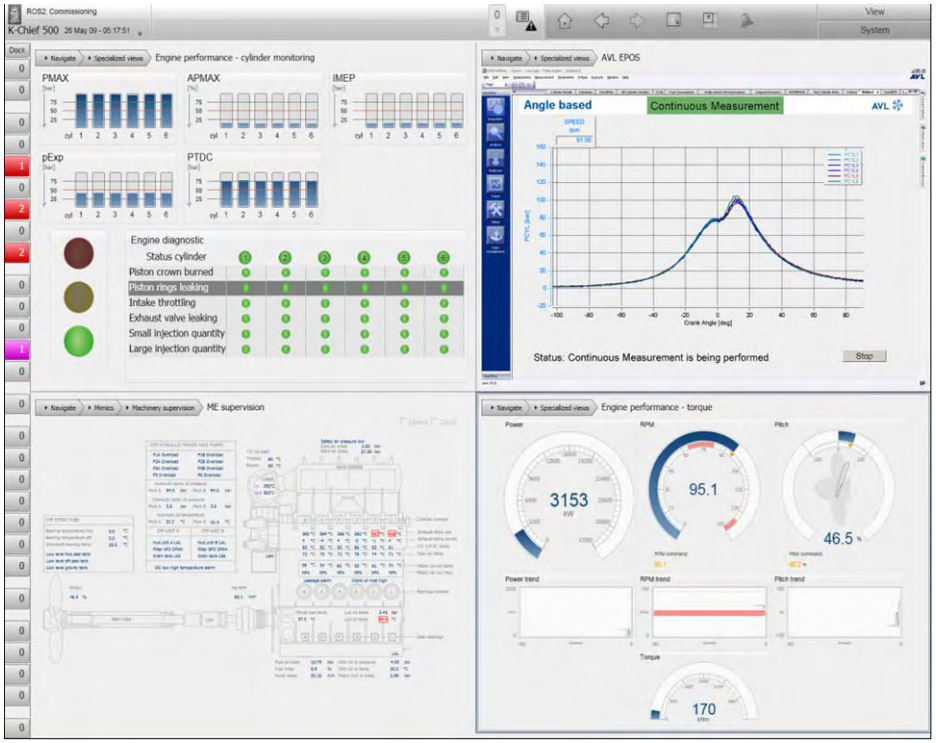

Day view

Night view

Engine Performance and Optimization

- Propulsion Control System (AutoChief C20)

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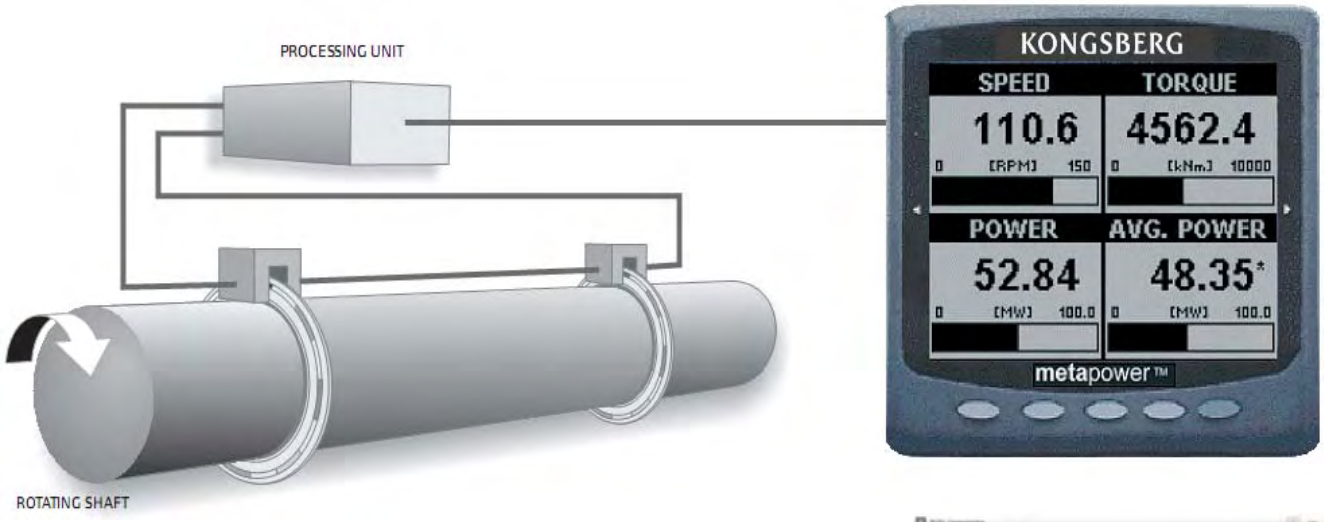
Engine Performance and Optimization

- Shaft Torque Measurement (MetaPower)



Advantages compared to conventional methods

- No sensitive electronics glued to shaft
- No mechanical wear
- No zero point drift over time
- Not affected by ambient temperature variations
- Easy to re-install

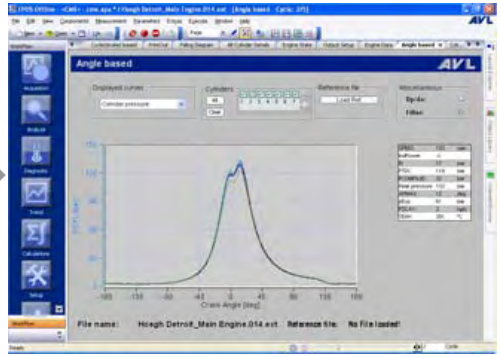
Service free operation

Engine Performance and Optimization

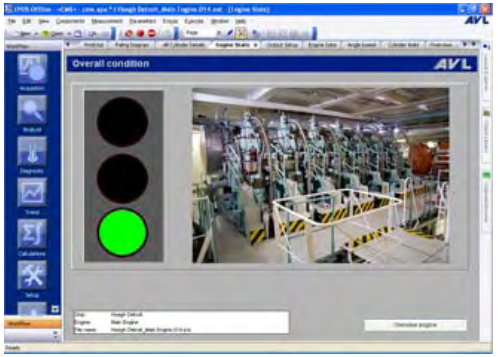
- Cylinder Pressure Measurement

- Continuous monitoring of cylinder pressures
- Diagnostic algorithms based on engine know-how & validated empirical results
- Provides the tool and guidance for engine tuning and optimization
- Sensor and diagnostic algorithms developed by AVL software integrated in K-Chief 600 and operated from the Remote Operation Stations

Monitoring



Analyses & diagnosis



Decision support

Engine Performance and Optimization

- Condition Monitoring Sensors

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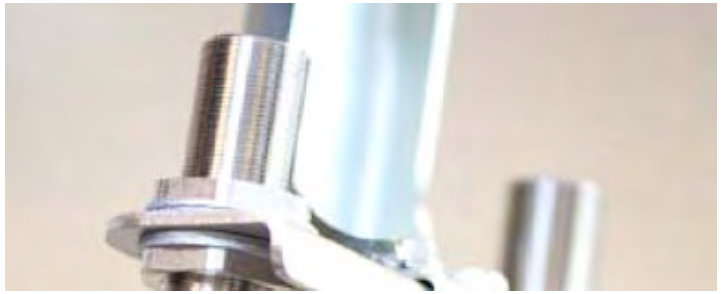
Bearing Wear Monitoring



MetaPower - Shaft Torque Monitoring

Bearing Temperature Monitoring

SENTRY – Wireless Temperature Monitoring

Water in Oil Monitoring

Liner Scuffing Control

Engine Performance and Optimization

- Summary

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- Continuous observation of engine performance
- Early detection of potential wear, failures or damages
- Decision support - assist crew in optimal engine adjustment
- Reduced fuel consumption – less emission
- K-Log is prepared for emissions report (e.g. Sox, Nox).
- Fleet-wide data base enables fleet bench-marking

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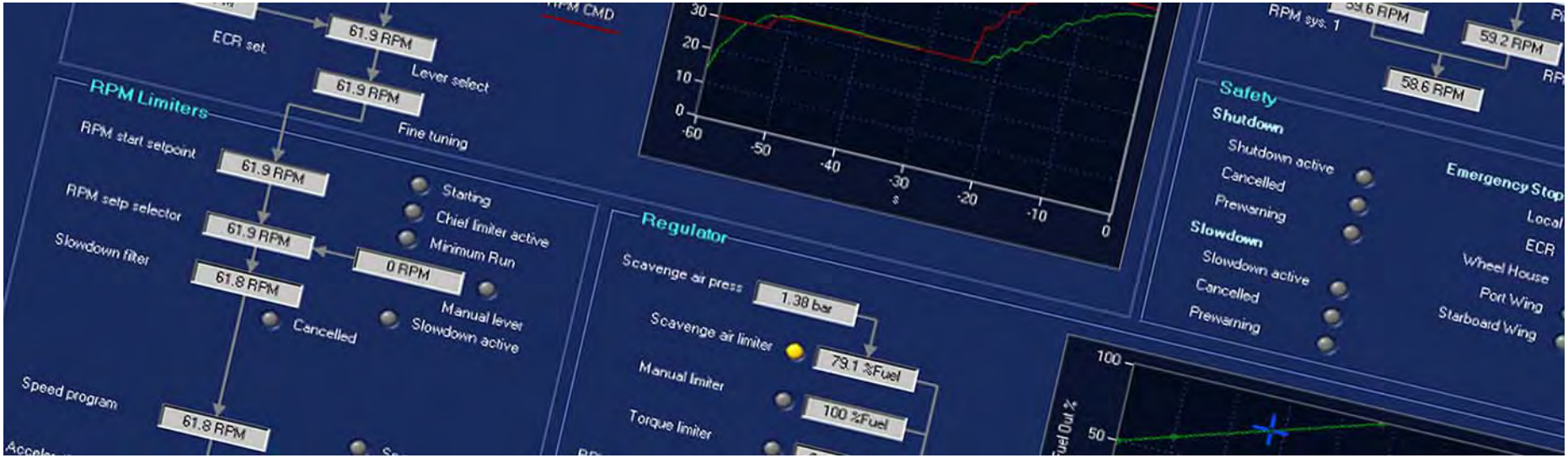
Energy Performance & Management



Energy Performance & Management

- Fully integrated in K-Chief 600

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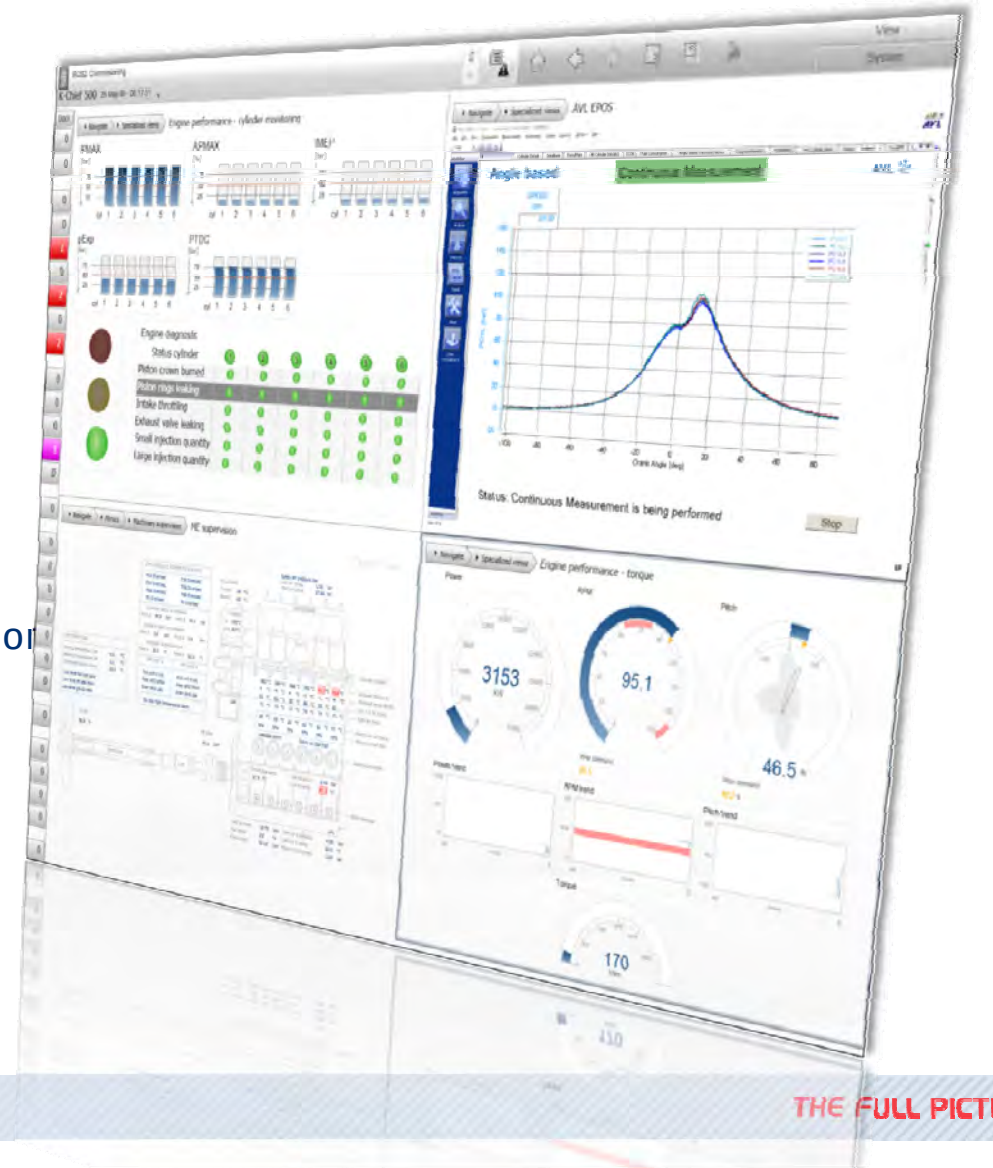
- ✓ Advisory Functionallity
- ✓ Emission Supervision
- ✓ Decition Support
- ✓ Server for 3rd Party Applications
- ✓ Fuel Manager
- ✓ Trim\List
- ✓ Propulsion
- ✓ Engine Performance & Optimizatior
- ✓ Turbo Charger Monitoring



Engine Performance and Optimization

- Fuel Oil Effiency

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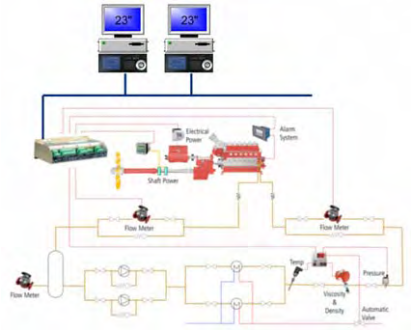
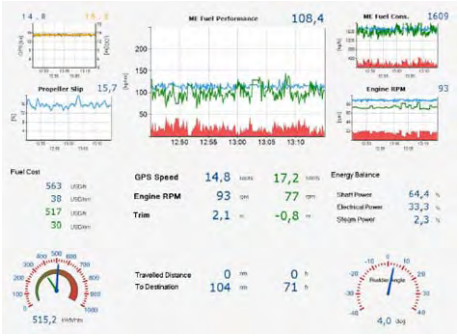
Calculation for Main engines, Auxiliary engines, Boilers, etc.

- Fuel consumption, cost, efficiency
- NOx, SOx, CO2
- Decision support
- Reports



Monitoring

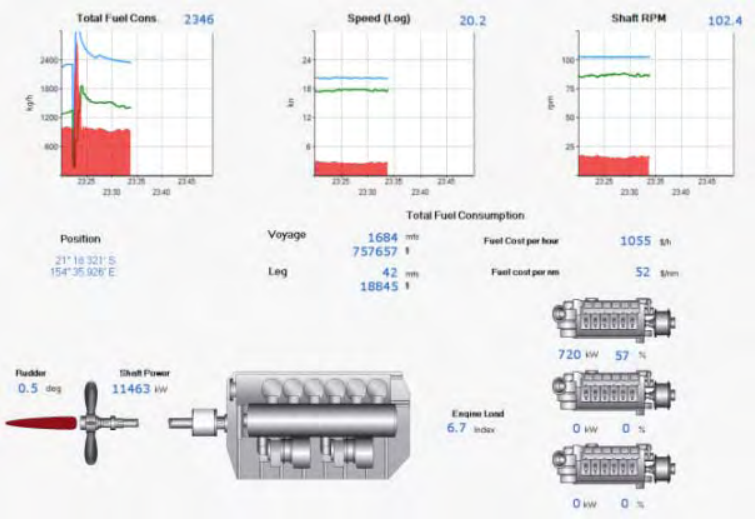


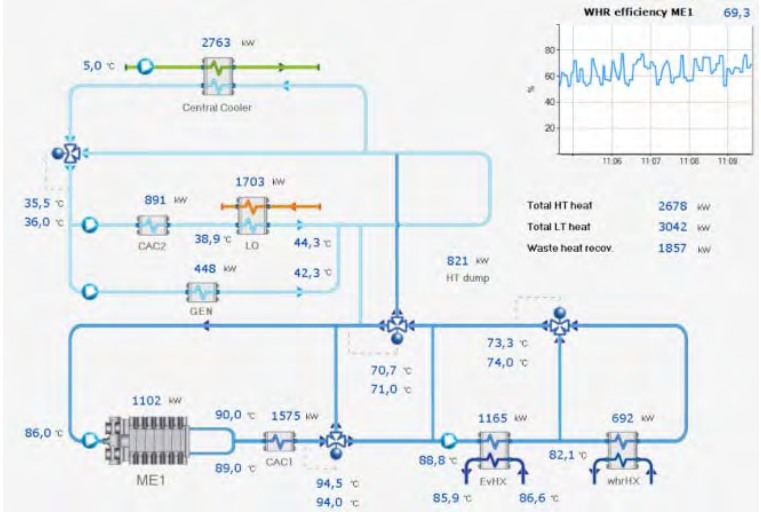
Analyses

Decision support

Energy Performance

- Compares fuel consumption with energy output
- Energy benchmarking (Boilers, Auxiliary Engines, Main Engine, Electricity consumption, etc.)
- Momentary and accumulated values for fuel consumption and propeller shaft power during a round-trip or sea voyage
- Decision support to reach optimum values based on mathematical models and trial data

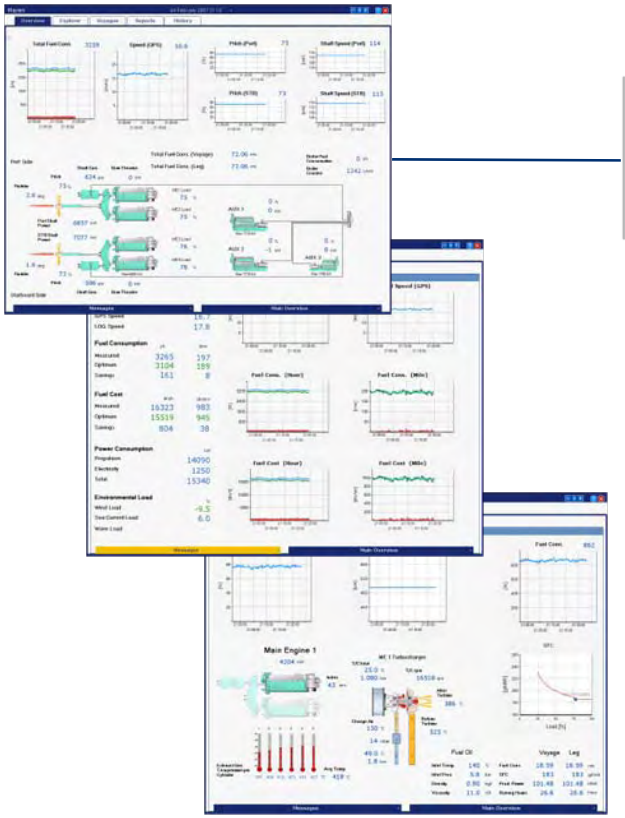




Energy Performance

MARORKA

KONGSBERG



Interface,
Data Storage
& History

Parameter Optimization,
Simulation
& Decision Support

Data
Sensors

Mathematical
Model

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Hull performance

Hull Performance

- Ballast & Cargo tank monitoring, control & management

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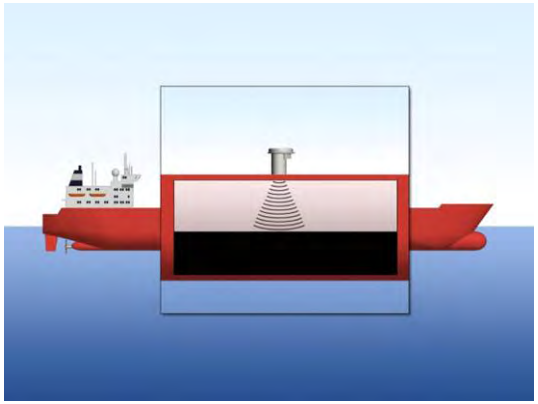
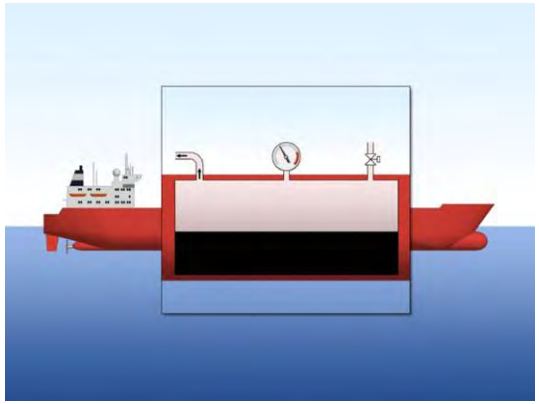
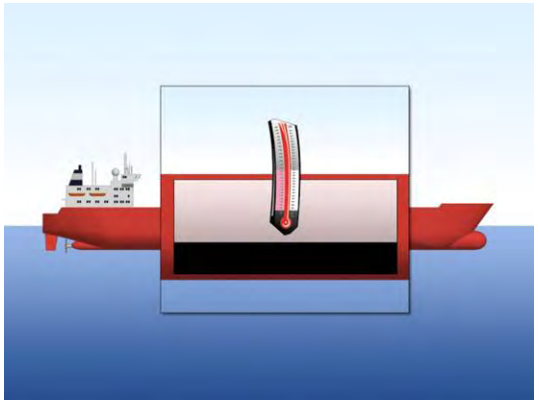
- K-Gauge main applications



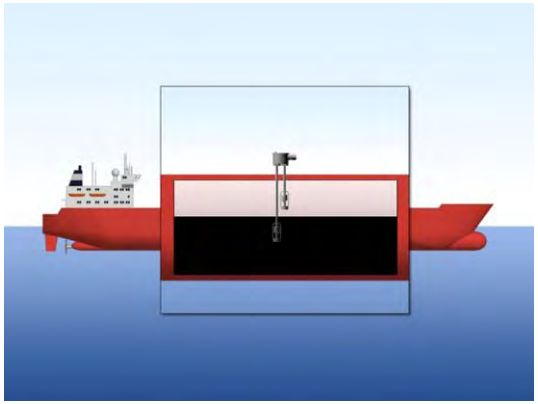
- Tank Level



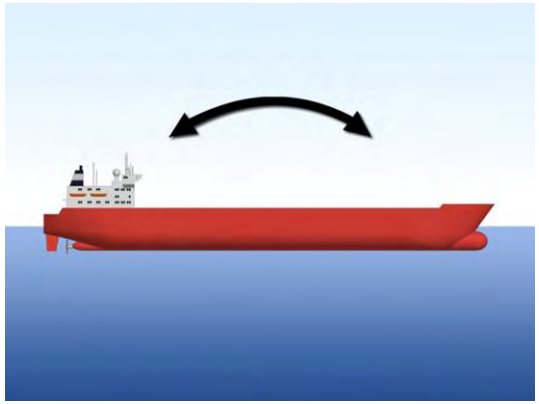
- Vapour Pressure



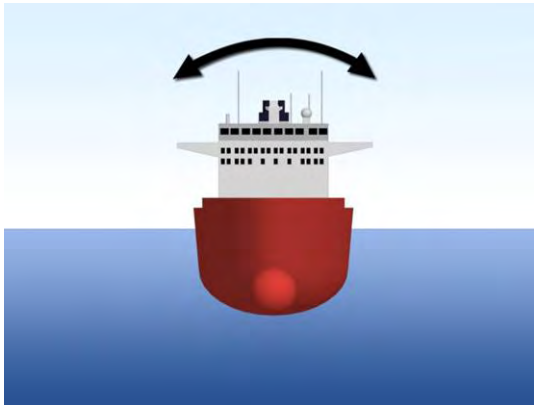
- Tank Temperature



- Overfill



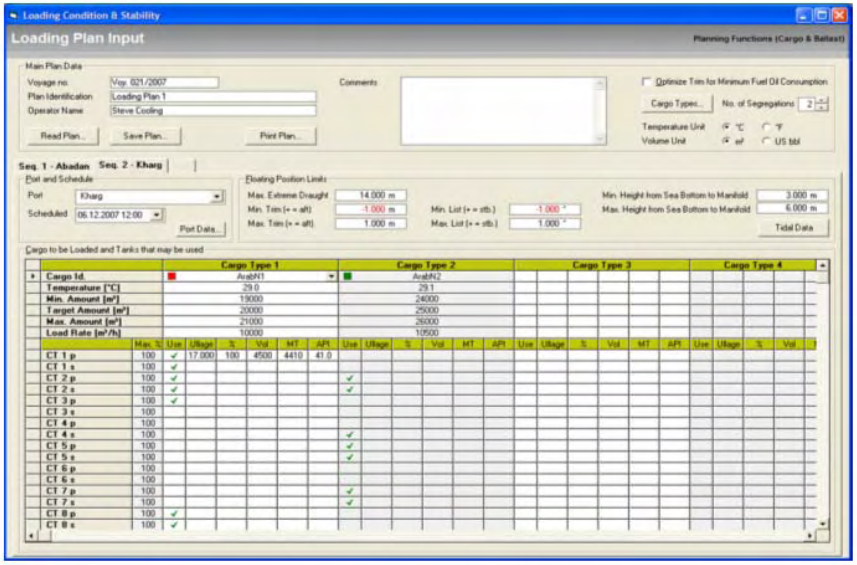
- Trim

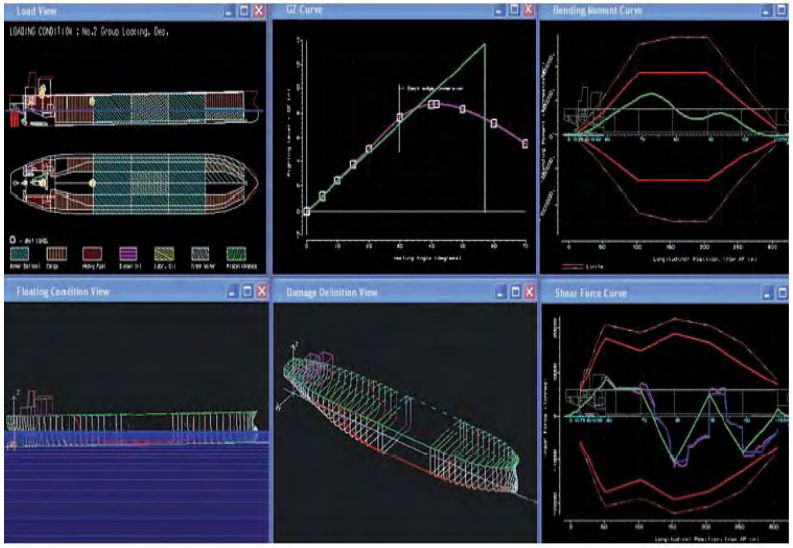


- List

Hull Performance Optimizer

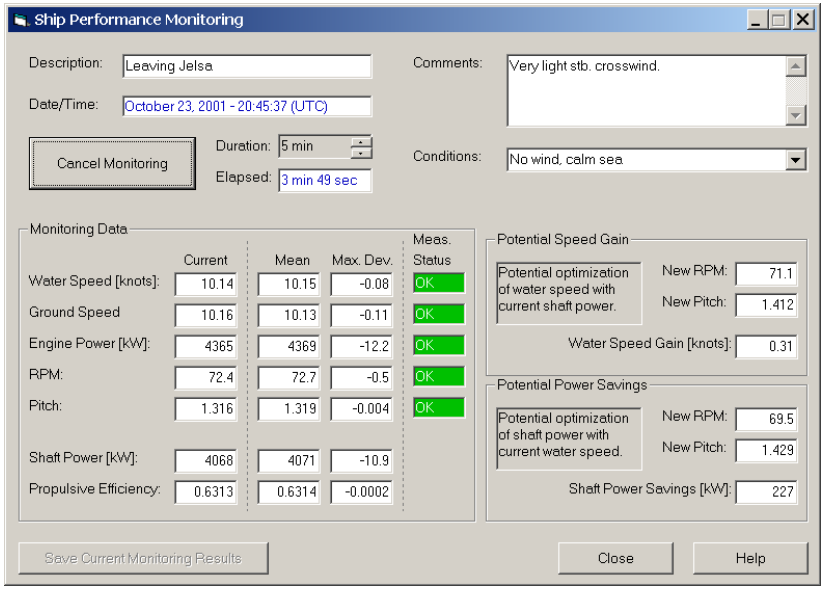
- Advanced loading computer built up by a 3-D vessel model for loading and stability solution
- Trim/draft optimisation to minimize fuel consumption
- Resistance calculations - Monitoring of hull/propeller fouling

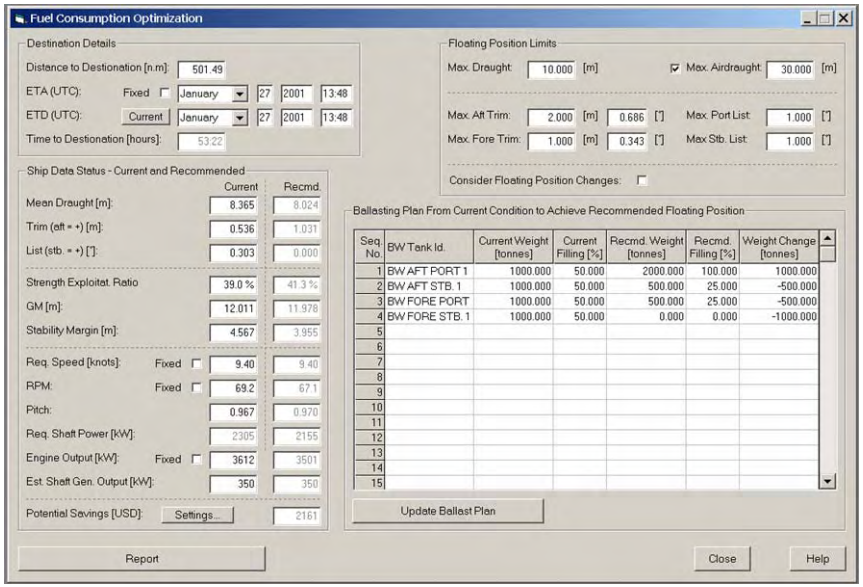




Hull Performance Optimizer

- Decision support for optimal Trim and Draft
- Decision support for optimal speed in relation with engine performance module
- Indicating speed loss or additional fuel consumption for hull and propeller fouling compared to clean hull





KONGSBERG

Nautical operations performance

Nautical Operation Performance

- Integrated Bridge System, K-Bridge

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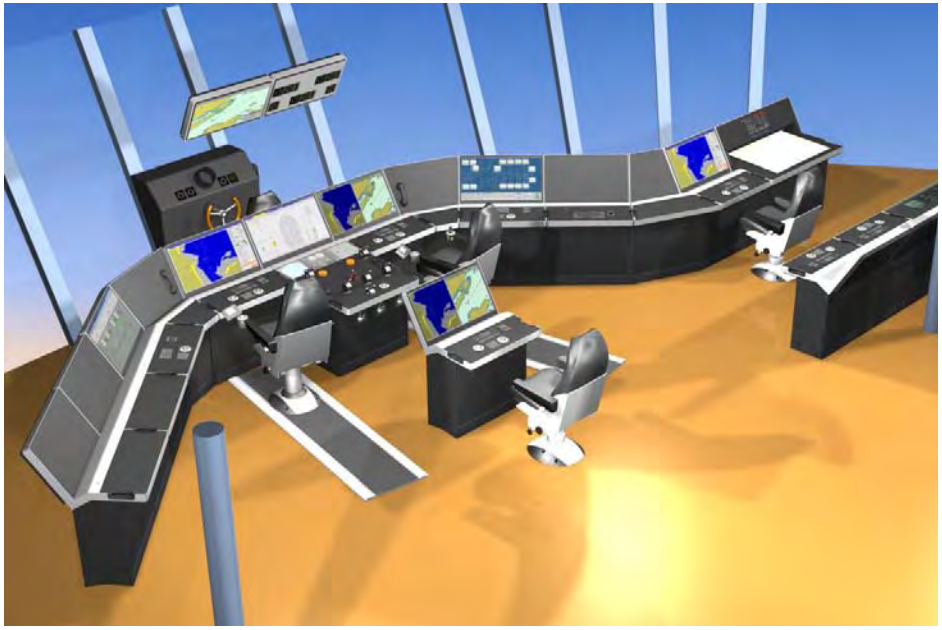
Nautical Operation Performance

- Integrated Bridge System, K-Bridge

- Multifunctional operator stations
  - ARPA
  - ECDIS
  - Conning
- Integrated Steering Control
- Integrated Autopilot and Track Pilot
- Integrated Central Bridge Alarm System
- Integrated control of Bridge Auxiliaries

- Route Planning
- Weather Routing



Nautical Operation Performance

- Route Planning & Weather Routing

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1. Route planning on ECDIS
   - ETA
   - Weather forecast via satellite communication
   - Tide
   - Sea current
   - Shallow water
   - Vessel response boundaries

2. Data to Vessel performance module
   - Waypoints
   - Weather forecast
   - Actual Weather data
   - Sensor input for actual fuel consumption, torque, speed, RPM, Engine performance etc.

3. Advice in optimal sailing
   - Speed profile on the leg
   - Trim and draft optimization

4. Reports
   - Cost calculation of the selected route
   - Route comparing tables

Nautical Operation Performance

- Benefits

- Optimize ship speed & speed profile for a voyage dependant on ETA, sailing route, weather data and tidal current
- Load planning functions to optimize applied draught and trim, including reduction of water ballast
- Speed loss and additional fuel consumption compared to clean hull

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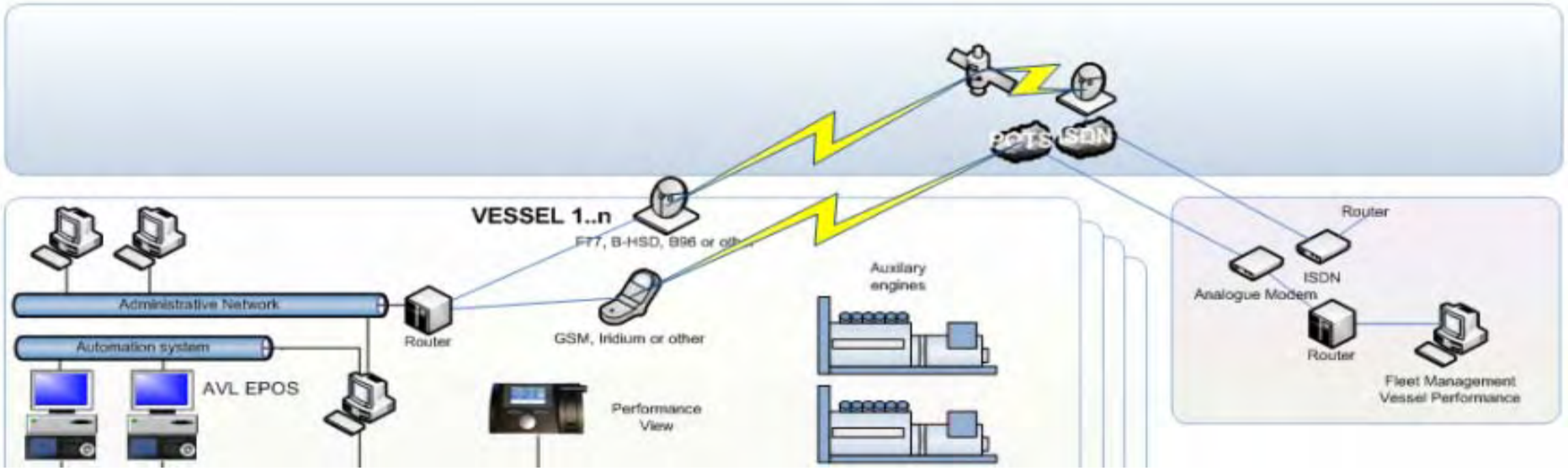
Shore Management for vessel performance



Vessel Support and Reporting

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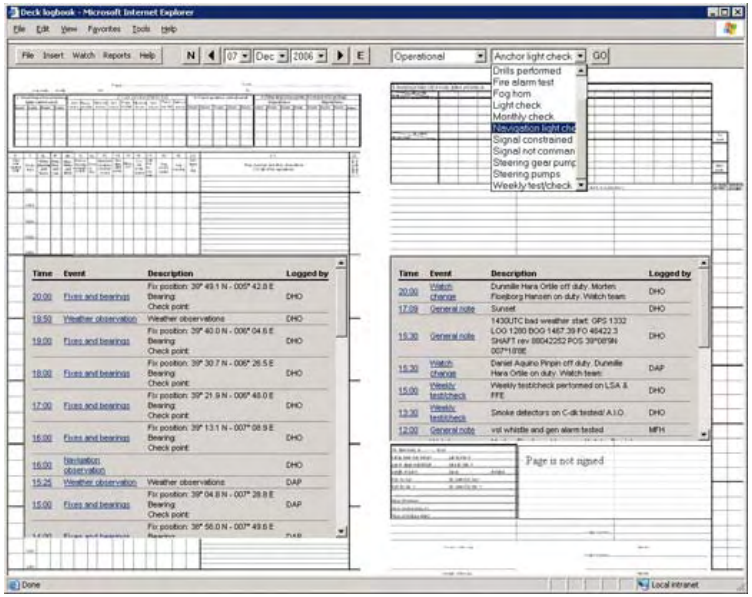
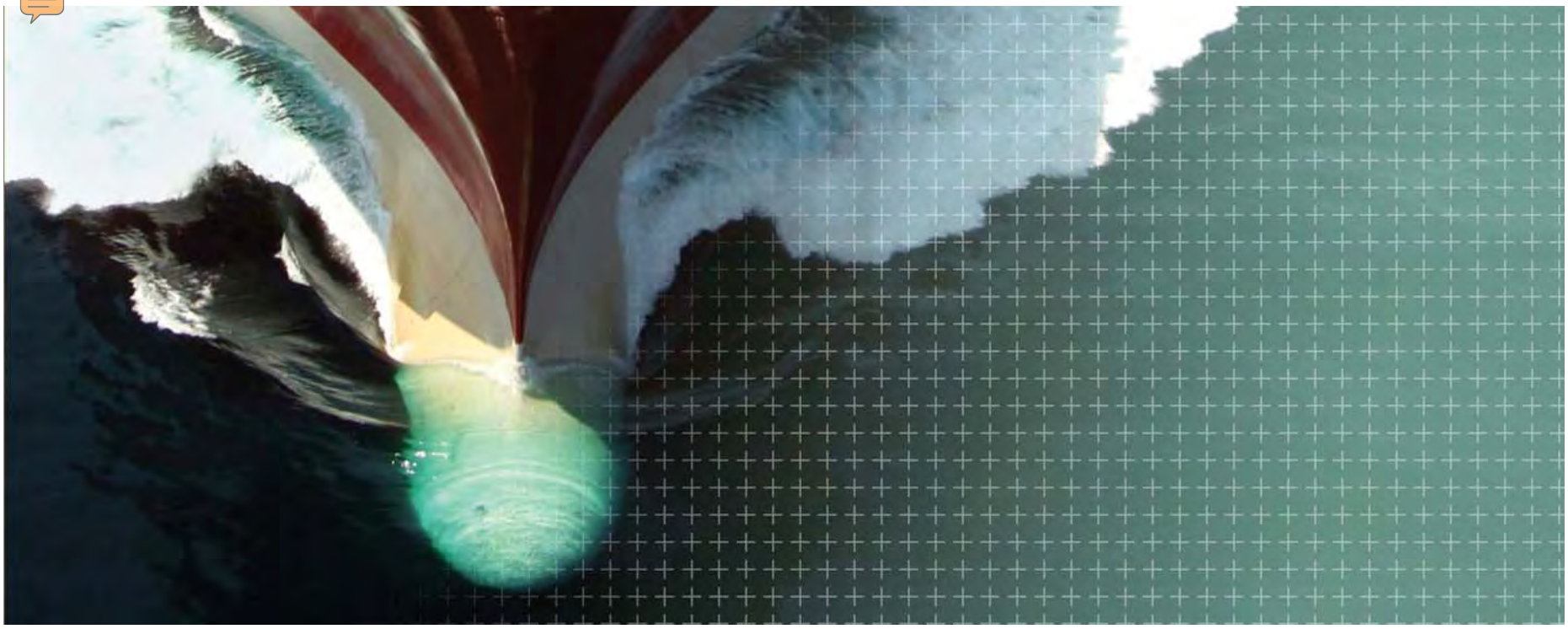
- Electronic logbook onboard, alternative to manual logbooks
- Performance log for reporting of ship performance data
- Environmental log / Emission log
- Ship Energy Efficiency Operational Indicator (EEOI)
- Fleet Data Manager acquires data from individual ships and processes data into a fleet-wide database



Shore Management

- Owner portal for vessel performance of complete fleet 'traffic light'
- Advanced diagnostics from remote
- Reports and comparing functionality



Green Ship: Less fuel – Less emissions

- Optimum engine performance
- Optimized routing
- Enhanced safety and reliability

Environmentally friendly voyage

KONGSBERG

Vision

WORLD CLASS

through people,
technology and
dedication