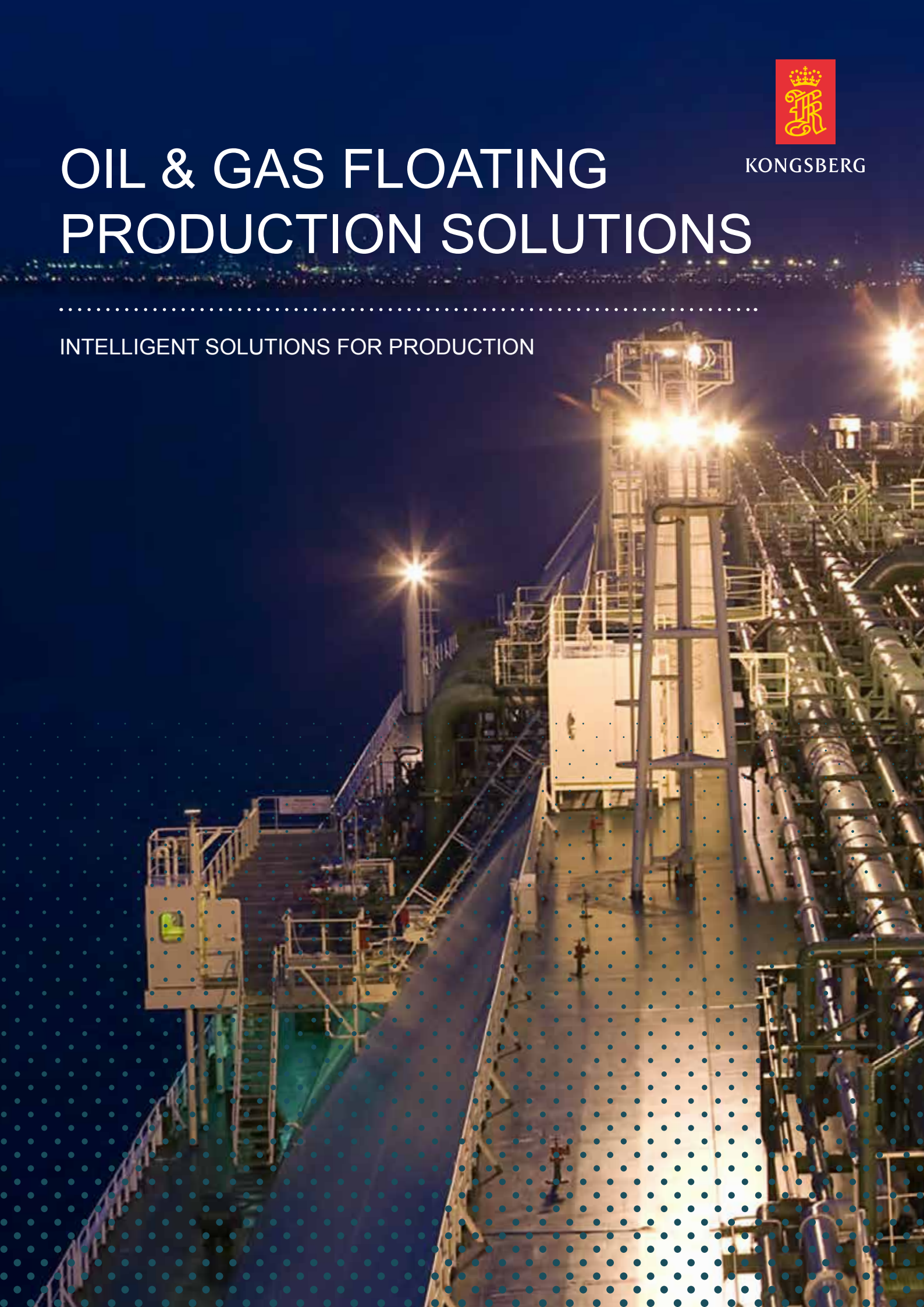
KONGSBERG

OIL & GAS FLOATING PRODUCTION SOLUTIONS

INTELLIGENT SOLUTIONS FOR PRODUCTION



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.

CONTENTS

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KONGSBERG SYSTEM PHILOSOPHY

Process control for floating production solutions

KONGSBERG is your industry business partner from concept to operation for oil and gas production plants.

The KONGSBERG process control system provides you with robust and reliable solutions for the automation and safety for production of oil and gas in a modern context. Over many years, KONGSBERG has been involved in the evolution of process control solutions, and an active participant in utilizing the synergy of dynamic process simulator and control system.

Robust solutions

KONGSBERG system philosophy is based on a distributed and open system design that employs a system-wide standardized communication network. The network facilitates free flow of information from sub systems, with system wide information on multi-functional workstations. A common base technology and user interface for all automation applications ensures a safe and reliable operation environment.

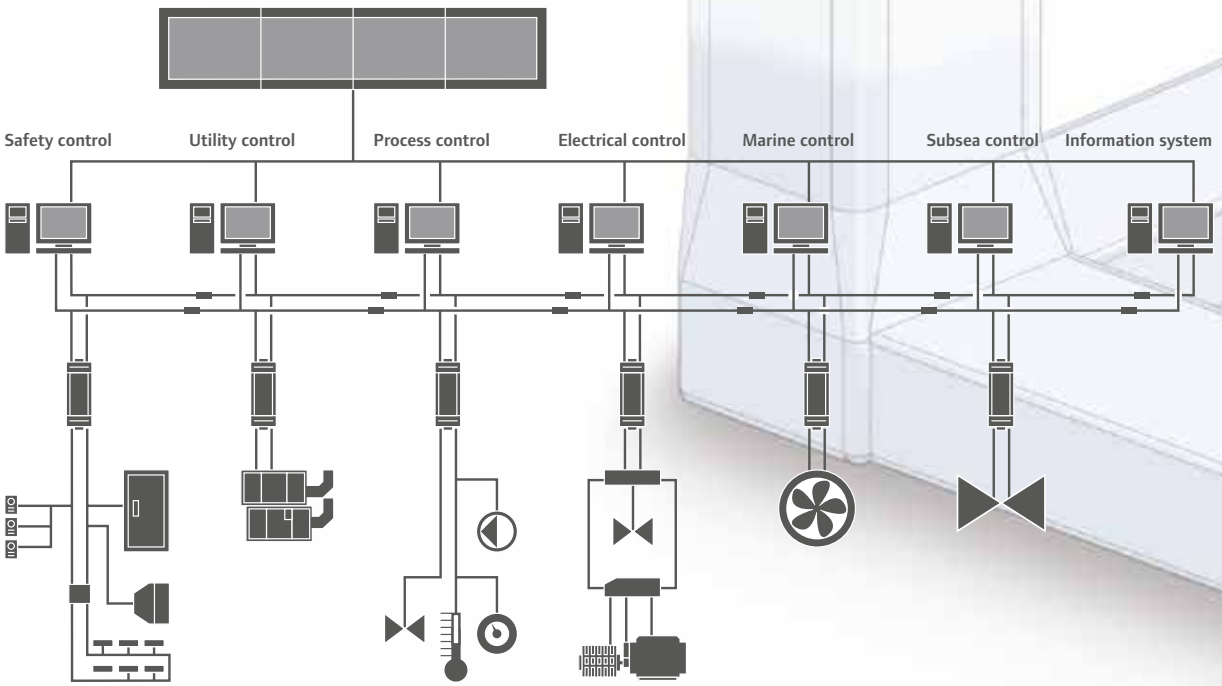
The full picture

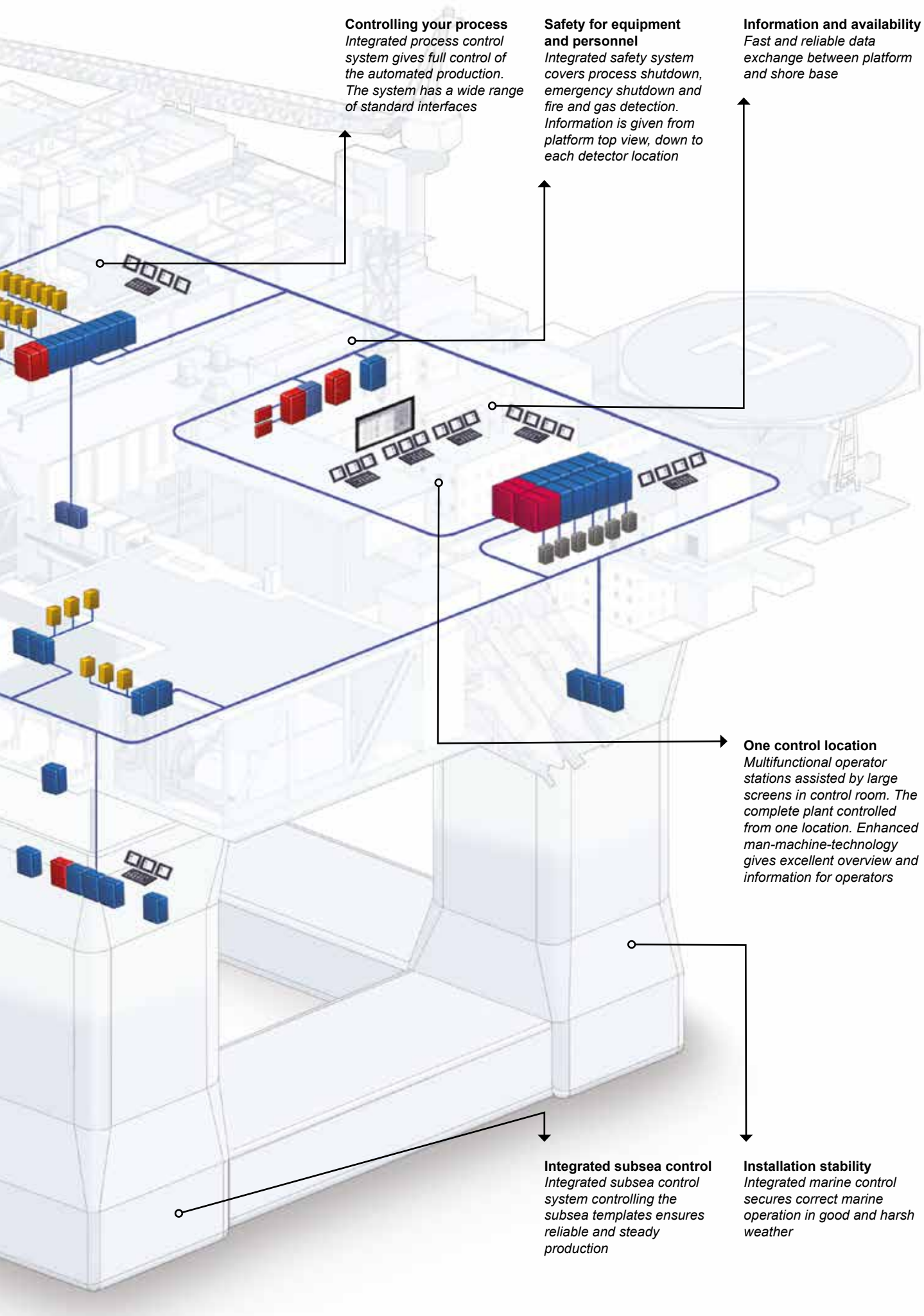
The KONGSBERG integrated control system is more than hardware- and software modules – it is a solution which ensures stable and optimal production of your asset. Combined with the KONGSBERG dynamic process simulator, for DCS checkout and control philosophy testing, this ensures excellent control of the process and reduces the need for flaring and CO2 emission.

THE FULL PICTURE

Stable and reliable communication
Distributed system architecture gives reduced cabling cost and flexibility in production and operation

Keeping your position
Reliability of position using anchor winch control assisted with position mooring software including position mooring simulator





Controlling your process
Integrated process control system gives full control of the automated production. The system has a wide range of standard interfaces

Safety for equipment and personnel
Integrated safety system covers process shutdown, emergency shutdown and fire and gas detection. Information is given from platform top view, down to each detector location

Information and availability
Fast and reliable data exchange between platform and shore base

One control location
Multifunctional operator stations assisted by large screens in control room. The complete plant controlled from one location. Enhanced man-machine-technology gives excellent overview and information for operators

Integrated subsea control
Integrated subsea control system controlling the subsea templates ensures reliable and steady production

Installation stability
Integrated marine control secures correct marine operation in good and harsh weather

Solutions tailored to your need

KONGSBERG integrated process automation system, K-LINE, is a distributed monitoring and control system. It's flexible and open architecture, makes K-LINE highly suitable for a wide range of control tasks for the oil and gas industry.
The automation system is designed for large scale integration of all automation applications in your installation. The real benefit of the integration is in operation, modification and maintenance; the operators have a unified operator interface and alarm system, easing the training of your operators. Common hardware and software platform reduces the amount of spare parts needed and thus reduces the life cycles cost.
A common information management system transfer information to the base organization for support and optimization of your reservoir and production processes. The level of integration may vary from full integration of control logic at the package level and integration of unit control panels, to common human machine interface.

Kongsberg integrated systems
The integrated system for control and safety, having applications for:

K-PRO
- Process and control applications
- Gas processing systems
- Power systems
- Utility and auxiliary systems
- Subsea control systems

K-SAFE
- Process shutdown systems
- Emergency shutdown systems
- Fire and gas detection

K-IMS
- Information management systems

K-CHIEF
- Marine applications

K-POS
- Position mooring

Input and output units
The KONGSBERG Remote Multipurpose I/O unit is a unique free programmable unit with 32 channels. This mean one can decide I/O channels at any time using software and thus independent of an early planning of I/O configuration

Real time controller
The KONGSBERG remote controller unit (RCU) 501 is a real time controller certified against cyber risks – Achilles 1 level. The controller connects to large number of I/O units and communication buses. It used both for process control applications as well as for safety applications is.

Distributed solution - safe and efficient operation
K-LINE yields a distributed and open system design, utilizing a system wide standardized communication network. The network facilitates for easy integration of 3rd part equipment and information from all subsystems, with process wide availability on multi-functional workstations. Common base technology and user interface provide for a safe and an efficient operational environment, with consistent operation and increased reliability.


RCU500
SDIO8400
SDIO8400
RCU
RMM400

INTEGRATED CONTROL SYSTEM

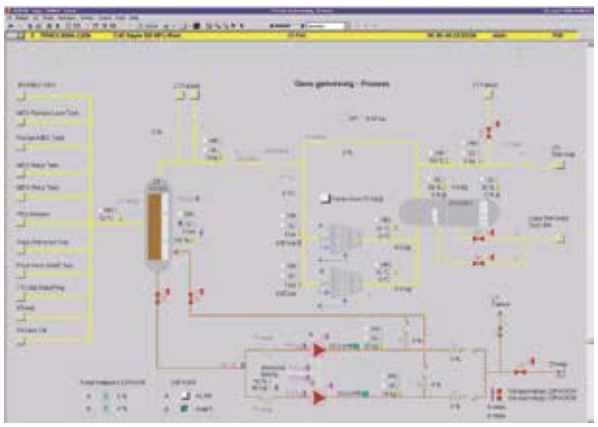
Process and control applications
The following are some of the process and control applications available:
- Hydrocarbon stabilization systems
- Gas sweetening, gas treatment and gas lift
- Power generation and distribution
- Generator control
- Turbine control
- Compressor control
- Fiscal metering
- Oil and gas export systems

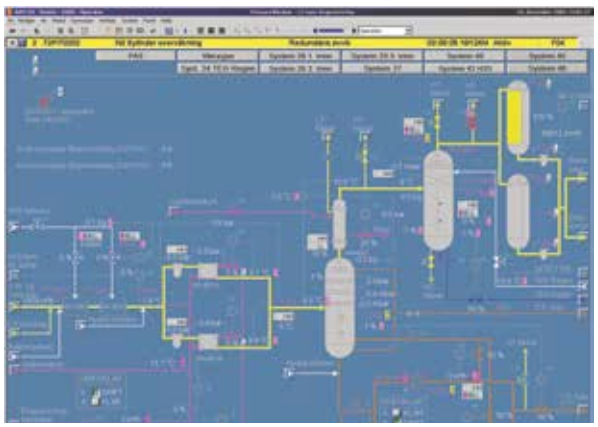
Utility and auxiliary applications
We have developed standard applications for various systems, to name but a few:
- Produced water treatment
- Fresh, hot and sea water distribution
- Gas, water and chemical injection
- Jet fuel and diesel oil system
- Nitrogen/Inert gas system
- Glycol storage and distribution system
- Lube oil, hydraulic oil and compressed air
- Topside open drain system
- Heating and cooling medium
- Flare system/fuel gas system
- HVAC

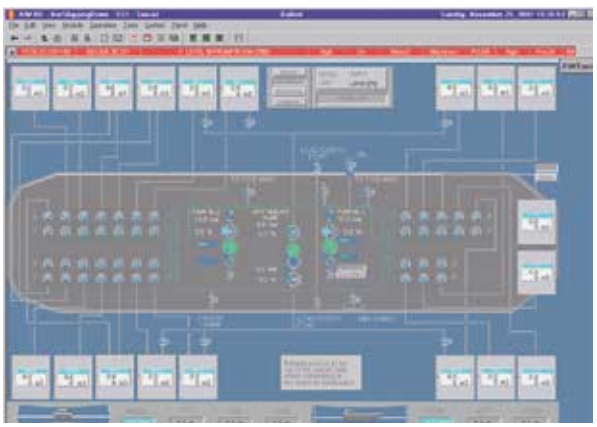
Subsea process application
Typical subsea control applications:
- Redundant subsea communication lines
- Well and manifold temperatures and pressures
- Sand detection
- Electrical power unit
- Hydraulic power unit
- Shutdown sequencing
- Valve, choke control and movement
- Water, gas and chemical injection
- Well control
- Manifold
- Multiphase flow meter
- Corrosion meter
- Valve signature
- Housekeeping functions

Electrical control application
Typical electrical control applications;
- Time stamping
- Advanced motor control
- Full power distribution control system (PDCS)

Marine control application
Typical marine control applications;
- Ballastand bildge control
- Anchor winch control
- Water tight doors
- Position mooring





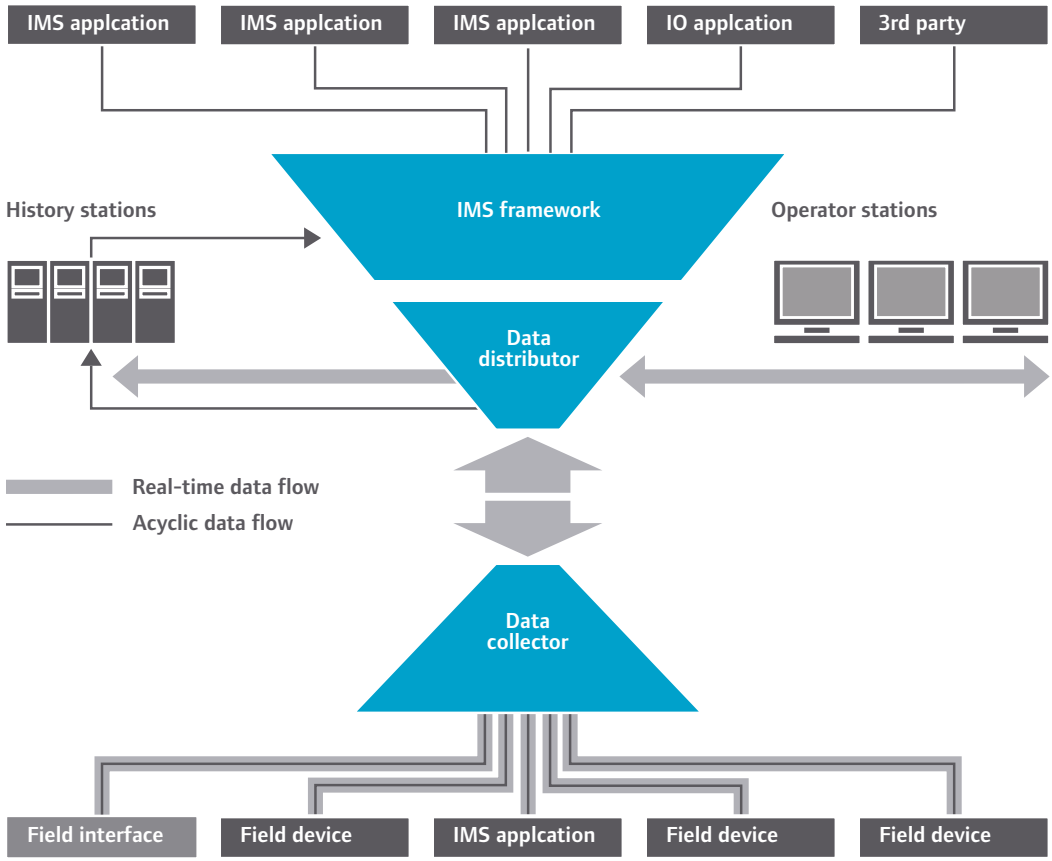


INFORMATION MANAGEMENT SYSTEM

Information management system K-IMS

The information management system (IMS) is an information architecture for plant wide information storage and retrieval. The operator station trend and report system transparently to the IMS server, which provides fast, scalable and reliable data storage for the process control system and other external applications:

- Operational data and maintenance data from all sources routed through the same system
- Integrated onshore operation centre access (and access control) to all data regarding operation and maintenance
- Key suppliers online access to relevant information with remote operation and maintenance of delivered equipment/systems from their base premises
- Field data used in control nodes and transported to the users of K-PRO



SAFETY SYSTEMS

Managing critical situations with K-SAFE

KONGSBERG supplies a full family of integrated and reliable Safety Systems (K-SAFE) covering Emergency ShutDown (ESD), Process Shutdown (PSD) and Fire and Gas Detection and Protection (F&G) systems. The K-SAFE safety management concept safely integrates all relevant information from these and other integrated systems to give the operators the information and tools necessary to handle critical situations and operate the installation in a safe manner.

K-SAFE systems are designed for maximum reliability and availability, and are certified in compliance with IEC 61508 for use in applications in accordance with safety integrity levels SIL 1 to 3. The solutions are also Type-approved by the major classification societies, such as DNV and ABS. These 3rd party approvals and certificates ensure the quality and compliance of the systems improving project execution as well as safe operation.

Emergency shutdown

The Emergency shutdown system (ESD) shall minimize the consequences of emergency situations, related to typically uncontrolled flooding and escape of hydrocarbons or outbreak of fire in hydrocarbon carrying areas or areas which may otherwise be hazardous. Traditionally, risk analyses have concluded that the ESD system is in need of a high Safety Integrity Level, typically SIL 2 or 3.

Typical actions from ESD systems are:

- Shutdown part systems and equipment
- Isolate hydrocarbon inventories
- Isolate electrical equipment
- Prevent escalation of events
- Stop hydrocarbon leakage
- Depressurize/blowdown
- Emergency ventilation control
- Close watertight doors and fire doors

Process shutdown

The Process shutdown system ensures a rapid detection and safe handling of process upsets. Traditionally, risk analyses have concluded that the PSD system is in need of low to medium Safety Integrity Level. The premise for a low to medium requirement, being that PSD systems, built in accordance with API RP 14C, have requirements for both primary (the computerized system) and secondary (mechanical devices) protection.

Special purpose I/O unit
The special purpose I/O units RDIO and RMP 420S are designed for safety application. The unit is TUV certified, and comprises 32 independant programmable channels.

Basically the system consists of field-mounted sensors, valves and trip relays, a system logic unit for processing of incoming signals, alarm and HMI units. The system is able to process all input signals and activating outputs in accordance with the applicable Cause and Effect charts.

Typical actions from PSD systems are:
- Shutdown the whole process
- Shutdown parts of the process
- Depressurize/blowdown parts of the process

Fire and gas detection and protection

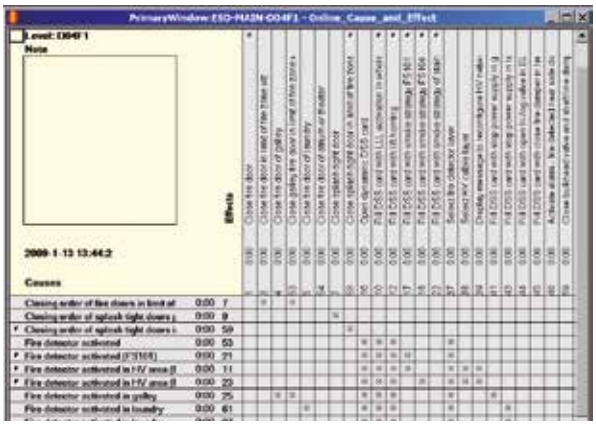
The fire and gas detection and protection system (F&G) shall provide early and reliable detection of fire or gas, alert personnel and initiate protective actions automatically or manually upon operator activation. Basically the system consists of field mounted detection equipment and manual alarm stations, a system logic unit for processing of incoming signals, alarm and HMI units. The system is able to process all input signals in accordance with the applicable fire protection data sheets or cause and effect charts.

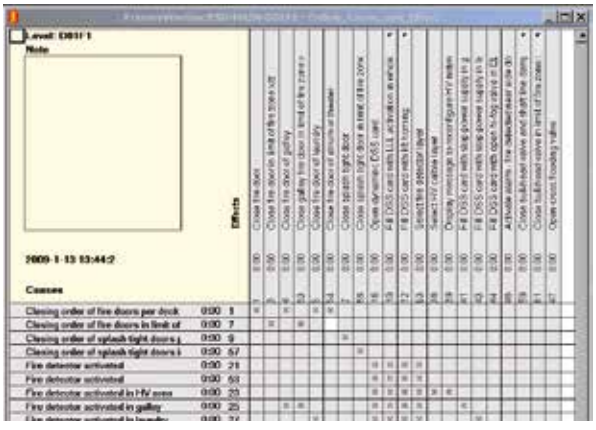
Typical actions from F&G systems:
- Alert personnel
- Release fire fighting systems
- Emergency ventilation control
- Stop flow of minor hydrocarbon sources such as diesel distribution to consumers
- Isolate local electrical equipment (may be done by ESD)
- Initiating ESD and PSD actions
- Isolate electrical equipment
- Close watertight doors and fire doors

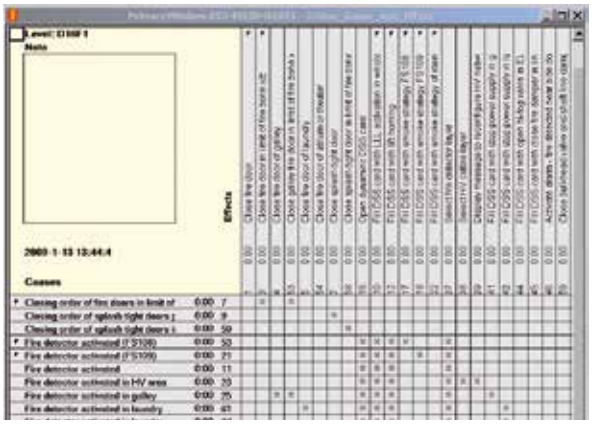
Fire and Gas typical system layout: The system is connected directly to the KONGSBERG real time controller in single or redundant configuration.

CE-Tool

Design, development and operation of the Safety System logic may utilize many different tools causing many sources of faults increasing the cost of a project and reducing the reliability of the systems. KONGSBERG has developed a Cause and Effect Tool (CE-Tool) for use in both offline engineering and online control. When used offline, the tool allows for C&E-design, Fire-zone and Shutdown-level definition, Tag allocation, C&E and Fire Protection Data Sheet (FPDS) documentation. When the CE-Tool is used during project execution, the tool may also be used for automatic development of the Safety-logic ensuring the quality and consistency of the SW-implementation. During operation, the CE-Tool is used online to provide the actual programmed C&E-charts directly on the Safety System VDUs and include real-time dynamic status information from the system. This is a very effective solution for operation, C&E-testing during both project execution and emergency operation of the plant, ensuring total control of inhibits, overrides and the logical correlation of the Cause and Effects.







DYNAMIC PROCESS SIMULATION

Life cycle dynamic simulation - enhances your operation

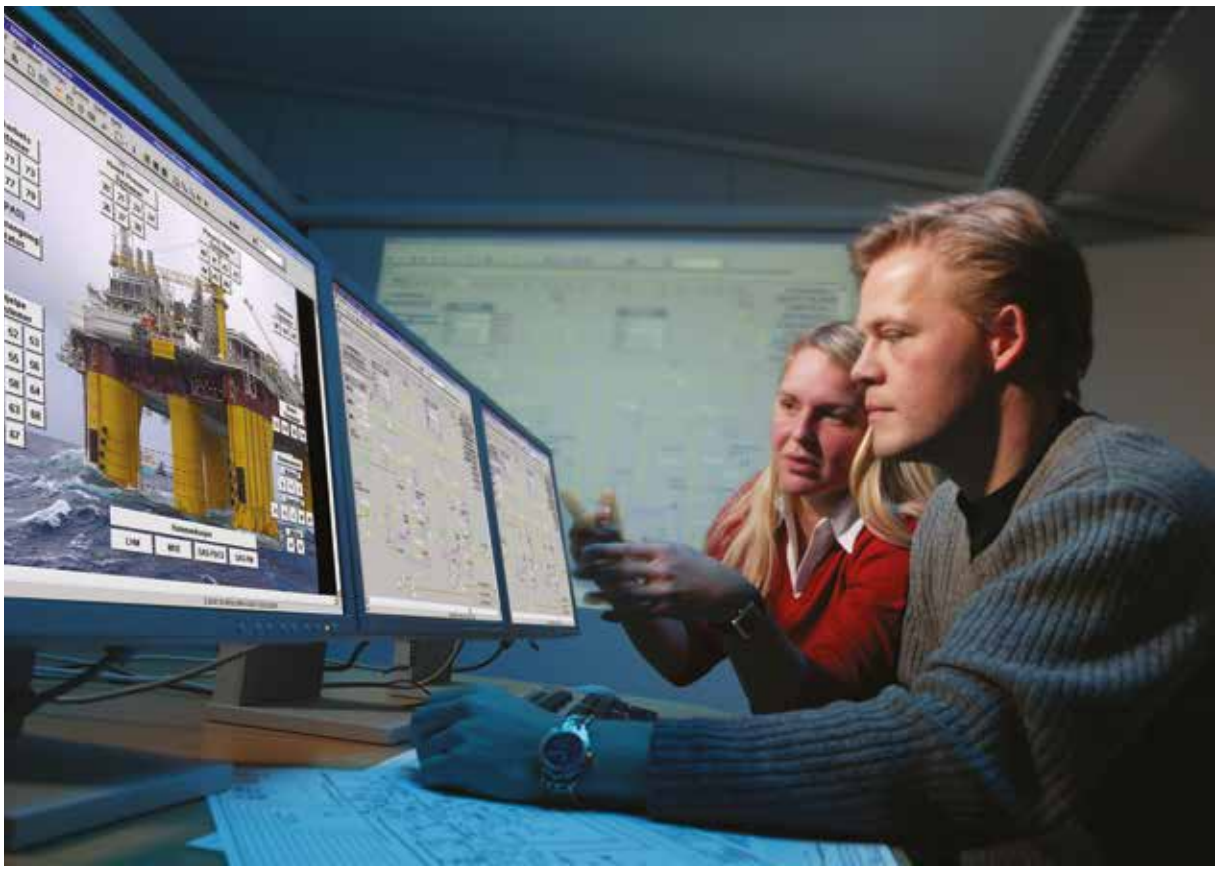
We provide dynamic real-time simulators for industrial processes ranging from single-unit operations to complex plants. Our simulators meet the highest requirements of real-time process simulation systems. The component modules may be standard (generic) or designed to specific customer specifications. The simulators are based on robust high-fidelity models that accurately reflect the behaviour of real processes over a wide range of operating conditions. Our simulators include the necessary features to create, study and modify a process plant model in order to reach an optimal process and control solution.

Operator training simulator

The operator training simulator (OTS) solutions include instructor interfaces and operator stations, and are generic (typical), emulated (realistic copy) or stimulated, i.e. the process models are linked to a software version of the real distributed control system (DCS).

Production management systems and life cycle management

In addition we have developed advanced real-time solutions for interface with the actual DCS, referred to as Production Management Systems (PMS), to serve as a real-time short term and life cycle decision tool for field operations. The PMS provides a valuable support for field monitoring and analysis, which greatly assist operational decision making, including analyses of unexpected events and start-up/shut-down campaigns to minimize processing and flow interruption. PMS is also an important contributor in obtaining safer operations and improved efficiency.



Operator training simulator

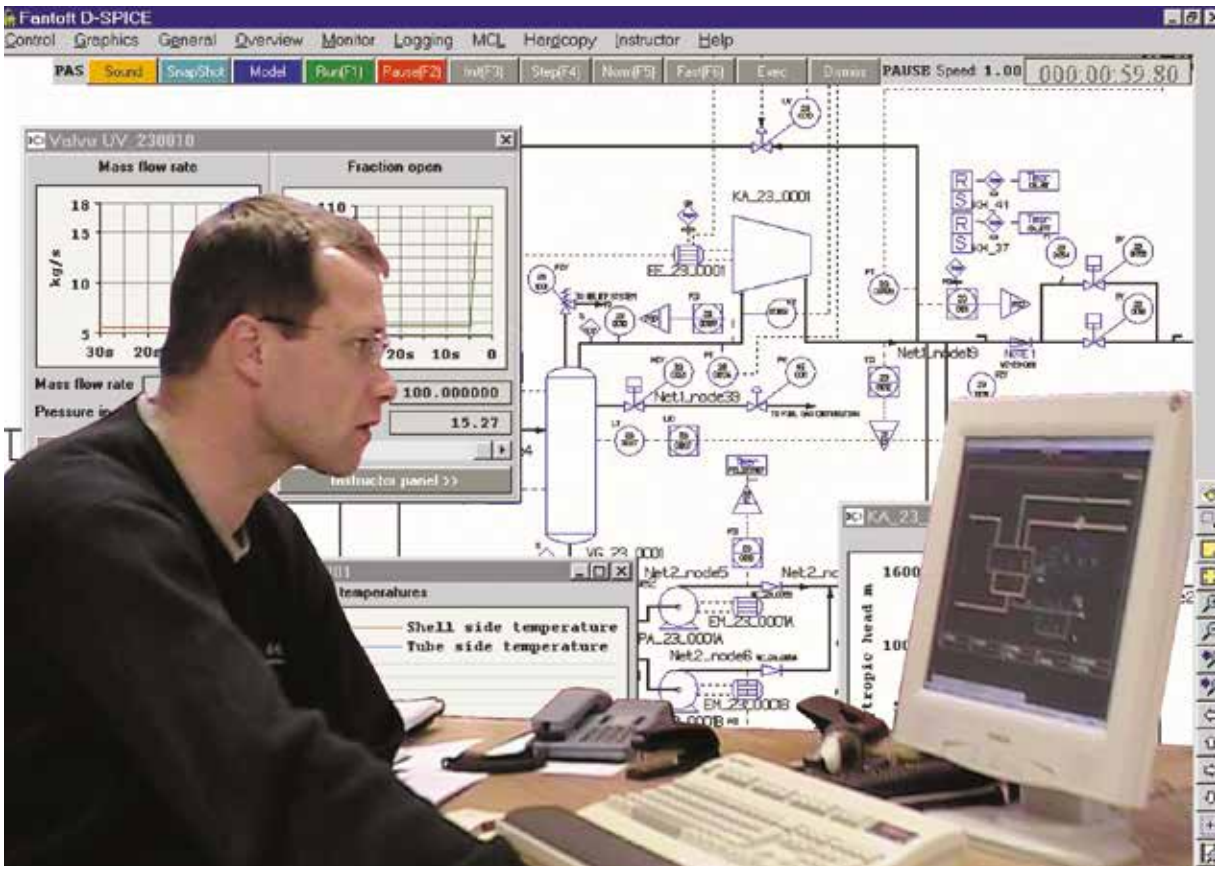
We have delivered a number of large-scale operator training simulator systems that connect the dynamic simulator plant model to a replica of the control system. The simulator models are highly realistic, thus enabling efficient training e.g.

- Plant familiarisation
- Distributed Control System operation
- Plant start-up and shutdown operations
- Equipment malfunctions and emergency conditions
- Testing safety procedures
- Testing operating procedures
- Collaborative training
- Communication with field operators

Engineering simulator

Our engineering simulators are used to analyze and verify process design and control strategies throughout the life cycle of a project. From the project design phase, through to the commissioning and start-up of a plant. Our engineering simulator provides an ongoing support tool for:

- Optimization studies
- De-bottlenecking studies
- Process retrofit studies
- Control and logic updates and verification
- Operator GUI updates and verification
- Autotuning of control loops
- Advanced process Control
- Maintenance Support



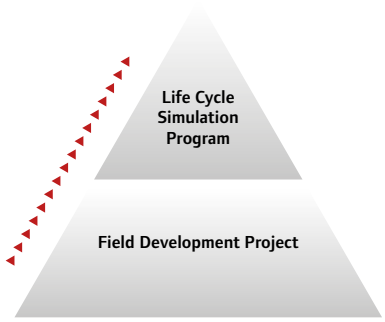
Life Cycle Simulation Program

The program

- Process shutdown systems
- Expert studies
- DCS check-out
- Operator Training Simulator
- De-bottleneck Studies

A Life Cycle Simulation Program is a constructive method to ensure better quality in a Field Development Project.

Field Development Projects consists of a range of challenges which are expected to be solved with high quality and on time.



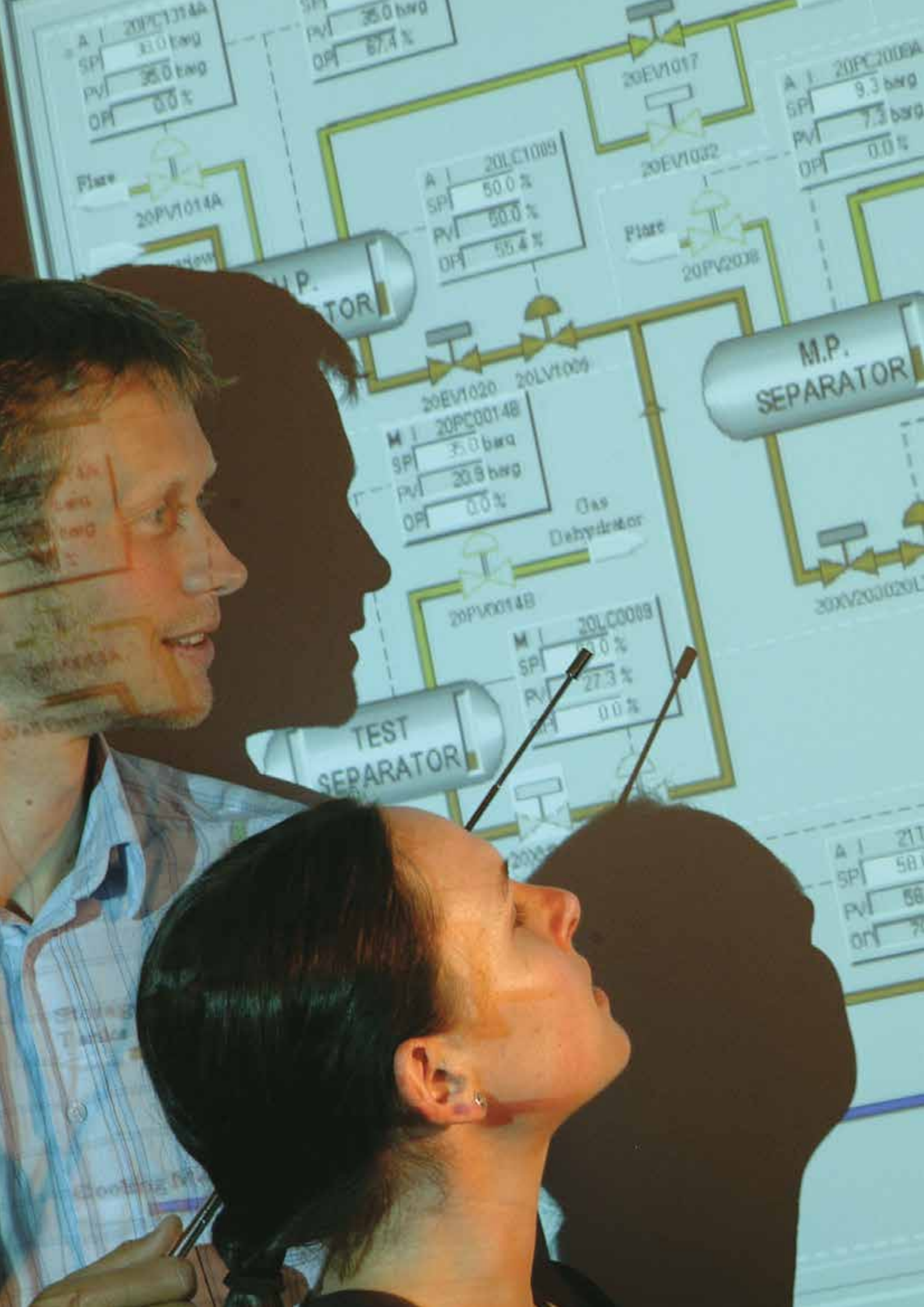
DCS simulator

The advanced DCS (Distributed Control System) checkout simulator analyzes selected control structures during control system verification. To obtain an optimal result the dynamic process model is directly linked to the selected control system. DCS test studies detects configuration errors, and improves the DCS implementation and thus speeds up the project in the critical and costly commissioning and start-up phases.

- Test and verification of control nodes
- Controller tuning
- Alarm setting and presentation
- Logic and sequence studies
- Verification of ESD/PSD
- Verification of Fire and Gas System
- Human Machine Interface development
- Control room ergonomic studies
- Pre-commissioning plant verification

LEDA flow simulation

A unique three dimensional CFD (Computational Fluid Dynamics) formulation has been developed, enabling first-principles simulation and visualization of waves, slugs, droplets and bubbles in a multiphase pipeline flow. This formulation has been implemented in LedaFlow® in one-dimensional, two-dimensional and quasi three dimensional software modules.


M.P.
SEPARATOR
TEST
SEPARATOR
20EV1017
20EV1032
20EV1020
20LV1009
20PV2038
Gas
Dehydrator

UPGRADES AND MODIFICATIONS

System lifecycle

Upgrades and modifications of control systems is part of the system life cycle. There are a number of reasons for upgrades and retrofit – here is a few:

- The plant is extended in lifetime, and new technology contributes to the extended lifetime
- The plant is extended with new process equipment, and the control system needs expansion beyond the original spare capacity
- New technology assists is increased oil recovery
- Development in 3rd party equipment controlled by the control system

KONGSBERG has been involved in a number of retrofit exercises. Our track record and experience proofs that the K-LINE control system can be upgraded with minimum downtime of the plant.

When upgrading the complete system onboard a platform, ensuring a shortest possible down time is a requirement. Such upgrades have been done more than once by KONGSBERG. One of the success factors in such upgrades is extensive testing, also involving the client.

Increased oil recovery (IOR) means upgrades of the control system and process equipment as the reservoir pressure is declining. Such rebuilds requires a revision of the dynamic model to verify rebuild of process equipment. As a consequence, the control and safety system also has to be upgraded.

IOR may require alternations in process equipment because of too low pressure, or means to increase the pressure by various means of injection, will be necessary. KONGSBERG takes interest in assisting the client using the dynamic process simulator to verify the process, the field equipment and modify the control and safety system accordingly. The upgraded simulator is a useful tool when training the operators prior to start-up of the upgraded plant.

INTEGRATED OPERATIONS

The systems for integrated operation and data collection

- Collaboration systems
- Data management software
- Intelligent oilfield decision environment
- Visualization and analyses software
- Environmental monitoring
- Vessel traffic surveillance

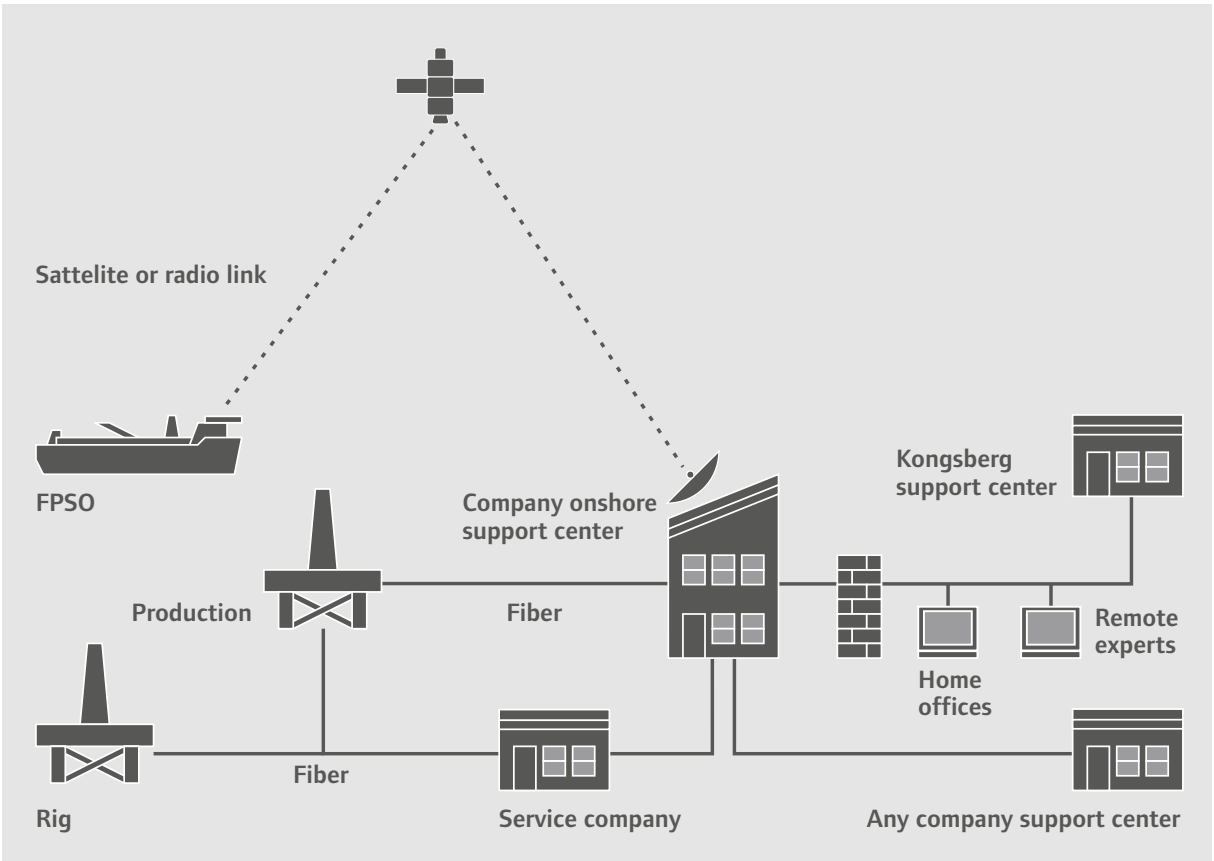
Our solutions for Integrated Operations provide for more cost efficient operations by increasing availability of human and technical resources together with historic and real-time data without compromising safety or adding risk. Thus, a system based approach to new challenges with cross-discipline and cross-site cooperation is stimulated, which in turn puts operators in position to make better decisions faster.

Integrated Operations is not only about technological adoption and integration. It's also about how we can support in implementing new and improved work processes and thus stimulate to more successful collaboration between people, technology and processes.

The human collaboration factor is a key to capitalize from Integrated Operations - and work process changes are necessary to maximize potentials from new technology.
Integrated Operations is a key tool to increase production, decrease field development and operating costs and extend field life – targets generally shared across the oil and gas community worldwide.

KONGSBERG want to be your partner in pursuing these targets.

Figure showing example of data integration between offshore and onshore installations. Involving oil company as well as service companies



KONGSBERG enjoys a long track record as supplier to the oil and gas industry, in which efficiency improvement through development and supply of advanced automation, control and monitoring systems has been the main contribution together with dynamic process modeling and simulation. Our experience extends the entire life cycle of projects from study phase through detailed engineering, operator training and start-up to field operations. Thus, our solutions entail historic, real-time and forecasting features, thus providing our clients with useful tools for long term targets.

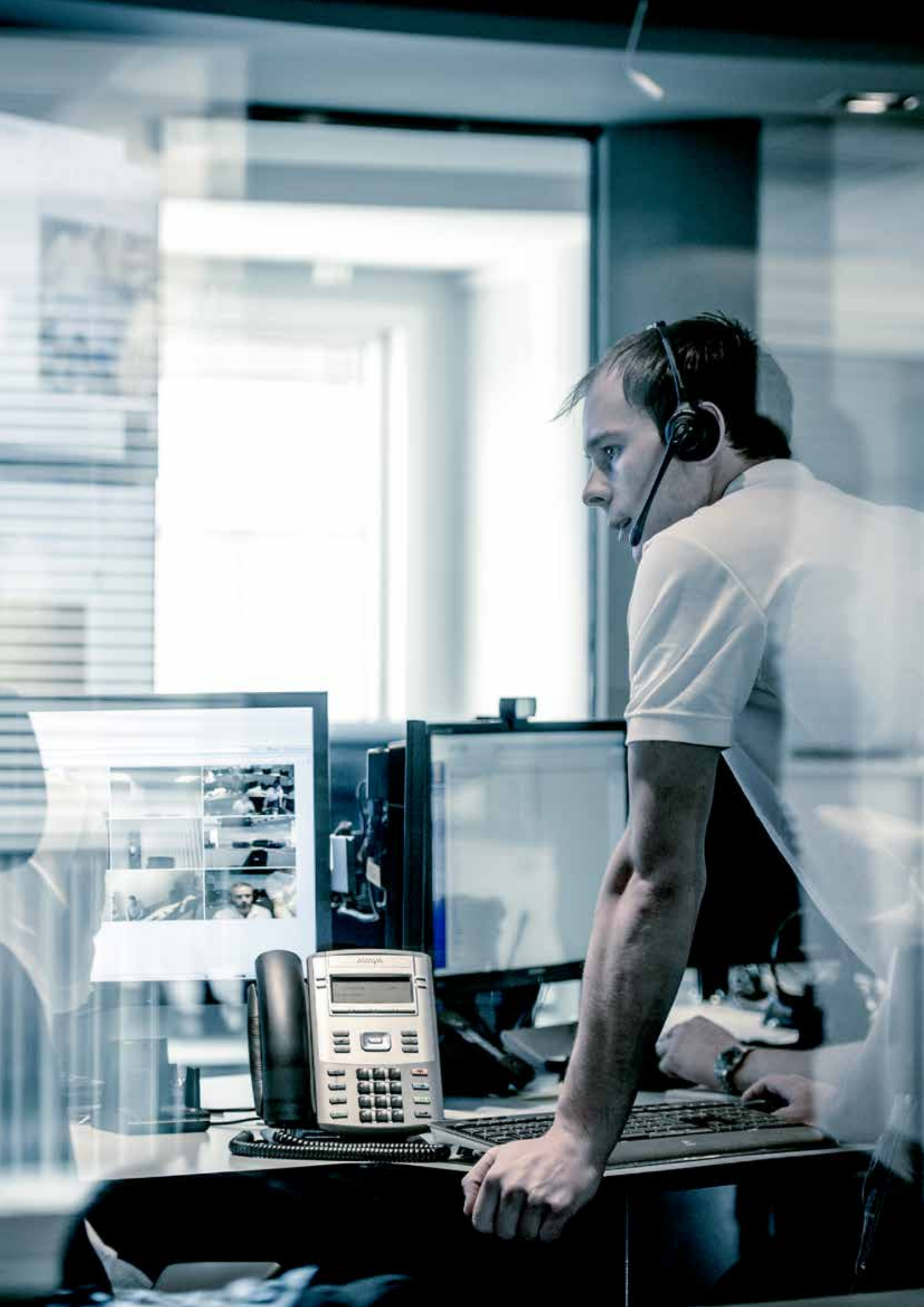
Lately we have expanded our capabilities by developing new tools, such as intelligent collaborative environments, on-line simulation solutions, 3D visualization and advanced information management systems for drilling, field development and production operations. Our solutions are based on open architecture and industry standards, which allow for integration with third party systems and scaling to specific project requirements as needed

Key building blocks in our Integrated Operations offering are:

- Intelligent collaborative operations centers
- Historic and real-time data management systems
- Dynamic process simulation incl. real-time/on-line tools
- Pipeline flow monitoring and prediction
- Tools for hydrate and slug monitoring in pipeline systems
- Applications for glycol (MEG/TEG) regeneration control and optimization
- Condition monitoring of equipment and rotating machinery
- Logistics planning and monitoring incl. interaction with ERP systems
- Personnel tracking systems
- Work process analyses and optimization studies
- Consultancy to explore cost/benefit potentials for Integrated Operations

Kongsberg's IO Lab

We have established an IO Lab at the KONGSBERG premises to serve as a test bed for developing and proofing practical applications for Integrated Operations. The lab offers state of the art facilities with telecoms and computer communication tools for collaboration across our own office sites and with clients remotely located whether onshore or offshore. Through the IO Lab people can be brought together on short notice to review, discuss and test ideas and proposals, including applications under development. This is an efficient way to reveal how cost/benefit may be maximized through Integrated Operations.



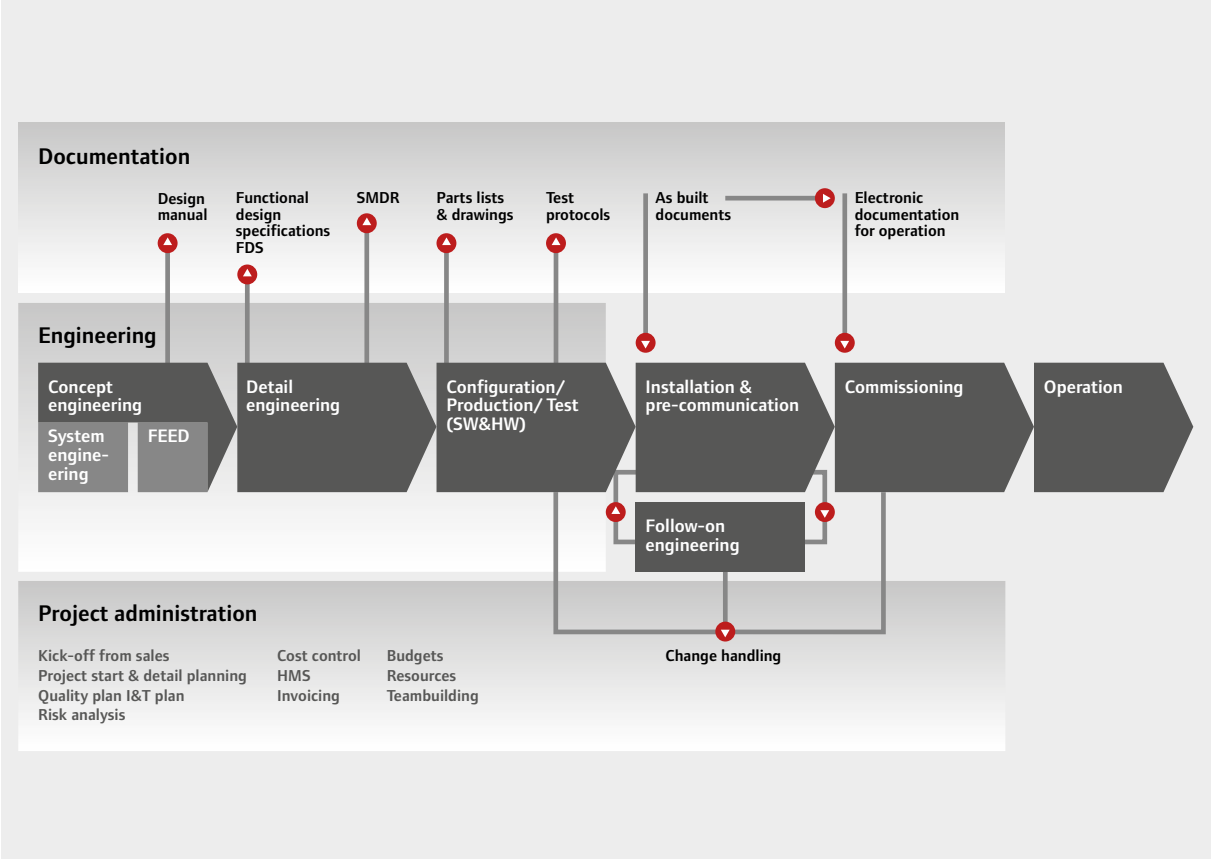
PROJECT MANAGEMENT

Organizing for success
Every project is unique with specific requirements and goals, and successful implementation requires experienced and knowledgeable management – to plan ahead, resolve questions and keep everything on track. These are all qualities and skills mastered by KONGSBERG.

On schedule
We take a holistic and tailored approach to project management. Our goal is to organize human resources so that every project is completed to high standards, and within the time and budgetary constraints agreed upon with our customers.

Project management services
We believe in creating partnerships with our customers, taking ownership of projects, and behaving in a proactive fashion. We utilize industry standard proven tools and established procedures as well as provide full transparency to our customers.

Project management highlights
- Project programming
- Design management
- Procurement/purchasing
- Installation management
- Quality management
- Site management
- Time and cost control
- Risk analysis
- Environmental quality and work environment management
- Maintenance management
- Audits



Interface engineering

The KONGSBERG engineering comprises comprehensive knowledge within electrical, telecommunication and instrumentation (EIT) activities.

We continue to make a difference for our customers

During the last 50 years, we have developed a wealth of knowledge on marine and offshore operations, user requirements and the many challenges the industry faces. We have evolved to meet these unique challenges by providing cost effective and sustainable lifetime solutions, making a real difference to your business.

Insight and innovation

We combine professional insight and creativity to assist you in finding innovative solutions for today's requirements and tomorrow's challenges. Our industry wide knowledge base is a platform for our insight, and our multitalented team approach inspires creativity, resulting in innovative and optimal solution.

When competence counts

Our core competence lies in project execution, engineering, technology, products and system integration. We offer a global single source solution for any size electroinstrumentation-telecommunication (EIT) contracts, both on an EPC and EPCI basis. By utilizing our versatile experience and in-house standard systems and system components, we are able to provide off-the-shelf solutions that generate both operational and financial benefits to our customers.

LIFE CYCLE SUPPORT

Designed to purpose – maintained to last

Our life cycle management service will assist our customers throughout all the phases, from design to commissioning and during the operational life time. Solid in-house competence, both in system design and user competence enables us to provide solutions that are fit to purpose and thus yields efficiency in operation.

Our common base technology provides robust designs, with few and reliable parts, an execellent foundation to maximize the output at competitive costs.

The distributed and open system design employs an industry standard communication network. Standard hardware components used for various applications and the open network approach results in:

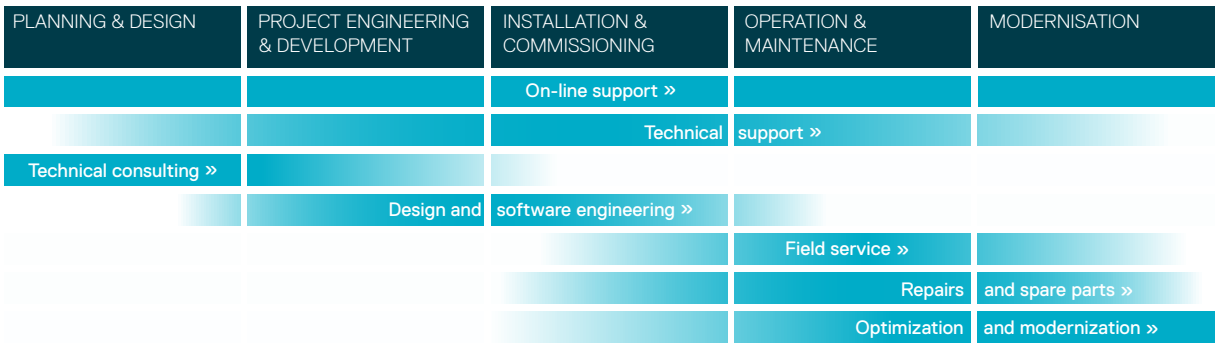
- Increased reliability
- Competitive life-cycle support
- Easy up-grade solutions

Evergreen

We offer continuous hardware and software upgrade to keep your vessel at maximum efficiency. Our system is designed with consistent boundaries between individual systems and control segments. This design strategy makes it easy to add new functionality or complete new control segments thus enable us to offer up-grades step by step to keep your system evergreen.

Training

Qualified personnel are one of your major assets in efficient and safe operations. Thus, we offer modular training courses for all major subjects – from operator training to technical training that keeps your crew fit on the job.



Supported by professionals

Our systems are easy to install and maintain – supported by professionals either on-site or through remote connectivity. They are designed for optimal operational availability and allow for favourable lifecycle expenditure

GLOBAL CUSTOMER SUPPORT

We are always there, wherever you need us
KONGSBERG customer services organisation is designed to provide high-quality, global support, whenever and wherever it is needed. We are committed to providing easy access to support and service, and to responding promptly to your needs. Support and service activities are supervised from our headquarters in Norway, with service and support centres at strategic locations around the globe – where you are
and the action is.

As part of our commitment to total customer satisfaction, we offer a wide variety of services to meet individual customers' operational needs. KONGSBERG support 24 is a solution designed to give round-the-clock support. For mission-critical operations, KONGSBERG support 24 can be extended to include remote monitoring. We can adapt the level of support needs by offering service agreements, on-site spare part stocks and quick on-site response arrangements.

Global and local support

We provide global support from local service and support facilities at strategic locations world wide. Service and support work is carried out under the supervision of your personal account manager, who will ensure that you receive high-quality service and support where and when you need it.
Your account manager will ensure continuity and work closely with your personnel to improve and optimise system availability and performance.
Under the direction of your account manager, and with a local inventory of spare parts, our wellqualified field service engineers will be able to
help you quickly and effectively.

SUPPORT 24

Call +47 815 35 355
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kongsberg.com

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