



KONGSBERG

ENGINE PERFORMANCE

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ENGINE DIAGNOSTICS & EMISSION MONITORING



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 utilizing and integrating our technology, experience and competencies in positioning, hydro-acoustics, 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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KONGSBERG ENGINE PERFORMANCE SYSTEMS

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The KONGSBERG ENGINE PERFORMANCE SYSTEMS consist of two main application areas:

Engine condition & diagnostic system

Engine Condition and Diagnostic system can be delivered in a wide range of variants from a simple MIP system with one movable sensor to an advanced diagnostic system with fixed sensors on each cylinder, approved log/report functionality and ship-to-shore solutions.

KONGSBERG engine condition system is a well-established condition monitoring system for all types of large-bore engines covering HFO, Diesel, but also gas and dual-fuel operation. It monitors and analyses the condition and operational behaviour. This enables operators and owners of stationary as well as mobile applications and on board of sea-going vessels to receive valuable information about:

- a not optimum engine operation
- upcoming operational problems or component damages
- component life times in combination with a respective maintenance planning

Engine emission monitoring system

In addition, operators of large-bore engines are able to monitor its emissions. The NOx module is the world's first model based expert system for emission monitoring (currently covering NOx, SOx and CO2) for 2-stroke and 4-stroke large-bore engines in all applications. The system design is intended to comply with IMO MARPOL Annex VI, resolution MEPC 103(49) and the 'NOx Technical Code'.

The software modules for advanced diagnostics and emissions are developed by KONGSBERG's partner AVL List GmbH.



SYSTEM PHILOSOPHY

A crystal clear solution

Kongsberg Maritime, as a supplier of integrated ship systems, plays an increasingly important role when optimizing the operation of vessels. Extensive investments in research and development have resulted in a modular concept, which contributes significantly to improved fuel efficiency and reduced emissions. The engine performance concept enables online monitoring and diagnosis of propulsion and auxiliary engines for 2-stroke and 4-stroke engines and forms the basis for condition based maintenance (CBM).

Partnership

In our quest to offer the best in environmental solutions for the shipping industry, KONGSBERG has teamed up with AVL List GmbH to offer an engine performance monitoring system that enables continuous monitoring of engine condition and performance. In combination with a powerful decision support system, engineers have an easy to use tool for maintaining main and auxiliary engines at optimum performance.

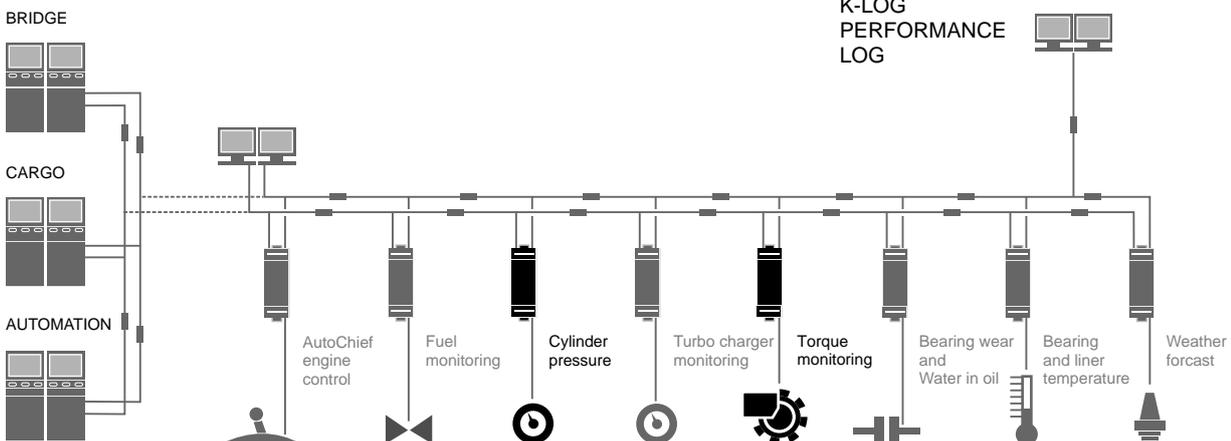
Modular and scalable concept

Systems may easily be extended by adding additional hardware units such as operator stations, input/output modules and additional measuring points. Kongsberg System Technology offers signal acquisition and processing units for installation in ER cabinets, ECR consoles or mounted directly on the engine. Processing algorithms are executed within the local acquisition units or in the powerful controller units. By distribution and segregation the consequences of a system fault are reduced and may even be eliminated.

The Kongsberg Engine Performance System concept yields a modular design, where various modules can be configured and combined to suit individual needs. Engine Performance Systems is integrated with the Kongsberg K-Chief automation system.



WORKSTATIONS



"Our marine automation systems offer functionalities that help reduce fuel consumption and thus emissions."

Ketil O. Paulsen
*Technical Director, Merchant Marine Division,
Kongsberg Maritime*



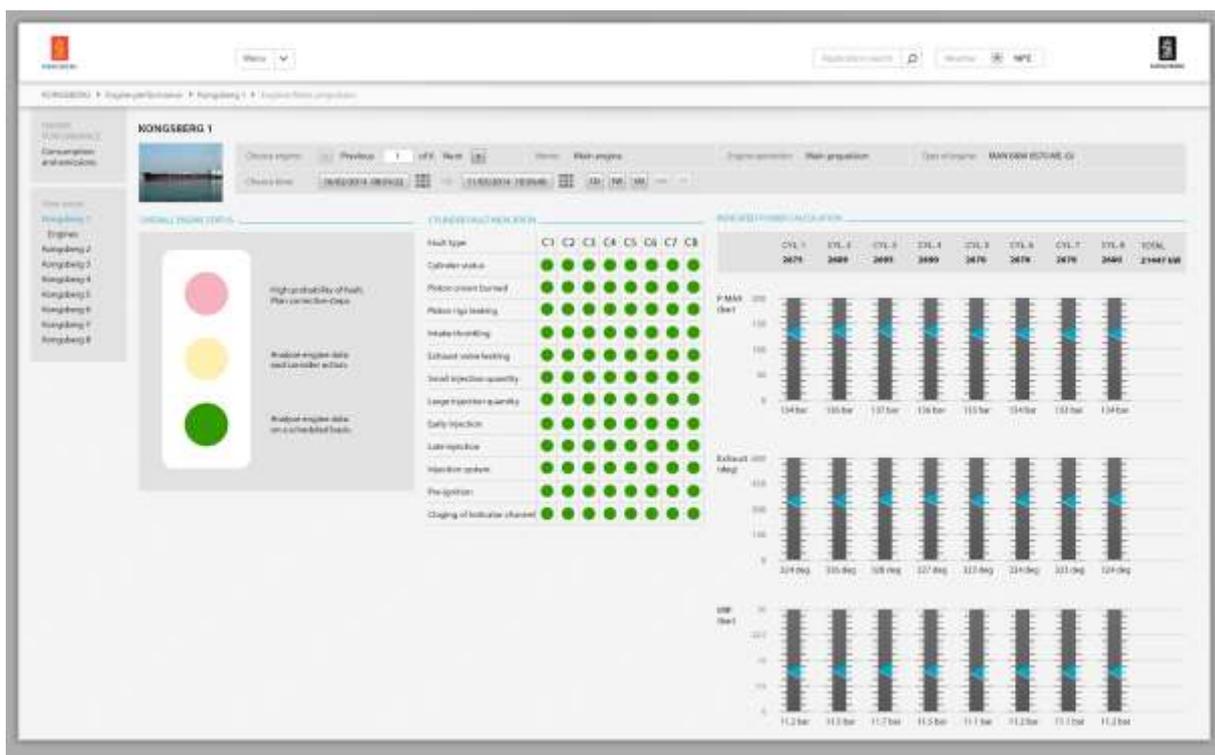
ENGINE CONDITION AND DIAGNOSTIC SYSTEM

The goal of the KONGSBERG Engine Condition and Diagnostic System is to achieve optimum thermodynamical and mechanical engine behaviour. This will again lead to low operating costs and high life cycle quality of the engines.

Included is:

- Continuous evaluation and permanent analysis of fuel injection process and combustion process. (Online or offline)
- Failure detection by expert algorithms regarding fuel injection system and combustion chamber area:
 - Intake manifold system
 - Fuel injection system
 - Overall combustion process
 - Liner/Piston group
 - Exhaust valves
 - Turbochargers
- Trend analysis (chronological, characteristic plot vs. engine load or speed) and trend prediction
- Integration of external monitoring devices
- Adaptive to:
 - different engine types (main propulsion engines, auxiliary engines)
 - operating conditions (full-speed, half-speed, slow, dead slow operation and slow steaming)
 - boundary conditions (very high / low ambient temperature, very high / low ambient humidity)
- Easy user interface with the use of traffic light indication

Engine overview





MODERN ENGINE TECHNOLOGY

With today's requirement for efficient and clean engines on board ships, we see an increased demand for online cylinder pressure measurement. The engines need to be in optimum running condition at all times to comply with tier 2 or 3 requirements. This can only be achieved with additional instrumentation.

MAN Diesel & Turbo has from March 2014 a requirement for all its new 2-stroke engines to have permanent installed pressure sensors on each cylinder as standard.

KONGSBERG has in cooperation with MAN Diesel & Turbo developed a custom interface to collect the data from these sensors. This greatly reduces the maintenance cost for the operator for such systems, while increasing the benefit for the vessel operator in respect to collecting data from the operation of the engine. KONGSBERG systems are positioned to work with any type of engine, fuel or technology.

Modern engines require modern instrumentation.

Reliable combustion pressure sensors available in the market.

Offline pressure sensor

The sensor is mounted on top of the indicator cock and manually moved from cylinder to cylinder.



Online pressure sensor

The sensor is permanently installed between the indicator cock and cylinder head of each cylinder allowing for online monitoring.



ADVANCED ENGINE DIAGNOSTICS

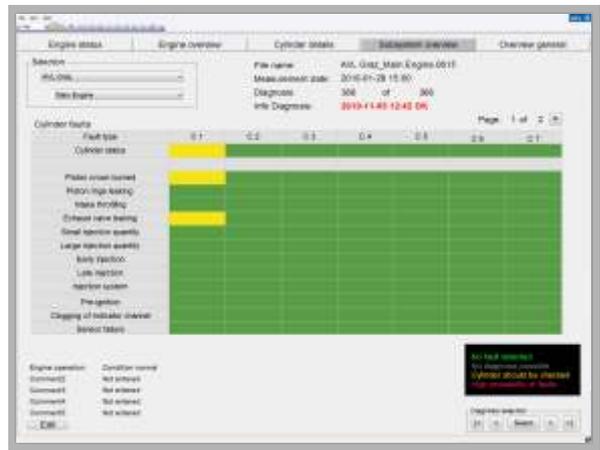
Through a simple user interface all measurement data is easily accessible for the operator.

State-of-the-art data analysis provides advanced engine diagnosis and decision support.

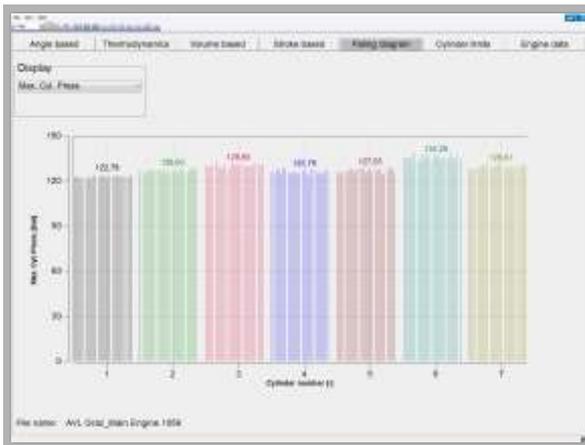
Engine overview diagram



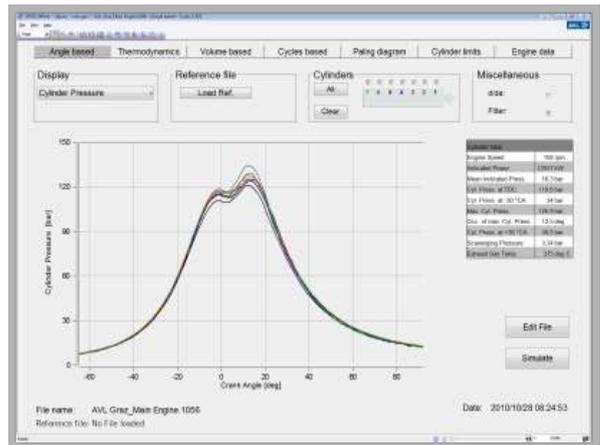
Engine subsystem diagnostics



Paling diagnostics



Angle based



ENGINE EMISSION MONITORING SYSTEM

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With the introduction of ECA zones and ever increasing demand for monitoring of the emissions from each vessel, KONGSBERG presents a integrated, robust and unique emission monitoring system for large bore engines. The system complies with Annex VI of IMO MARPOL, resolution MEPC.103(49) and the 'NOx Technical Code'.

KONGSBERG Engine Emission Monitoring System represents a groundbreaking new technology. While other systems measure the emissions by analyzing the exhaust in the funnel, KONGSBERG measures and analyzes the process that generates the emissions i.e. the combustion.

In more detail, the KONGSBERG approach is to determine the NOx emission with the help of a physical model based on the cylinder pressure measurements and the derived combustion analysis. Any changes to the process will therefore be detected and the model adapted to the changes automatically. No recalibration needed and sensor lifetime is typically more than 20.000 running hours.

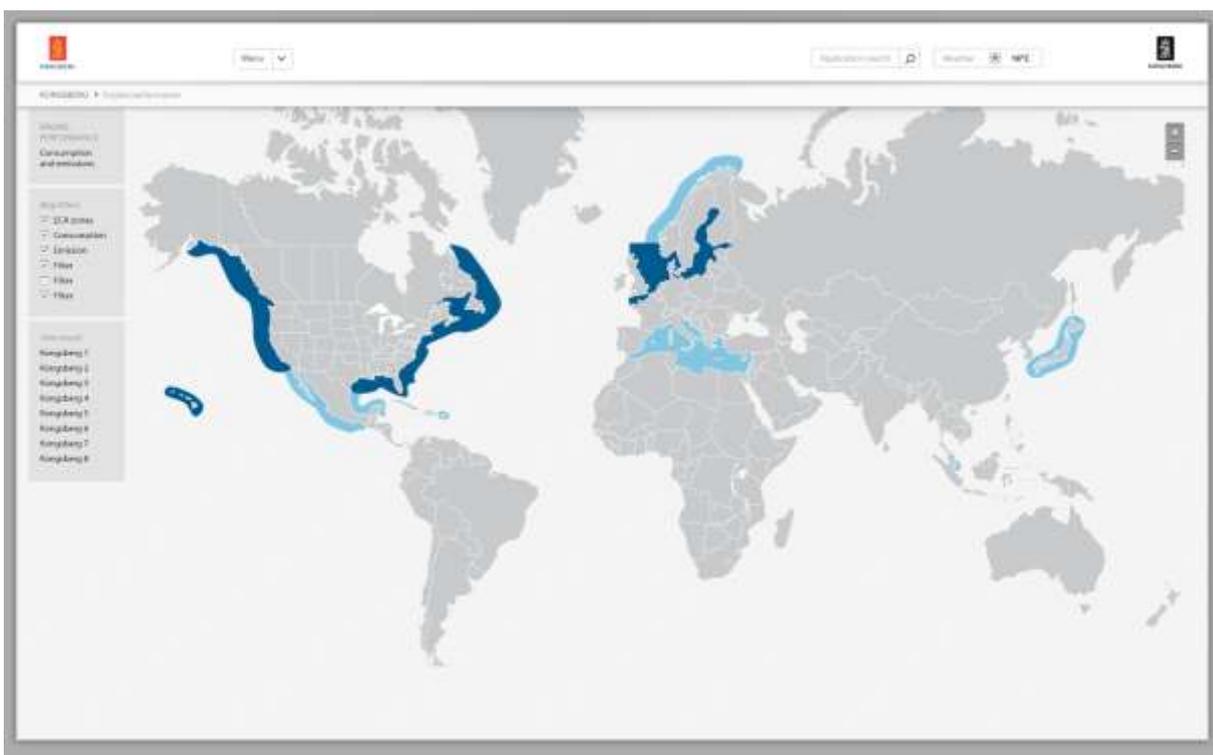
Required input for engine emission monitoring

- Cylinder pressure and crank angle signal
- Torque
- Engine load and speed
- Fuel consumption
- Fuel analysis report / Bunker specification
- Scavenging pressure
- Ambient temperature, pressure and humidity

To complete the emission report, CO2 and SOx results are computed directly from the mass-balance calculation applied to the adjusted fuel consumption and air mass flow together with combustion analysis.

KONGSBERG uses the physical model created by AVL List GmbH, our long term partner.

Overview of ECA zones

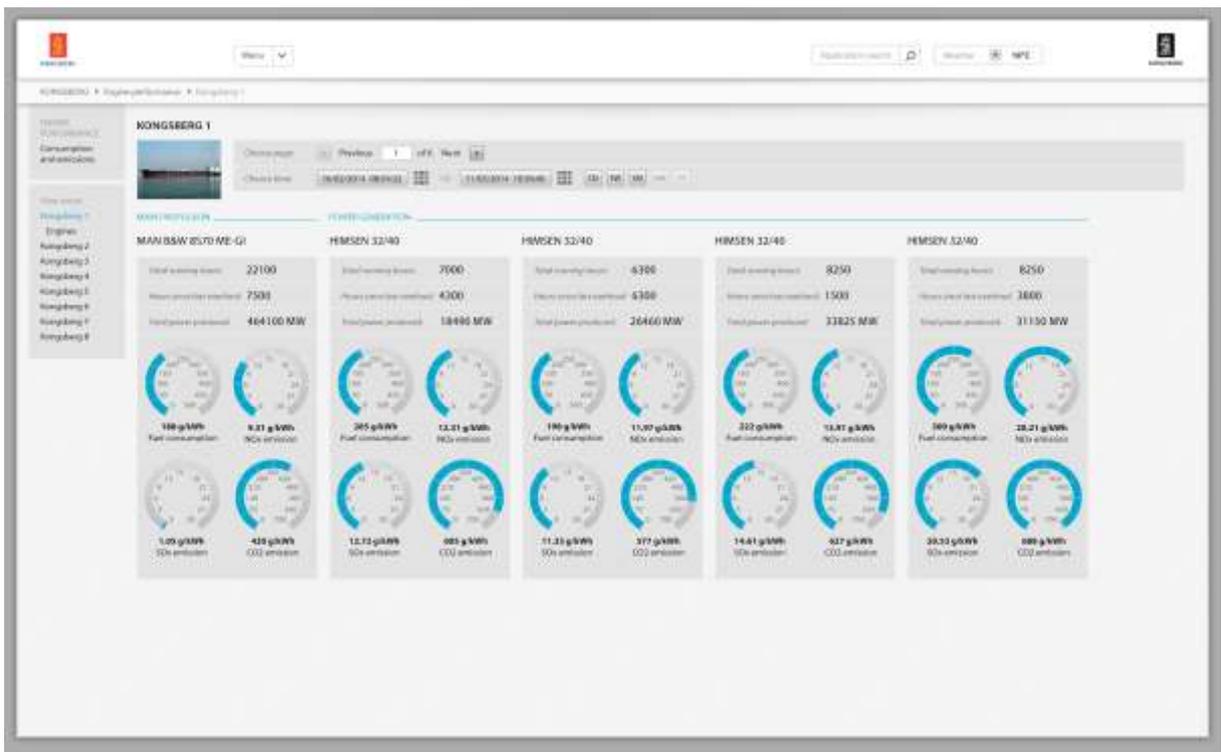


VESSEL AND FLEET CONTROL

Fleet view: Consumption and emission



Vessel view: Consumption and emission



CUSTOMER BENEFIT

Engine condition & diagnostic system

- Integration with K-Chief automation system
- Continuous engine and subsystem diagnostics during operation
- Warning in case of risk of damage
- Enabling operation optimization and fuel consumption reduction
- Trend analysis and prognosis of engine component condition
- Easily extendable to emission monitoring system

Engine emission monitoring system

- Easy to use emission monitoring
- Fully automatic operation
- Online, history and trend data available
- Automated report functionality
- No maintenance necessary (sensor life time more than 20.000 operating hours)
- No exhaust gas sampling necessary
- Easily extendable to condition monitoring system



REMOTE DIAGNOSTICS

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Remote diagnostics uses an online system and health monitoring to provide KONGSBERG customer support with remote access to ensure reliability.

The global network solution consists of two groups of devices, communication hubs and node network devices. All network traffic between network devices are encrypted. Any IP-based communication link can be utilized as a communication carrier.

Online service for instant analysis and assistance:

- Operational support and guidance
- Inspection of on board systems and interfaces
- Preparation and investigation prior to service visits
- Remote update of on board systems.

DATA FROM A MULTITUDE OF SOURCES ON BOARD SHIPS IS AVAILABLE FOR SAFETY ASSESSMENT ACTIVITIES



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 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-upgrades step by step meeting your changing requirements.

We take pride in knowing that KONGSBERG will give your training an additional competitive edge by:

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

World-class support program

Our customer support program provides world-class flexible system support to our global simulation system customers. The Long Term System Support Program (LTSSP) consists of three different levels of support: Basic, Priority and Premium Customized Care. Each support level offering is designed to address the customer's needs. Investing in an LTSSP ensures that your simulation system is always current and operating at peak capacity; and provides the assistance you need in order to deliver the best simulation training available.

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 instructor to technical training that keeps your staff fit on the job.

PLANNING & DESIGN	PROJECT ENGINEERING & DEVELOPMENT	INSTALLATION & COMMISSIONING	OPERATION & MAINTENANCE	MODERNISATION
		On-line support »		
		Technical	support »	
Technical consulting »				
	Design and	software engineering »		
			Field service »	
			Repairs	and spare parts »
			Optimization	and modernization »



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 favorable life cycle 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 worldwide. 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 optimize system availability and performance. Under the direction of your account manager, and with a local inventory of spare parts, our well qualified field service engineers will be able to help you quickly and effectively.

SUPPORT 24

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