

Complete Integrated Marine Solutions



Ingeteam

Ingeteam Power Technology - Marine: Adding Value Through Integration

Since its foundation in 1972 Ingeteam has been providing complete and specific solutions for the drive systems of electric motors and industrial plant process automation for the industry sector.

At Ingeteam Marine, we offer complete integrated solutions for the marine sector. Inside Ingeteam Group, we are the Business Unit leading the supply of turnkey electric projects, combining our electric engineering expertise with equipment manufactured in the Group.

We complement our products and systems with first-rate customer service, based on continuous collaboration with the Group, from the moment each system is designed and throughout the whole of its life cycle. This integrated approach allows us to deliver solutions adapted to each customer's exact needs.

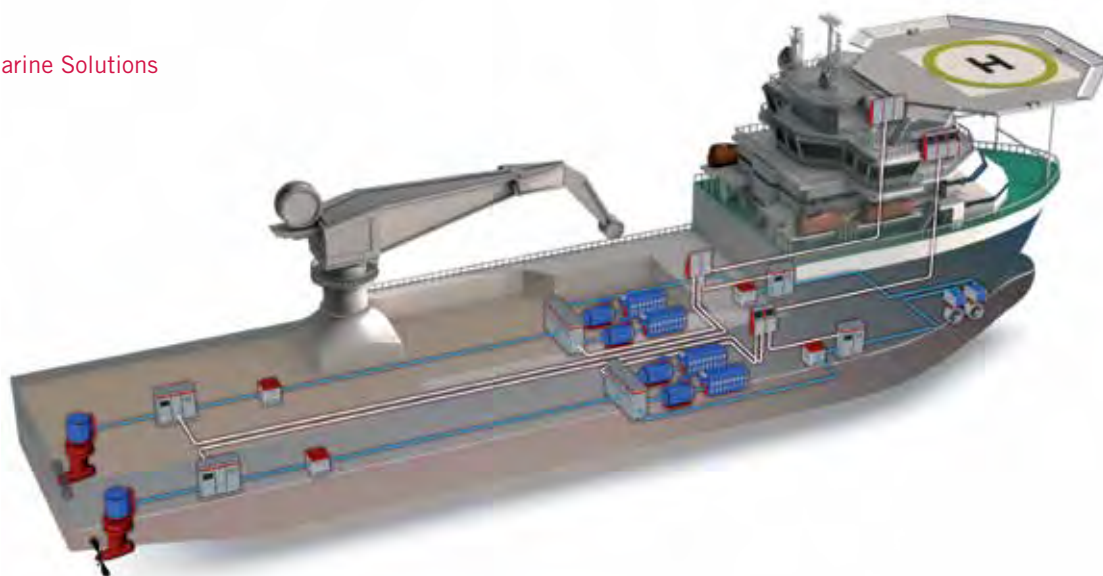
Our commitment to total quality, competitiveness, internal efficiency, preciseness and cautious business actions is the identity mark behind our company project. This way our company obtains added-value and hence protects the interests of shareholders and employees. To this end, Ingeteam assumes a proactive role in the continuous improvement philosophy implemented in all spheres



of activity; this takes us a step further in our way to the Business Excellence.

This spirit of adaptability is the force behind our own advanced technology which, in turn, allows a strong position in the international markets. That is the only way to win, to break limits and reach new goals.

Complete Marine Solutions



Our experience in the design of installations and equipment, our capacity to integrate other manufacturer's equipment, our proposals' flexibility, and a permanent coordination between our departments, enable us to attain the optimal solution for our customers. We are well-known in the market for providing customized solutions to meet the particular needs of each vessel. Our investments and projects in R&D+I allow us to maintain our technological position in the market.

For us it is also important to work side by side with our customers in the follow-up of the project, supervision of manufacturing

processes, integral test and sea trials.

Our turnkey deliveries include both basic and detailed engineering, as well as commissioning, and comprise all electric components of the vessel, such as:

- Electric Generation and Distribution.
- Electric Propulsion.
- Dredge Drives, Submersible motors.
- Integrated Automation, Control and Monitoring systems.
- Remote Assistance - INGESHIP RAS.

Fully Integrated solutions

POWER GENERATION AND DISTRIBUTION

SYNCHRONOUS GENERATORS

Our products are especially designed for application in the marine sector. By working in close collaboration with the manufacturers of diesel engines we are able to cater for the specific technical needs of each vessel, shipyard or ship-owner. Given the flexibility in their design, the INDAR (an INGETEAM brand) range of generators is manufactured in their standard format or custom-made according to each specific need. In both cases, INDAR offers a wide range of powers, speeds, voltages and cooling systems.

The power ranges available in synchronous generators varies from 1,250 kVA to 35,000 kVA, with 690 Vac to 15 kVac voltage ranges. Air or water-cooled, open or closed architecture, with brushes or brushless, with or without PMG.

High performance and capacity to withstand the overloads and vibrations generated by drives.

The mechanical design, protection level and type of cooling are studied individually to ensure they are compliant with the specifications of the ship-owner/shipyard.

Equipped with AVR (Automatic Voltage Regulator) Generators are designed and manufactured according to the main international standards (IEC, NEMA, VDE) and classifications societies (BV, LR, DNV, GL, ABS, RINA, KR, RMRS, CCS, etc).



INDAR SGM Series

The INDAR SGM generator series is especially designed for marine applications. The product range covers a wide range of constructive design and cooling solutions, always in compliance with the requirements of the corresponding classifying bodies.

Main features

Power	From 1250 kVA up to 35,000 kVA
Excitation	Brushless or with direct excitation (with brushes)
Speed	Whole range, from 4 poles
Voltage	Up to 15 kV
Generator isolation	Up to class H (180°C)

Other characteristics

Construction	Horizontal
Protection level	Up to IP-56
Cooling	Air, air-water (self-cooled or with forced cooling)
Supports	With anti-friction bearings or sleeve bearings
Other options	Possibility for adaptation to existing ship structure or constructive limitations

Standards

Design and manufacturing standards	According to IEC, IEEE, CSA, etc.
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Main options

Lub-oil, hydrostatic group, excitation equipment, braking systems, lifting systems, special sensors (vibration, partial discharges, speed, etc.).



MAIN AND AUXILIARY SWITCHBOARDS

We design and manufacture all types of main and auxiliary switchboards, both low and medium voltage featuring a wide range of voltages, currents and breaking capacities, using in-house design enclosures to maximize the robustness of our equipment.

Medium and Low Voltage Switchboards are equipped with the most reliable and robust switchgears and protection devices for marine activities.

The quality of our products and services is backed by the careful design and construction of equipment, acceptance tests carried out at workshops, for the purpose of obtaining the corresponding certificates. After more than 30 years of activity in this field we have acquired considerable knowledge and skill in this area. We supply the following switchboards:



Medium Voltage Main Switchboards

Medium Voltage Main Switchboards, built in withdrawable units, for the vessel's main electrical distribution. With voltage ranges of 3.3 kV, 6.6 kV and 11 kV and short circuit capacity of up to 50 kA. Compliant with IEC standards and classification societies requirements.

Medium Voltage Main Switchboards have been subjected to the following types of tests:

- Internal arc fault test 50 kA, 0.5 sec according to the IEC 62271-200 standard.
- Temperature rise test up to 3,150 A, according to the IEC 62271-200 standard.
- Short-circuit test 50 kA, 3 sec. according to the IEC 62271 standard.
- Dielectric and protection rating tests according to the IEC 62271-200 standard.
- Seismic test according to the IEC 60068 and IEE344 standards, and the ETGI-1020 general technical specification.





Low Voltage Main and Auxiliary Switchboards

Low voltage main and auxiliary switchboards are designed either fixed, modular or draw-out, with certification of up to 100 kA short-circuit capacity, for the following purposes:

- Main Switchboards up to 690V
- Motor Control Centres (LV MCC)
- LV panels with individual starters (direct, with variable speed converters and soft-starters).
- AC/DC Low Voltage Distribution Cabinets
- LV Auxiliary Panels
- Electric Equipment in containers
- Special panels (generator governing and control, high power rectifiers, AC/DC regulator cabinets with air or water cooling).

Our LV Switchboards are guaranteed by the following type tests, conducted by an approved laboratory:

- Short-circuit test up to 100kA according to the IEC 60439 standard
- Temperature rise test up to 2500A according to the IEC 60439 standard
- Protection rating test according to the IEC 60439 standard
- Seismic test according to the IEC 60068 and IEE344 standards, and the ETGI-1020 general technical specification.



ELECTRIC PROPULSION SYSTEMS

Ingeteam Group provides electric propulsion systems tailored for optimal efficiency, reliability and performance, we manufacture frequency converters and electric propulsion motors as well as other types of motors for marine sector.

The benefits of electric propulsion for Vessels are numerous:

- Optimal performance of the propeller.
- Availability of the maximum torque at every speed.
- Optimal acceleration response.
- Minimal vibration, noise, and smoke emissions.
- Savings in hull space.
- Optimization of power installed on board.
- Power provided up to 15.000 kW.
- Low operating cost.
- Layout flexibility.
- Reduced maintenance.

FREQUENCY CONVERTERS



With over 40 years' experience, Ingeteam's drives cover a wide range of applications in Marine Sector.

Ingeteam designs and manufactures MV and LV variable speed drive solutions for the most demanding applications in terms of control requirements and environmental conditions. With the latest design in power electronics and control, Ingeteam offers an extensive portfolio of drives.

INGEDRIVE™ is a family of low- and medium-voltage modular AC drives designed for demanding single-motor or multi-motor applications handling and controlling synchronous, induction, and permanent magnet motors.

These drives are suitable for four-quadrant operation, driving and braking in both rotational directions.

INGEDRIVE™ is available with power ratings up to 36 MVA, from 400V to 690V in low voltage and 3.3 kV to 6.9 kV in medium voltage, offering great performance, robustness, reliability, and long life expectancy.

Main Features

Wide range of powers and voltages: the use of different types of semiconductor for each range, as well as appropriate topologies makes it possible to provide the best solution for almost any application.

Modular design: the modular design upon which the INGEDRIVE™ family is based makes it possible to design a "Custom-Made Configuration" for each client and application.

Converter architecture: the control system is based on two elements - the CCU (Converter Control Unit) and the PMM (Power Management Module) associated to each of the BPMs (Basic Power

Modules) combined with which a wide range of configurations can be achieved. Furthermore, this hardware facilitates easy expansion of I/O capacity and communication modules.

Flexibility: this is achieved thanks to the combination of basic power modules (BPMs) and control modules, which allow the rectifier to choose from DFE (6, 12 or 24 pulses) or AFE (Active Front End) topologies and different inverter modules for single or multi-drive solutions according to client requirements.

Intuitive troubleshooting: The system includes the "Web Server" functional feature with no additional parameterizing program requirements. This enables remote access to converters and permits the analysis of potential failures, thus minimizing repair times whilst maximizing drive availability.

High quality: the parts and elements used in the converter are selected according to quality and life expectancy improvement concepts, thus extending the availability and life expectancy of the drive system as a whole.

Safety: INGEDRIVE™ is based in our Safety Drive Cabinet (SDC) system, which is a system guaranteeing safe, "0" voltage access to converters both in low and medium voltage. Other safety features also include flame-retardant and halogen-free properties, wiring and cable ducts.

Standards: the entire INGEDRIVE™ converter family complies with IEC international standards for low and medium voltage converters. The high quality of our equipment enables us to attain certification from the most renowned classification bodies, such as Lloyd's Register, DNV, ABS and BV.

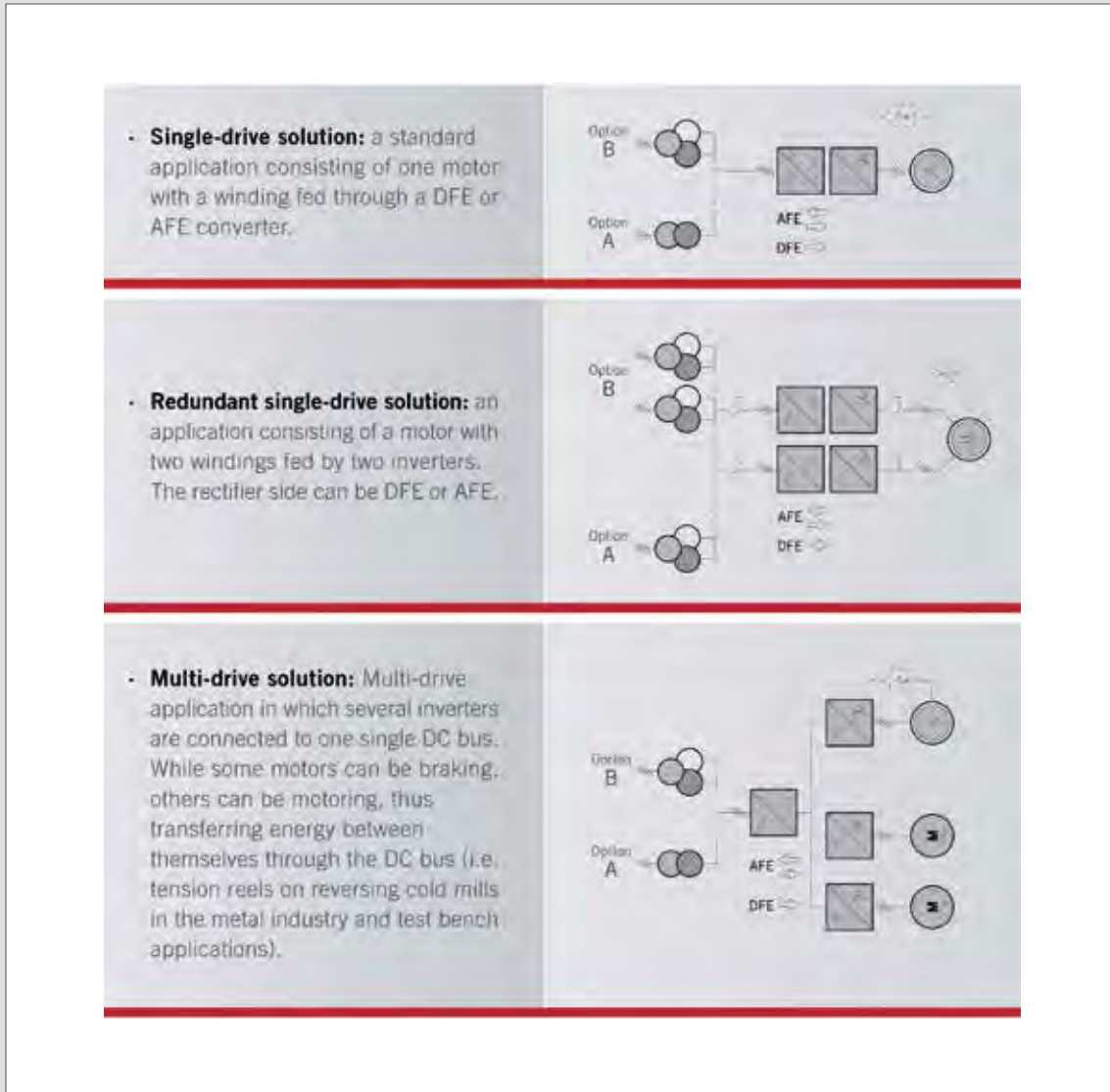
Excellent performance: the high performance of INGEDRIVE™ families makes it possible to achieve energy savings and improvements in efficiency.



Topologies and Configurations

INGEDRIVE™ can be applied to custom made to specific requirements. It can control motors with one or several windings and cater to the needs of redundant, single-motor and multi-motor solutions. Parallel connection of several inverters to the

same motor is feasible allowing higher converter output. It is also possible connect several AFE rectifiers in parallel so that more power can be handled.



Cooling Systems

The INGEDRIVE™ family offers converters cooled by air or by water (fresh water or sea water). Our water-cooled equipment is manufactured in stainless steel. Easy maintenance and reliable materials such as quick connectors, three-way valves for regulating the incoming temperature, redundant deionizing systems for

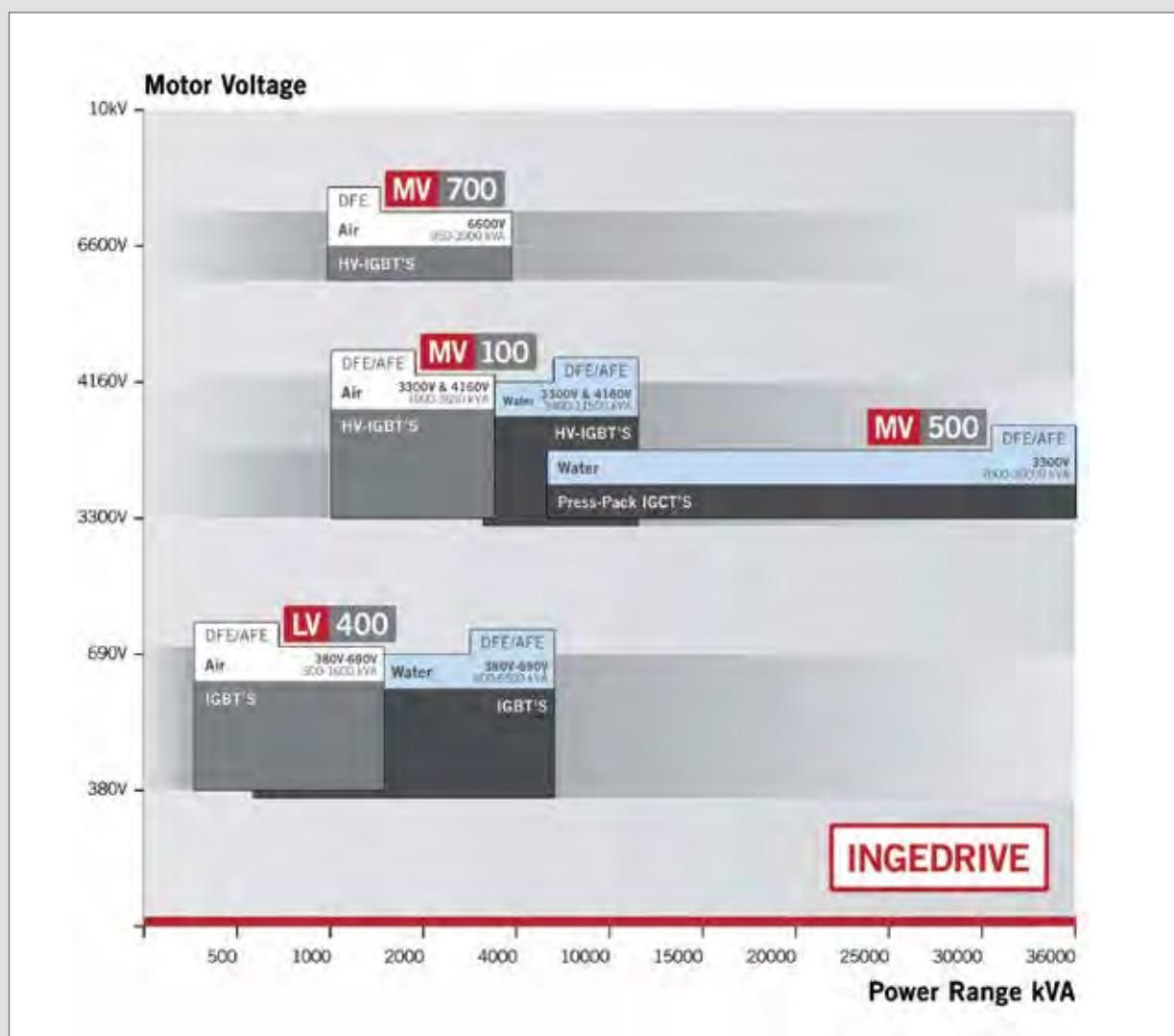
medium-voltage drives (for MV500 family based in IGCTs) and redundant pumps with valves are installed. All parameters such as pressure, temperature, leakage and conductivity are constantly monitored.

Product Range

INGEDRIVE™ offers different configuration options depending on your needs, such as non-regenerative systems, 6, 12, or 24-pulse DFE or AFE regenerative systems, as follows:

- LV400 (low-voltage AC drive based on IGBTs. Air and water cooled) 6P DFE, 12P DFE, AFE as standard.
- MV100 (medium-voltage AC drive, based on HV-IGBT modules. Air and water cooled) 12P DFE, 24P DFE, AFE as standard.
- MV500 (medium voltage AC drive, based on IGCTs and water cooled) 12P DFE, 24P DFE, AFE as standard.
- MV700 (medium voltage AC drive, based on HV-IGBT modules. Air cooled) 24P DFE as standard.

The AFE topology makes it possible to work with a unity power factor with lowest harmonics throughout the application's entire functional range. A further advantage in AFE systems is the regeneration of the motor's kinetic energy during braking, resulting in a highly-efficient configuration.



ELECTRIC MOTORS

INDAR (100% Ingeteam Group subsidiary) manufactures all types of motors, alternating as well as direct current motors, required for the drives installed on board of the vessels, especially those used for electric propulsion. INDAR manufactures all type of motors used in the Marine Sector.

- Synchronous or asynchronous motors designed to cover power ranges from 400 kW to 15 MW and voltage ranges from 690 Vac to 15 kVac. Available in the horizontal and vertical construction variants. Different protection and cooling levels. These motors are used in the main electric propulsions or in auxiliary bow and stern propulsions, pump drives, deck equipment, etc.
- Direct Current Motors, with power ranges from 400 kW to 4 MW. With extremely precise speed regulation, based on state-of-the-art converters. These motors are used in fishing machinery and propulsions with low noise emissions (especially designed for oceanographic vessels). Meeting the extremely demanding rules as ICES 209 and DNV Silent-R.
- Compliant with the requisites of the main international standards (IEC, NEMA VDE) and classifications societies (BV, LR, DNV, GL, ABS, RINA; KR, RMRS, CCS, etc.).

Product Range

The INDAR range of electric motors provides a response to the technical demands used in the Marine Sector.



INDAR IM

The INDAR IM Series is a family of squirrel cage and slip ring motors designed and manufactured by Indar.

Main Features

Power	From 400 kW to 15000 kW
Speed	From 1800 rpm to 100 rpm
Voltage	From 400 V to 15000 V
Motor isolation	Class H
Temperature increase	According to Class B or Class F

Other Characteristics

Construction	Horizontal or vertical
Protection level	Up to IP-56
Cooling	Air, air-water, air-air (self-cooled or with forced cooling). If an air-water cooler is used, the cooling will be studied according to the characteristics of the application
Supports	With anti-friction bearings or sleeve bearings
Ambient temperature	Up to 65 °C
Colour	Standard colour RAL-5015

Standards

Design and manufacturing standards	According to IEC or NEMA
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Main Options

Heating resistor, PT-100 in windings, PT-100 in bearings, PT-100 in air circuit, thermometers, lub-oil, cooling units, speed measurement device.

Certification by classifying bodies such as BV, LR, DNV, RINA, ABS, KR, RMRS, CCS, etc..



INDAR DCM

The INDAR DCM Series is a family of DC motors designed and manufactured by Indar. The DCM series is available in two versions: one is for standard DCMI industrial applications and the other, called DCMM, is designed for marine applications with low noise requirements for compliance with ICES 209 and DNV Silent-R recommendations.

Main Features

Power	From 400 kW up to 4000 kW
Speed	From 1800 rpm to 100 rpm
Voltage	From 400 V up to 1000 V
Motor isolation	Class H
Temperature increase	According to Class B or Class F

Other Characteristics

Construction	Horizontal
Protection level	Up to IP-56
Cooling	Air, air-water, air-air (self-cooled or with forced cooling). If an air-water cooler is used, the cooling will be studied according to the characteristics of the application
Supports	With anti-friction bearings or sleeve bearings
Ambient temperature	Up to 65 ° C
Colour	Standard colour RAL-5015

Standards

Design and manufacturing standards	According to IEC or NEMA
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Main Options

Heating resistor, PT-100 in windings, PT-100 in bearings, PT-100 in air circuit, thermometers, lub-oil, cooling units, speed measurement device.
Certification by classifying bodies such as BV, LR, DNV, RINA, ABS, KR, RMRS, CCS, etc.



DREDGE DRIVES

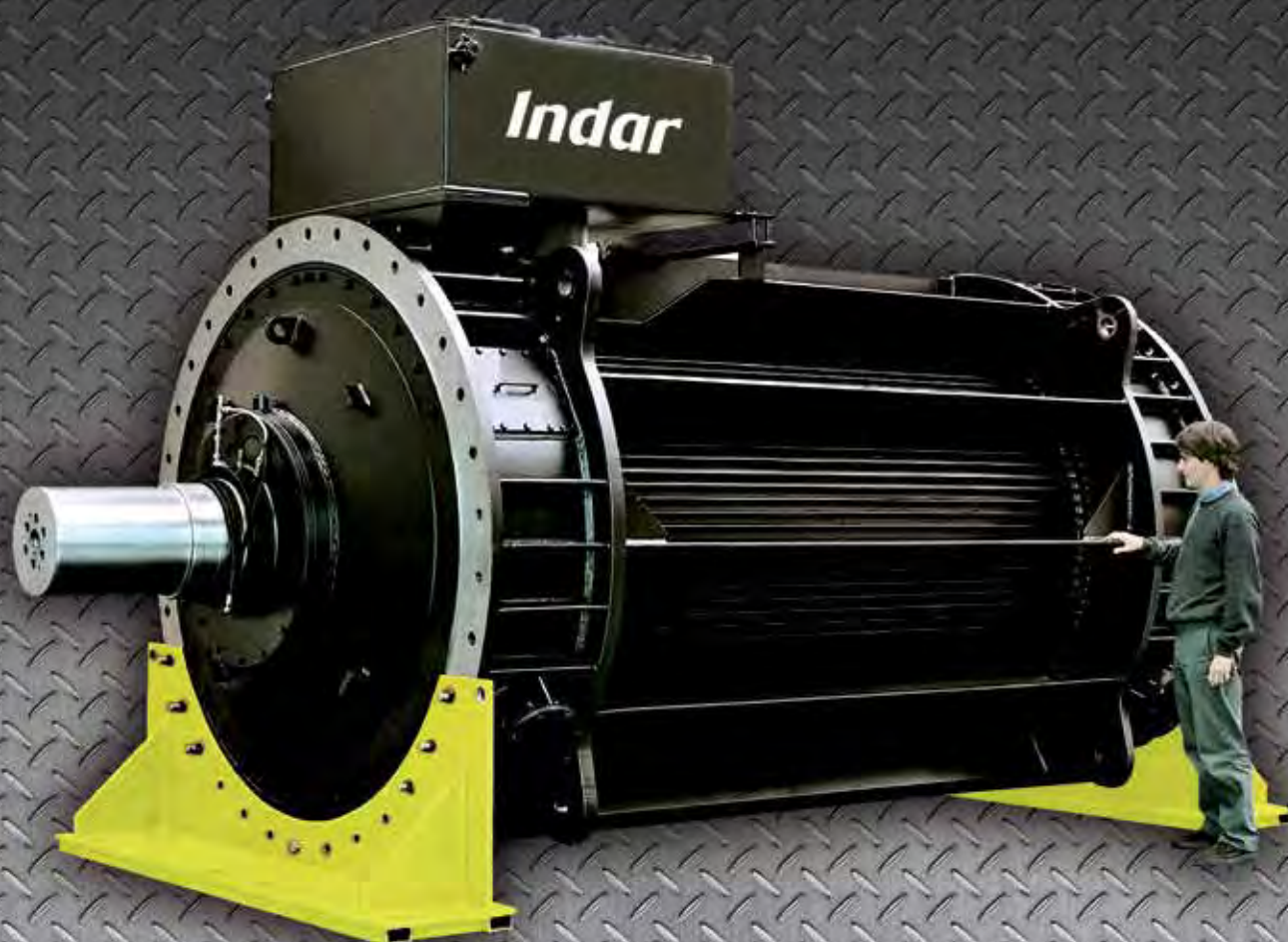
SUBMERSIBLE MOTORS

The experience built up in the INGETEAM Group has allowed us to tackle these solutions with induction motors with power from 1.000 kW up to 10.000 kW and voltage from 690 Vac up to 15 kVac, used as direct or indirect pump drives in dredgers and cutters.

Degree of protection IP68 (the design of the cover, connection box and bearing box is of fundamental importance).

Different types of cooling (oil, water or air). Submersible up to a depth of 1.000 meters.

INDAR is a world leader in this line of hi-tech equipment, having manufactured and installed the highest range power submersible motor currently in the world.



INDAR ISM

The INDAR ISM Series is a family of submersible squirrel cage motors capable of working at depths of up to 1000m. It covers a range of powers from 400 kW up to 8000 kW and power supply voltages from 400 V to 6.600 V. The INDAR ISMS series is composed of submersible motors designed for dredging applications, mining or equipment working in deep waters.

Main Features

Power	From 400 kW to 8000 kW
Speed	From 500 rpm to 200 rpm
Power Supply	Directly from the grid or from frequency converters
Voltage	From 400 V to 6600 V
Motor isolation	Class H

Other Characteristics

Construction	Horizontal
Protection level	IP-68
Work angle	From 0° to 90° with the horizontal
Supports	With bearings

Standards

Design and manufacturing standards	According to IEC
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Main Options

Heating resistor, PT-100 in windings, PT-100 in bearings, PT-100 in air circuit, thermometers, speed measurement device.



INTEGRATED VESSEL AUTOMATION SYSTEMS

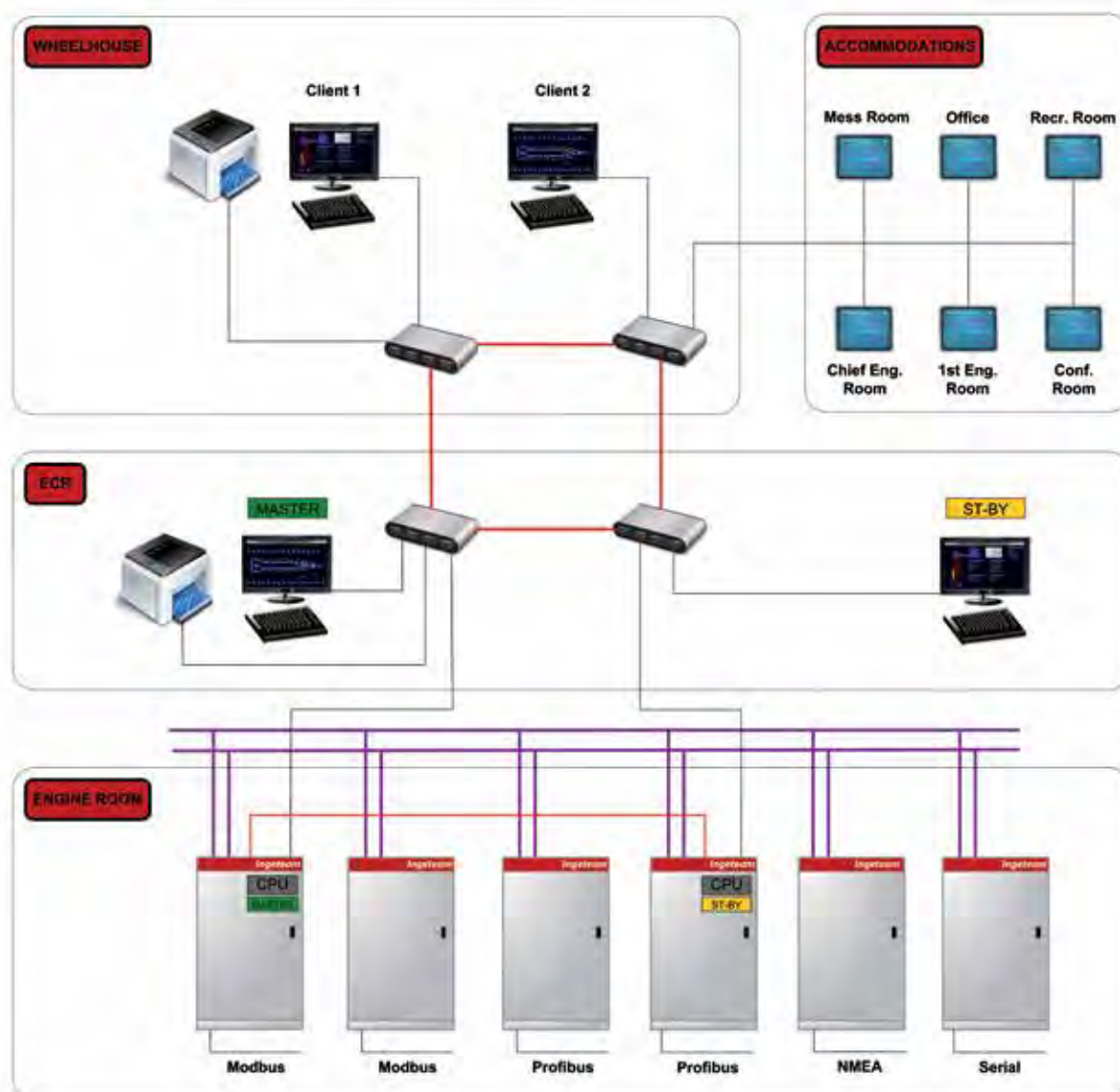
INGESHIP IAS

INGESHIP IAS (Integrated Automation System) is designed to meet the requirements of the modern vessels.

The system is formed by COTS (Commercial Off-The-Shelf) PLCs and computers which allow total availability of spares.

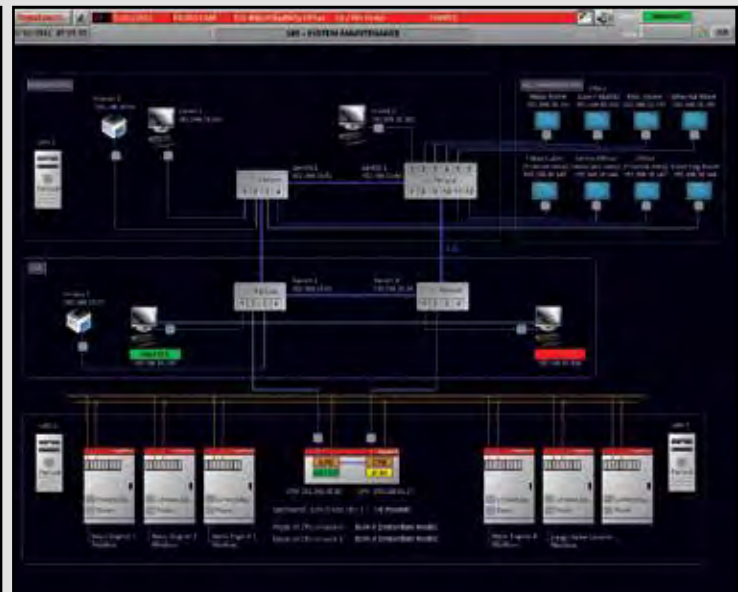
Both on the controller level and on the working station servers level, fully hot-stand-by redundant equipment is used, achieving the highest degree of redundancy of the installation.

Configuration





PROPULSION CONTROL AND MONITORING



DIAGNOSTICS & MAINTENANCE TOOLS

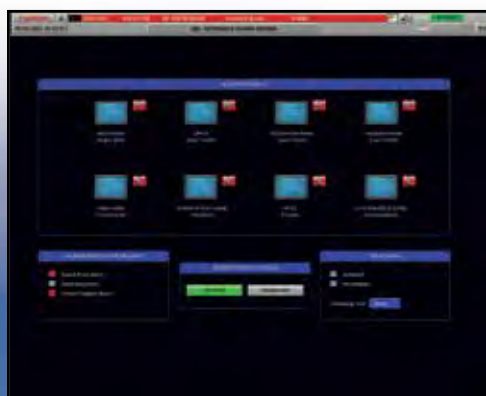




POWER MANAGEMENT SYSTEM (PMS)



ENGINE MONITORING



EXTENSION ALARM SYSTEM



CONTROL OF ENGINE ROOM AND CARGO SYSTEMS

INGESHIP IAS TechFunctions

Ingeteam, in close cooperation with the ship-owner, also develops special custom solutions for high-tech vessels designed for specific marine works like dredgers and subsea rock installation vessels. These solutions allow the operators to monitor and to control a complex process in an easy way.



SOLUTIONS BASED ON THE VESSEL TYPE

Depending on the vessel type, Ingeteam is able to supply solutions for:

- | | |
|-------------------------------------|-------------------|
| • Trailing Suction Hopper Dredgers | • Anchor Handlers |
| • Subsea Rock Installation Vessels: | • Cable Layers |
| - Fall-Pipe and Mining Vessels | • Pipe Layers |
| - Side Stone Dumping Vessels | • Jack-Ups |

Solutions for Trailing Suction Hopper Dredger

MONITORING AND REMOTE CONTROL OF THE DREDGE VALVES, JET WATER VALVES, GLAND VALVES AND FLUSHING VALVES



MONITORING AND REMOTE CONTROL OF THE DREDGE PUMPS, GLAND PUMPS, FLUSHING PUMPS AND JET PUMPS



AUTOMATIC DREDGE PUMP CONTROL
 SUCTION TUBE POSITION MONITORING
 DISCHARGE PROCESS CONTROL: DUMP, PIPELINE, RAINBOWING



Solutions for Fall-Pipe Vessel



PIPES STORAGE MANAGEMENT



FALL PIPE ASSEMBLY AND DISASSEMBLY



FALL PIPE ASSEMBLY AND DISASSEMBLY



PRODUCTION MEASUREMENT AND CONTROL



Solutions for Side Stone Dumping Vessel



MONITORING AND REMOTE CONTROL OF THE SLIDES AND FLAPS FOR THE STONE COMPARTMENTS



BALLAST SYSTEM AUTOMATIC FUNCTIONS



Common Features



MONITORING AND REMOTE CONTROL OF THE HYDRAULIC SYSTEM AND ANCHORS



DRAUGHT AND LOADING MONITORING

DIAGNOSTIC SYSTEM, TRIP REPORT AND DATA EXPORT FOR FURTHER ANALYSIS



INGESHIP PMS

INGESHIP PMS (Power Management System) is an essential part of the automation and electrical systems on marine vessels, especially in those with electric propulsion. The PMS controls the power system in order to maximize the blackout prevention capabilities and decrease the maintenance costs, due to the protection of the equipment against faults and malfunctions.

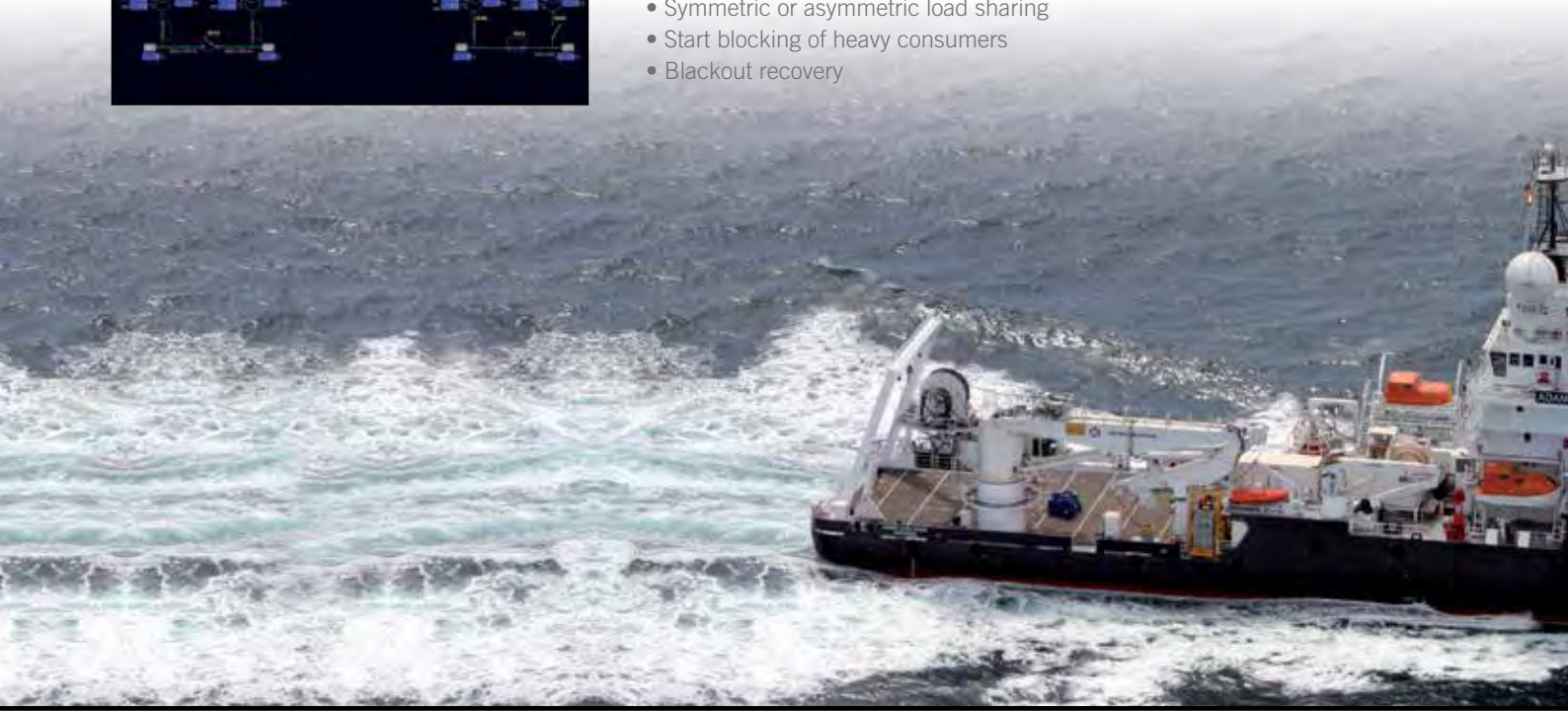


This system can be stand-alone, or completely integrated in the INGESHIP IAS. In both cases, the features of the system are:

- Reliability
- Safety
- Complete redundancy of system
- User-friendly SCADA

Functions

- Circuit breakers connection & synchronization
- Diesel generator control:
 - Manual start and stop of engines.
 - Load dependant automatic start or stop request
 - Automatic start request from blackout recovery function
 - Automatic start due to failure condition on other diesel generator
- Power Limitation of Frequency Drives
- Load shedding of non essential services
- Symmetric or asymmetric load sharing
- Start blocking of heavy consumers
- Blackout recovery

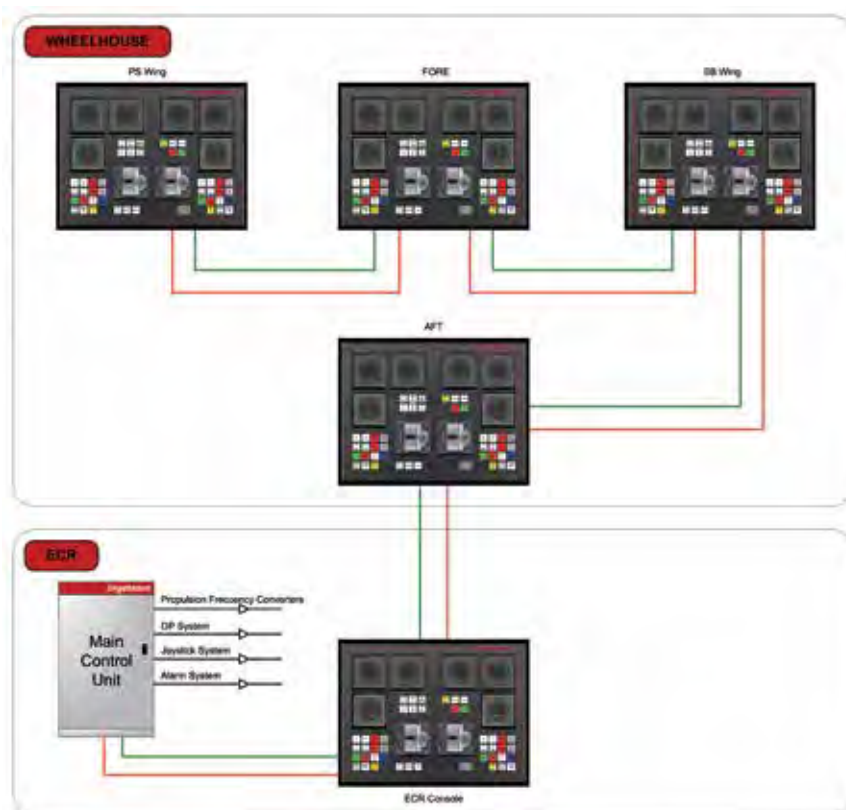


INGESHIP PCS

INGESHIP PCS (Ingeteam Propulsion Control System) is the perfect solution for controlling the main propulsion of a diesel electric vessel in an efficient way and with a reduced cabling cost. The system is based in a field bus communication in ring configuration allowing redundancy in communications.

Main features

- Control from various bridge locations and ECR.
- Control modes:
 - Speed mode
 - Power mode
- Smart Power/Speed curves
- Reduced cabling
- Modular design
- Integration with INGESHIP IAS



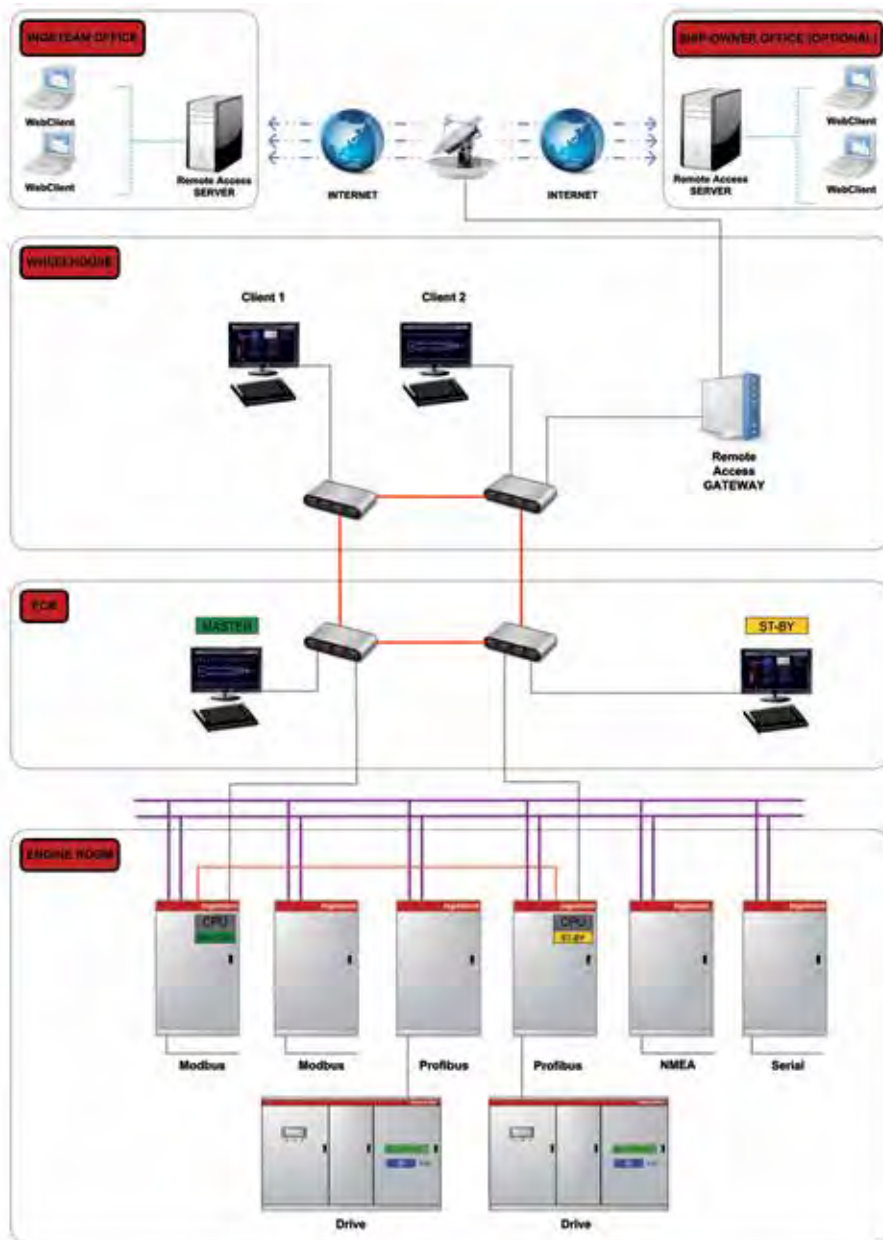
INGESHIP RAS

The main purpose of the INGESHIP RAS (Remote Access System) is to allow supervision, control and maintenance of our automation systems from any place with an internet connection and the correct access rights.

The technical staff in charge of maintenance, can access the equipment (frequency converters, recorders, PLCs, HMI systems) over the Internet securely and simultaneously to perform

maintenance tasks. This solution provides technical personnel a complete view of the status of the installation at any time and also allows preventive maintenance to be carried out on the equipment.

The system is implemented by means of a series of distributed applications and agents that communicate with each other using web services.



- Remote Access SERVER: This software is installed on the Ingeteam server and allows technicians to access, via the Web interface, the equipment at the installations for which they have authorisation. Optionally, in order to have an independent control of the installations, another server may be installed on the ship-owner facilities.
- Remote Access GATEWAY: This software is installed in the remote access gateway equipment and provides a secure connection from the outside to the installation equipment.
- Remote Access NODE: This software is installed in the equipment distributed in the remote installation (HMI's, Frequency Drives Configurator, ...) and enables them to be controlled remotely.
- Remote Access WebClient: This software is used by users to access the remote installations using an Internet browser.

CONSOLES

Ingeteam supplies the needed consoles in order to integrate all the systems involved onboard.

Integrated systems:

- Alarm Monitoring and Control System,
- Navigation and communication equipment (BNWAS, Radars, ECDIS, DGPS, Gyrocompass, Telephones, etc),
- DP/DT system,
- Engine Control System,
- Dredging Control System,
- Fall-Pipe and Mining Control System,
- Side Stone Dumping Control System,
- Cargo System,
- Survey System, CCTV, etc.



Types of Consoles:

CENTRAL NAVIGATION CONSOLES



WING CONSOLES



ENGINE CONTROL ROOM CONSOLES



CARGO / PROCESS CONSOLES



INGETEAM SERVICES

In its commitment to offer its client comprehensive, custom-made solutions, INGETEAM provides 360° CRS service with its entire product range.

360° CRS is a dynamic, customized service that covers all of the phases and points of contact between INGETEAM and our clients.

This service is supported by a professional technical team whose goal is customer satisfaction and continuous improvement

Consultancy, Engineering and Custom-Made Supply

Design and execution of basic and detail engineering of the whole vessel's electrical installation, including the supply of all the required and related equipment.

Installation and assemblies

Following a previously developed project and in compliance with agreed upon regulations, between the ship owner and classification entities, the execution and supervision of the assembly works is carried out by specialist personnel, who have participated in the elaboration of the engineering.

Commissioning

Carried out by our technical personnel that actively participated in the elaboration of the project. Before commissioning the systems installed in the vessel functional test are carried out at our premises. These tests reduce costs and the execution delay of this part of the project ensure that commissioning is performed with maximum quality, safety and efficiency.

Training

Carried out at our headquarters or the ship owner's and/or shipyard installations, through tested-out courses adaptable to each type of vessel. Our training personnel offers you a comprehensive range of learning solutions. These solutions are designed to give the required technical understanding and working skills to guarantee the functionality of vessel installation.

After-sale Technical Support, Maintenance and Spare Part Management

The required assistance is carried out by establishing a connection between our headquarters and the different communication

of products and services always hand in hand with the latest advances and technologies in each application.

Our technical staff permanently provides direct assistance and support to our clients for the equipment that we supply. We provide this support during the project development as well as after the contractual guarantees have expired.

These services include:

solutions, IngeRAS and cover technical assistance of up to 24 hours/365 days a year.

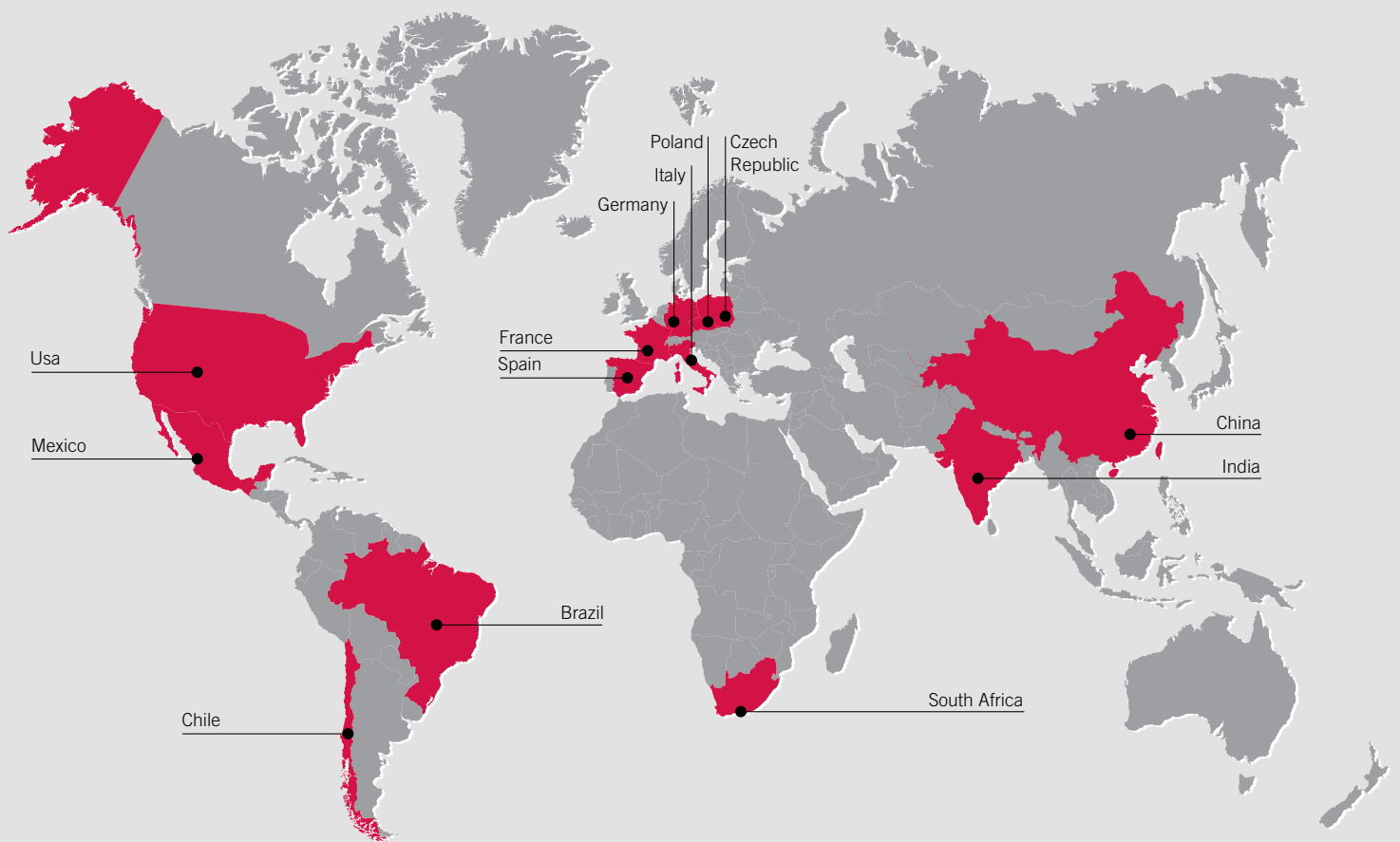
Our service, together with our workshop network allows us to offer an effective and agile service. The initial analysis made during the commissioning of our machines and equipment allows us to develop personalized maintenance programs.

Response times, key account engineers and support demands can be defined by agreement, and aligned with the level of availability required. Such an agreement can be combined with the maintenance services and a spare parts availability contract.

Through our spare parts service, we establish calendars and specific initiatives in close coordination with our technical assistance team.



INGETEAM WORLDWIDE



Ingeteam

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