



**Experience in Wind,
Strength in Design,
Partnership in Business.**

Power converters
Generators
Turbine controllers
Condition Monitoring Systems (CMS)
SCADA management systems
Services

Ingeteam

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THE FORMULA OF THE NEW ENERGY



Energy

Industry

Marine

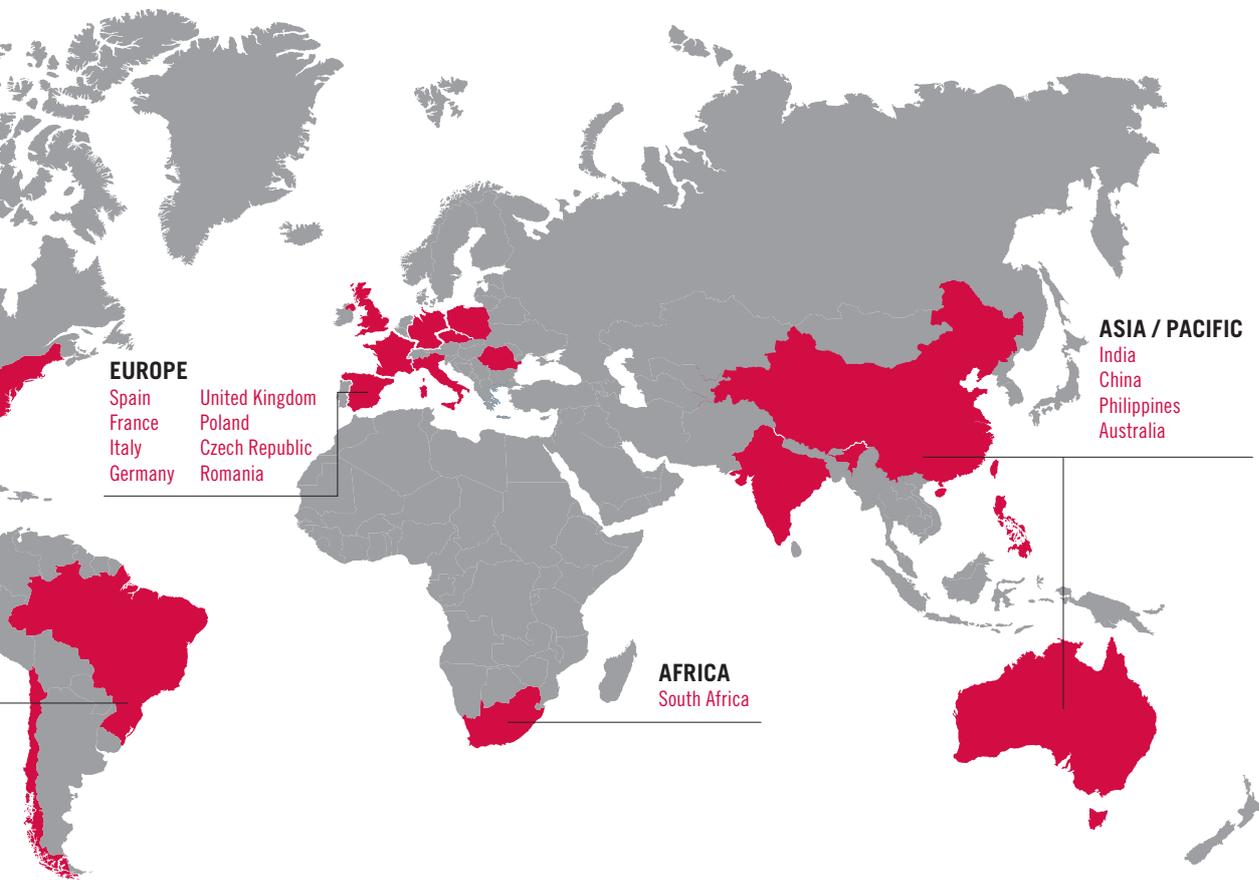
Traction

Basic Technologies

Services



Innovation and commitment



Ingeteam is a global corporation specialized in 6 different sectors (Energy, Industry, Marine, Traction, Basic Technologies and Services); customer oriented and specialized in power and control electronics, electrical machines and application engineering.

With more than 60 years of experience in the electrical sector, Ingeteam's 3,032 professionals are dedicated to engineering, project development and manufacturing. Ingeteam is committed to investing in technology and innovation as the drivers of future growth.

Since 1990, the Energy business unit of Ingeteam is dedicated to supplying equipment for the renewable energies sector: wind power, photovoltaic, solar thermal, hydro-power, biomass and biofuels.

Ingeteam is a complete solution provider. We design, develop, manufacture and provide maintenance for a complete range of wind turbines, offering a tailored solution to meet every project's requirements.

30 GW OF INSTALLED WIND POWER CAPACITY WORLDWIDE



Tailored electrical solutions



Why Ingeteam?

Ingeteam is an independent supplier of **power converters, generators, turbine controllers, condition Monitoring Systems (CMS), SCADA management systems and services for wind turbines up to 10 MW for onshore and offshore applications.**

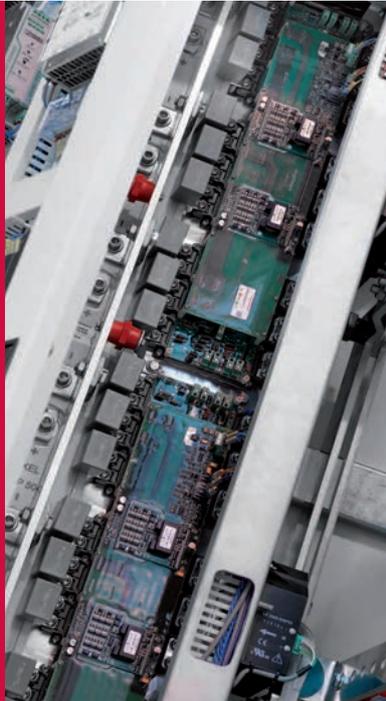
Thanks to our extensive product range and experience acquired through multiple business sectors, Ingeteam is the global market leader in wind turbine electrical conversion equipment.

Since 1995, Ingeteam has fitted more than 20,000 wind turbines with Ingeteam converters and generators, accounting for a power output capacity of 30 GW.

Our value proposition:

- **R&D**
We are committed to innovation and development of full in-house technology. *R&D expenditure accounts for 9% of net sales.*
- **FLEXIBILITY**
We are flexible. Our engineering teams can provide you with solutions tailored to meet your project needs.
- **GLOBAL PRESENCE**
We have manufacturing facilities and service centers strategically located in Europe, Asia, North and South America to deliver the most efficient support and service to you.
- **EXPERIENCE**
We have 30 GW of installed wind power capacity worldwide and 20 years of experience in the wind industry. *Almost 10% of all wind turbines worldwide operate with Ingeteam technology.*
- **PARTNERSHIP**
We are partners, providing you active support for each specific project throughout the entire product life cycle.

Ingeteam offers a comprehensive range of proven and reliable electrical equipment for wind turbines up to 10 MW for onshore and offshore applications.



1

Power converters

Low and Medium voltage power converters, optimized for DFIG and FC topologies.

Full power converters specifically designed for each generator technology (PMG, IG, EESG).

Air cooled, air/water cooled and full water cooled solutions for harsh environments.

Up to 10 MW for onshore and offshore applications.

2

Generators

Synchronous or asynchronous technology.

Air and water cooled.

Low and medium voltages.

Direct drive, medium and high speed.

3

Turbine Controllers

Turbine Controller systems offering advanced performance, with regard to input-output signals, processing capacity and communications, to meet the requirements of each and every wind turbine manufacturer.

Product range



4

Condition Monitoring Systems (CMS)

A rotary machine condition monitoring system providing all information on the operating status of the wind turbine drive train's key elements through the analysis of vibration levels, oil condition, components temperature, etc. reducing the risk of failure and maintenance costs.

5

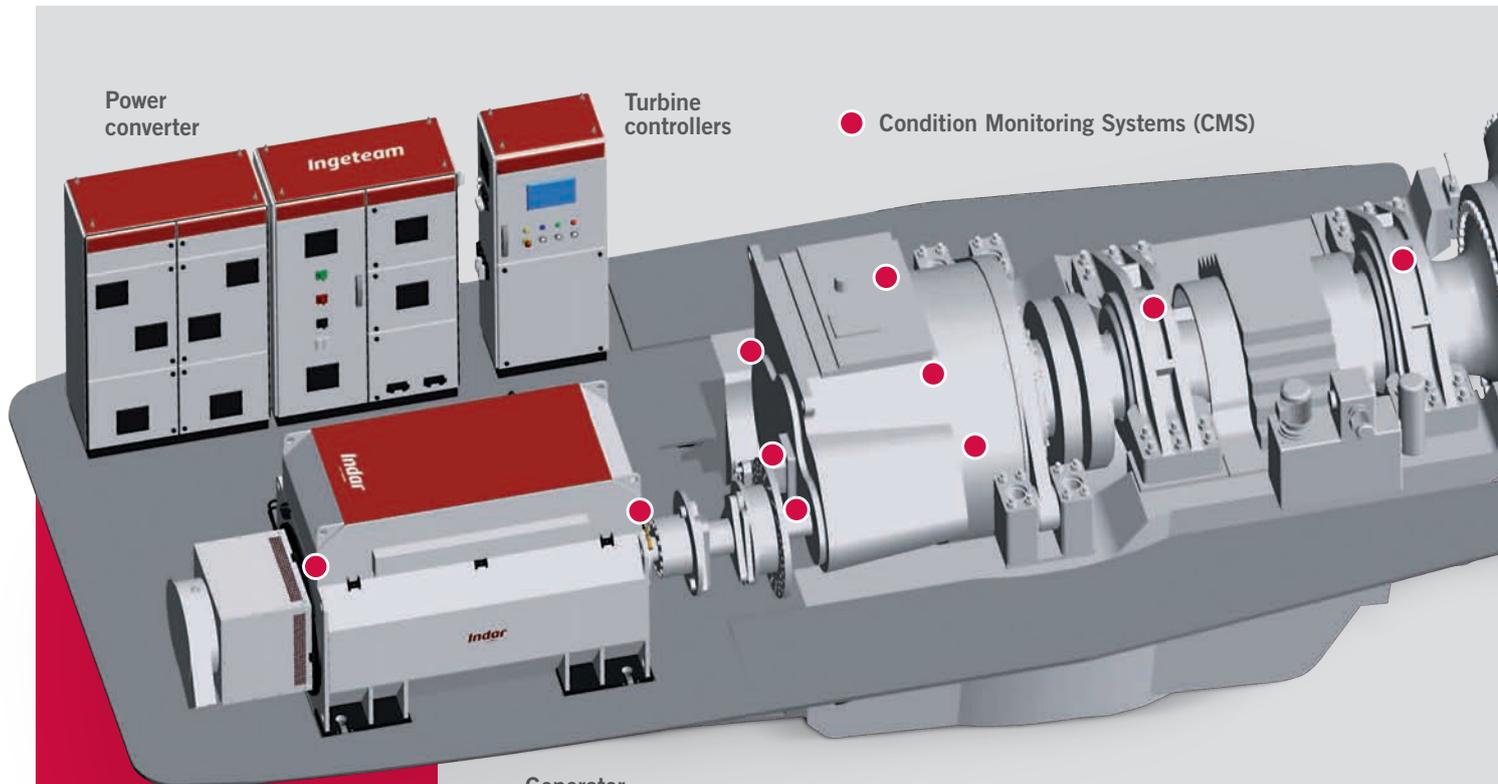
SCADA Management Systems

Complete integration of all wind power plants in a single system, regardless of the wind turbine manufacturers' platform and location.

6

Services

Ingeteam provides expert service throughout the entire product life cycle, supported by an extensive international network.



Ingeteam produces and markets all the electric and electronic equipment required for wind turbines, using state-of-the-art technologies.

Generator

SCADA management systems



Services

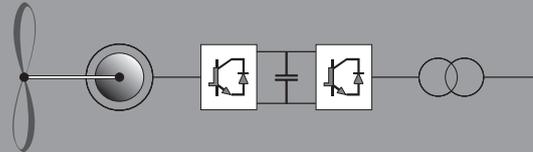


A comprehensive range of products and technologies



FC

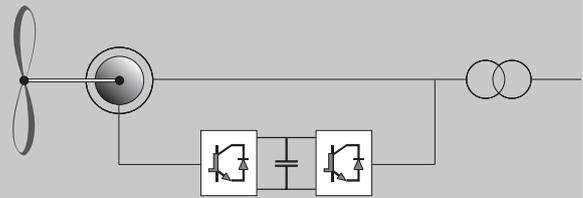
Full power converter for wind turbines equipped with a synchronous or asynchronous generator with direct drive, medium speed or high speed drive train technology.



A technology used by many wind turbine manufacturers due to its operating flexibility, energy management advantages and high efficiency at low wind speeds. The generator is brushless and offers the possibility of either eliminating or reducing the number of gearbox stages in the drive train.

DFM

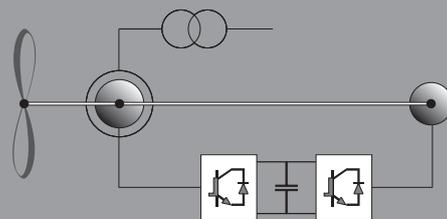
Doubly fed power converter for wind turbines equipped with a doubly fed induction generator with high speed drive train technology.



A mature technology used by many of the main turbine manufacturers. A key advantage is its costs and sizes savings, as a result of the fact that the converter and associated parts are sized for 30% of the rated power.

xDFM

Exciter doubly fed power converter for wind turbines equipped with a doubly fed induction generator and an exciter with high speed drive train technology.



This technology, featuring a power converter not connected to the grid and an additional generator acting as an exciter, has been named xDFM. It is an innovative, variable speed technology offering significant advantages over the DFM and Full Converter systems.

- High quality power.
- Excellent performance during grid faults (LVRT).
- Dynamic electric braking capacity.
- No power transformer required to power the converter.
- Back-up power from the exciter.





Power Converters



INGECON WIND

INGECON® WIND power converters are based on IGBT, IEGT and IGCT power semiconductors.

Low voltage DFIG power converters have been developed with a modular FRT solution in order to optimize cost effectiveness and fulfill international grid codes.

Low voltage FC single power converter units up to 4 MW and parallelized power converters up to 10 MW. The power converters can be adapted to the generator technology and the environmental conditions.

Medium voltage FC HV IGBT power converters up to 5 MW have been optimized for parallelized solutions in order to increase efficiency, minimize down time and reduce impact on overall cost. IEGT and IGCT power converters up to 10 MW are also available.

INGECON® WIND power converters are equipped with a web application service tool that allows monitoring and remote control.

Main features:

- High efficiency in low wind speed conditions.
- Designed for output grid voltage up to 900 V @ 50/60 Hz.
- LV DFIG modular FRT solutions that can be customized on site. FGW certification approved.
- MV solutions up to 4.16 kV designed for easy maintenance.
- INGECON® WIND power converter products are developed under international standards.

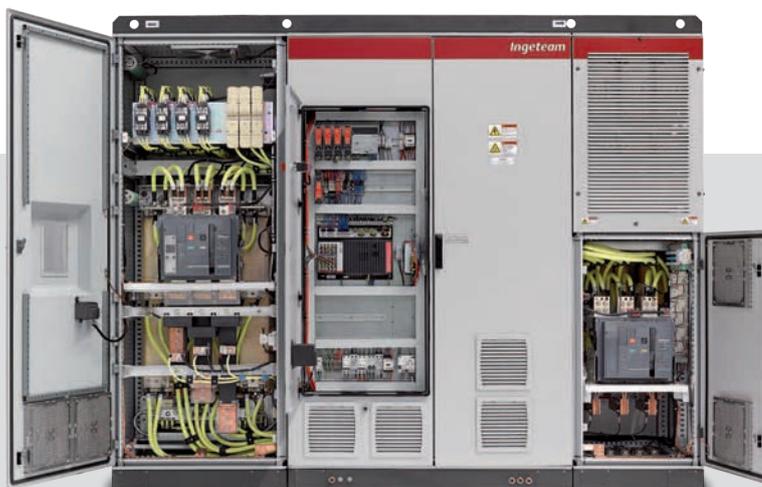
With Full Converter, DFM or xDFM technologies

Features:

- Two (2L) and three level (3L) back to back power converters with new generation IGBTs.
- Designed for output grid voltage up to **900 V @ 50/60 Hz**.
- Optimized for all generator technologies.
- Solutions for varying environmental conditions (air cooled, air/water cooled and full water cooled).
- Compliance with all international grid code.
- Developed under international standards.



Low Voltage Power Converters



Power ranges:

- **Full converter:** from 100 kW to 10 MW.
- **DFM** systems from 500 kW to 6 MW.
- **xDFM** technologies: from 500 kW to 6 MW.

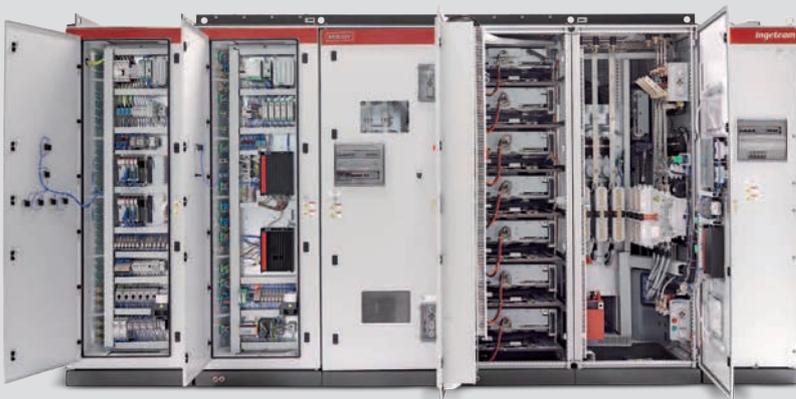
With Full Converter medium voltage technology

Features

- **Water cooled** (de-ionised water is not required except for press-pack devices).
- **HV-IGBT, IEGT or IGCT** converters with vector modulation.
- Easy-to maintain, highly modular design.
- Designs for output voltages up to **4.16 kV**.
- Machine side frequency range **0-120 Hz**.
- **Total active and reactive power control**.
- Excellent power quality: **THDi <5%** (depending on grid filter).
- Protection, sectioning and earthing switchgear included.
- Redundant and tailored **Offshore Applications**.
- Manufacturing Marine and large Industrial drives provides the additional experience to successfully design offshore wind converters.



Medium Voltage Power Converters



Power ranges:

- HV-IGBT, IEGT, IGCT: from 3 MW to 10 MW.



Generators



INDAR

As part of Ingeteam, **Indar Electric** is a company dedicated to the design and manufacturing of generators, suiting the requirements of each and every customer. Indar has manufactured generators and motors since 1940 and hosts one of the most capable test benches in the world.

This test bench allows Indar to fully test its designs for all kind of environmental conditions and to guarantee the best quality of its products.

Indar has a dedicated, high-tech, high-capacity wind turbine generator production line, in addition to an efficient after-sales service. The mechanical and electrical software employed for the generator design is based on in-house technology. Advanced simulation tools, such as finite element analysis and magnetic flow measurements are used during the generator design phases.

Our wind generators are designed to operate in a range which covers the entire market energy requirements. Indar supplies asynchronous and synchronous generators with output powers ranging from 1 MW to 9 MW and voltages from 690 V to 12 kV.

At the heart of the generator manufacturing process, the materials, insulation and impregnation systems are of the highest quality to ensure compliance with international standards. This ensures the generators will be extremely reliable, require low-maintenance, and meet all performance specifications.

The more than 15,000 wind generators supplied to date is a clear indication of the trust that customers have placed in Indar generators.

Features

- Generators of power levels **from 1 MW to 9 MW.**
- Asynchronous doubly fed or synchronous with permanent magnets.
- Direct Drive, medium or high speed.
- **Air or water** cooled.
- Up to insulation class H for all types of machines.
- Voltage **from 690 V up to 12 kV** for DFIG Technology.
- Voltages from 690 V to 6.6 kV for PMG Technology.
- Frequency: 50 Hz or 60 Hz.
- **Onshore & Offshore** applications.
- Various fabrication structures and forms.
- Noise level adjusted to client needs.
- Compliance with international standards: IEC, UL, CSA, USTC, etc.
- Taylor made solutions according to customer specifications.

Wind applications

Doubly Fed & Squirrel cage (Asynchronous)



Customized design solutions for different environment applications:

- Cold Temperatures: **-30 °C, 50 °C.**
- High Corrosion Resistant: **C3H, C4H, C5MH.**
- Desert Conditions: **Sandstorm.**
- Frequency: **50 Hz or 60 Hz.**



Wind applications

Permanent Magnet Generators (PMG) (Synchronous)

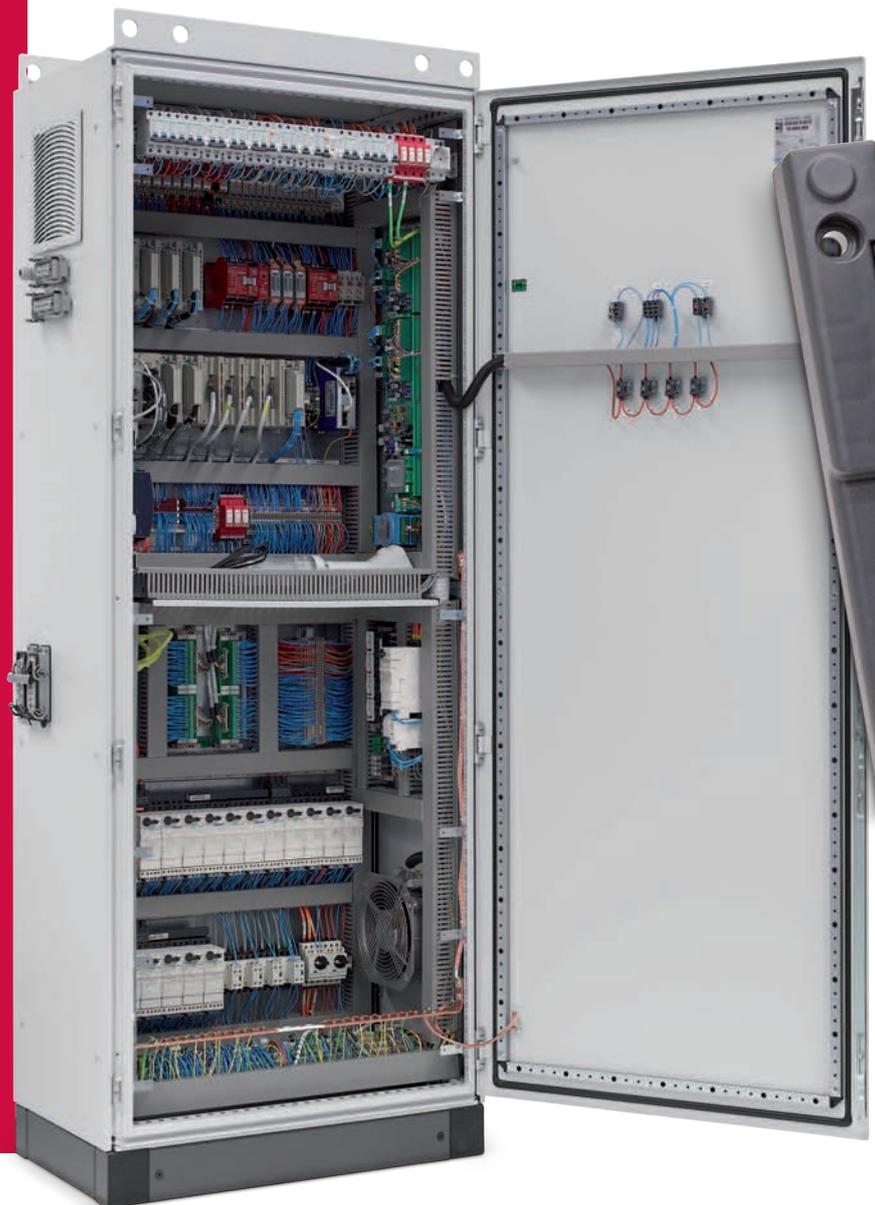


Power ranges:

- PMG up to 9 MW (low, medium or high speed) with LV (<1 kV) or MV (<6.6 kV) converter.
- DFIG technology up to 9 MW, 50/60 Hz, voltage levels up to 12 kV.
- IG (Induction Generators) up to 9 MW, with LV (<1 kV) or MV (<6.6 kV) converter.

Features

- **Tailored control solutions.**
- **Power and flexibility** to adapt to current and future market requirements.
- **Versatile, thanks to its** extensive range of CPUs: a single system for both simple and complex applications with cycle times of less than 1ms.
- Modules specifically designed for wind turbine control.
- Wide range of **connectivity** interfaces: Profibus, CANopen, EtherCAT, Web Services, Modbus/TCP, OPC, FTP, USB, amongst others.
- Integration with **MATLAB/SIMULINK**: reduced design and validation times for advanced control algorithms.
- Possibility of integrating **C language** functions and libraries.
- Advanced functionalities in order to incorporate added value into the system: **Web applications** and applications in **.NET**.
- Hot swap and **redundant topology** options.
- Powerful and **user-friendly** development environment, based on the IEC 61131-3 standard and with an extensive range of function libraries.
- Easy to use and maintain: powerful diagnostic tools.



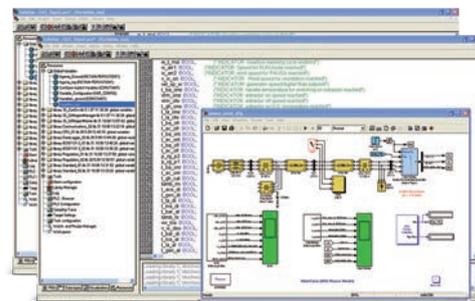
Turbine Controllers



INGESYS IC3

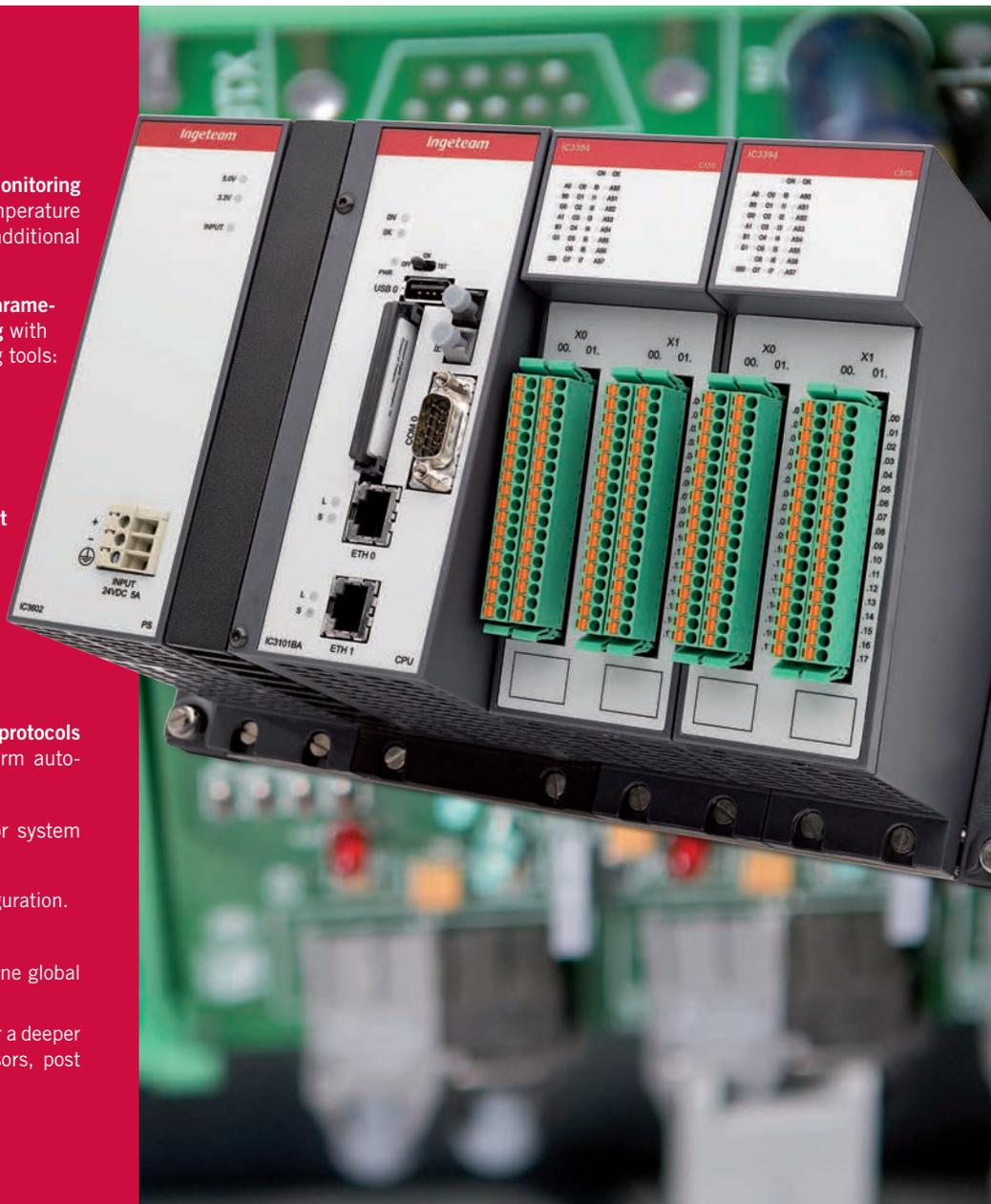
The INGESYS® IC3 turbine controller family features cutting edge technology in a **compact, robust system** that is particularly suitable for such demanding applications as wind turbine control.

The customized control solutions make Ingeteam the ideal partner for the provision of a **holistic solution**.

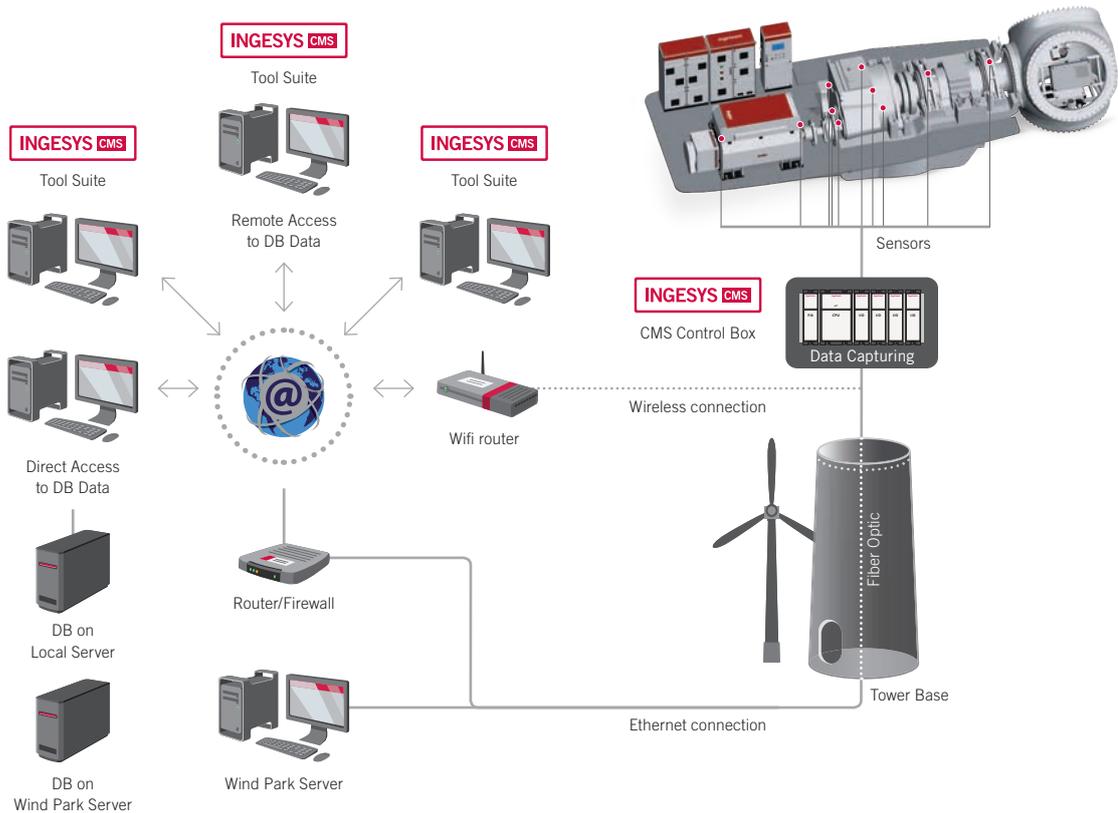


Features

- **Wind turbine condition monitoring** through vibration, oil, temperature analysis and a wide range of additional sensor measurements.
- **Open system enabling user parameterization and/or programming** with a wide variety of programming tools: IEC 61131-3, C/C++, Matlab/Simulink.
- **Extended system diagnostics** information.
- **Advanced alarms management** to detect early anomalies and to facilitate operator supervisory tasks.
- **Scalable and configurable** to multiple monitoring applications.
- **Wide range of communication protocols** for integration in the wind farm automation network.
- **INGESYS® CMS Tool Suite** for system configuration and monitoring:
 - Intuitive and easy data configuration.
 - Alarm generation Wizard.
 - Graphical definition of machine global status.
 - Advanced graphic features for a deeper signal analysis: specific cursors, post processing skills...



Condition Monitoring Systems (CMS)



INGESYS CMS

A **rotary machine condition monitoring system** that provides all information on the operating status of the wind turbine drive train's key elements through the analysis of vibration levels, oil condition, components temperature, etc. reducing the risk of failure and maintenance costs.

The INGESYS® CMS Tool Suite provides system parameterization, monitoring and diagnostics, enabling the plant manager

to implement a condition based maintenance strategy, reducing the maintenance costs to a minimum.

Two possible system configurations:

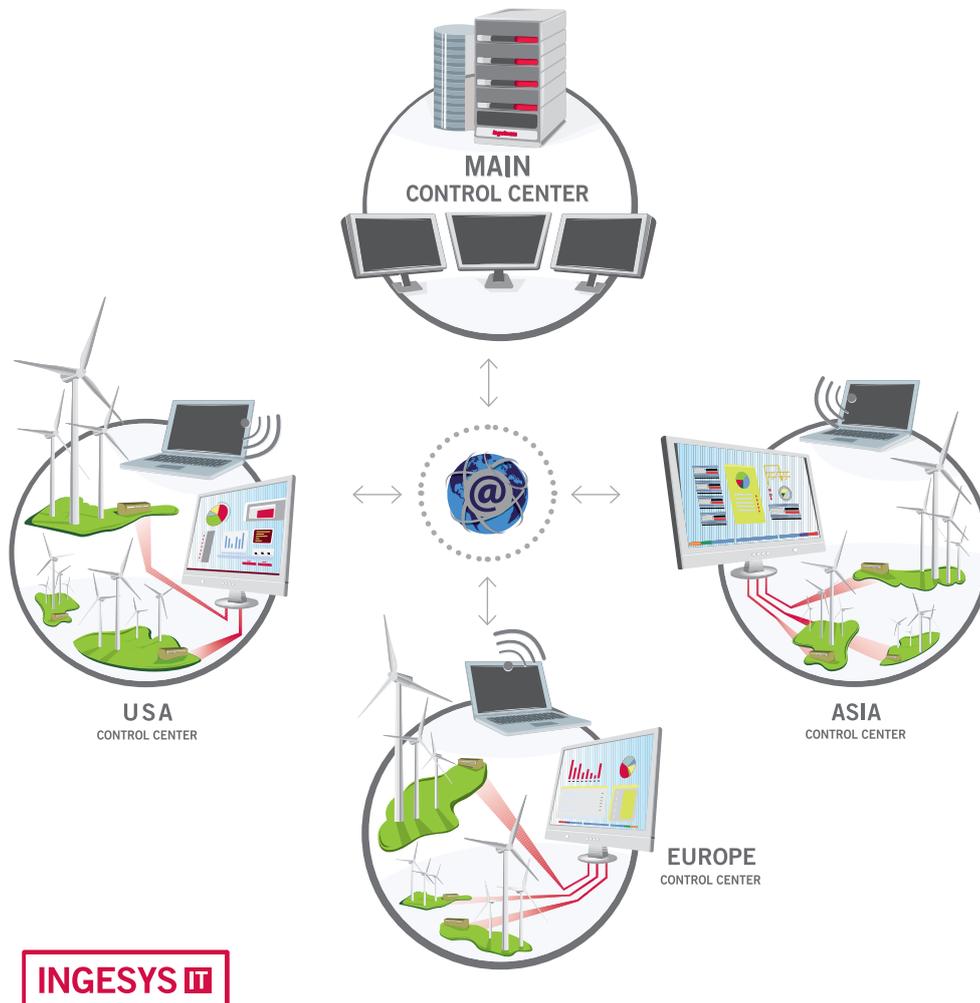
- Stand-alone monitoring system.
- INGESYS® IC3 Controller integrated monitoring system.

Features

- **Complete integration** into a single system:
 1. Real time Operation and Monitoring
 2. Advanced Operation Analysis.
 3. Operations Manager.
 4. Management Dashboard.
- **Open** system.
- Communication protocols: OPC DA, HDA y AE, OPC XML DA, IEC 61400-25, IEC 61850, 60870-5-101, -104, DNP3, Modbus RTU/TCP, C30, low bandwidth solutions and custom protocols.
- Advanced tools for **Operation, Optimization and Analysis.**
- Total Power Control.
- **Experience:** more than 9,000 MW worldwide (**Europe, USA, China, Korea, Mexico, Australia, Chile...**).



SCADA Management Systems



Optimized wind farm operation

The INGESYS® WIND IT solution makes it possible to integrate into a single system all the operating, analysis and management requirements of all the developer's wind farm portfolio, regardless of global location or technology.

This scalable, robust, modular standards-based architecture makes it possible to adapt the system to ongoing customer requirements, thereby guaranteeing the investment made.



Operation & Maintenance Services

- On/Off-shore commissioning services.
- Blade Services.
- Major Corrective Services.
- Spares.
- Retrofits and Maintenance support.
- Maintenance Engineering and Management.
- Life-time Extension.
- High voltage services.
- External Audits and QC/QA.
- INGESYS® CMS Condition monitoring system.
- Ingeboards® Tool for the Advanced Operation of Wind Farms.



Services



Ingeteam provides ongoing support throughout the entire product lifecycle, offering an expert and customized service to meet your project needs. Maximum performance is achieved by facilitating **commissioning, integrated maintenance** and wind farm management & **operations** support.

Ingeteam offers global technical services, with bases in Europe, Asia, North & South America, working alongside customers to support their global expansion.

Leading O&M Services provider in South America with 1.2 GW, and more than 6 GW in the world.

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