



READY FOR YOUR LCoE OPTIMIZATION

POWER CONVERTERS
AUTOMATION SYSTEMS
O&M SERVICES

Ingeteam

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POWER CONVERTERS

AUTOMATION SYSTEMS

Turbine controllers

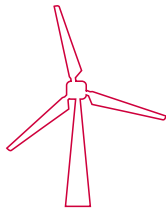
Condition Monitoring Systems (CMS)

Smart SCADA management systems

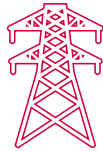
O&M SERVICES

Ingeteam

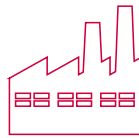
INNOVATION AND COMMITMENT AS DRIVERS OF FUTURE GROWTH



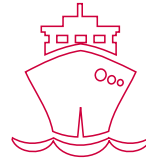
Energy



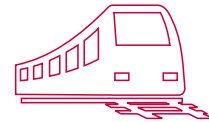
Power transmission
& distribution



Steel



Marine



Rail

Ingeteam is a global corporation specialized in 5 different sectors (Energy, Power transmission & distribution, Steel, Marine and Rail); customer-oriented and specialized in power and control electronics, electric motors, generators & submersible pumps and motors; electrical engineering and generation plant engineering.

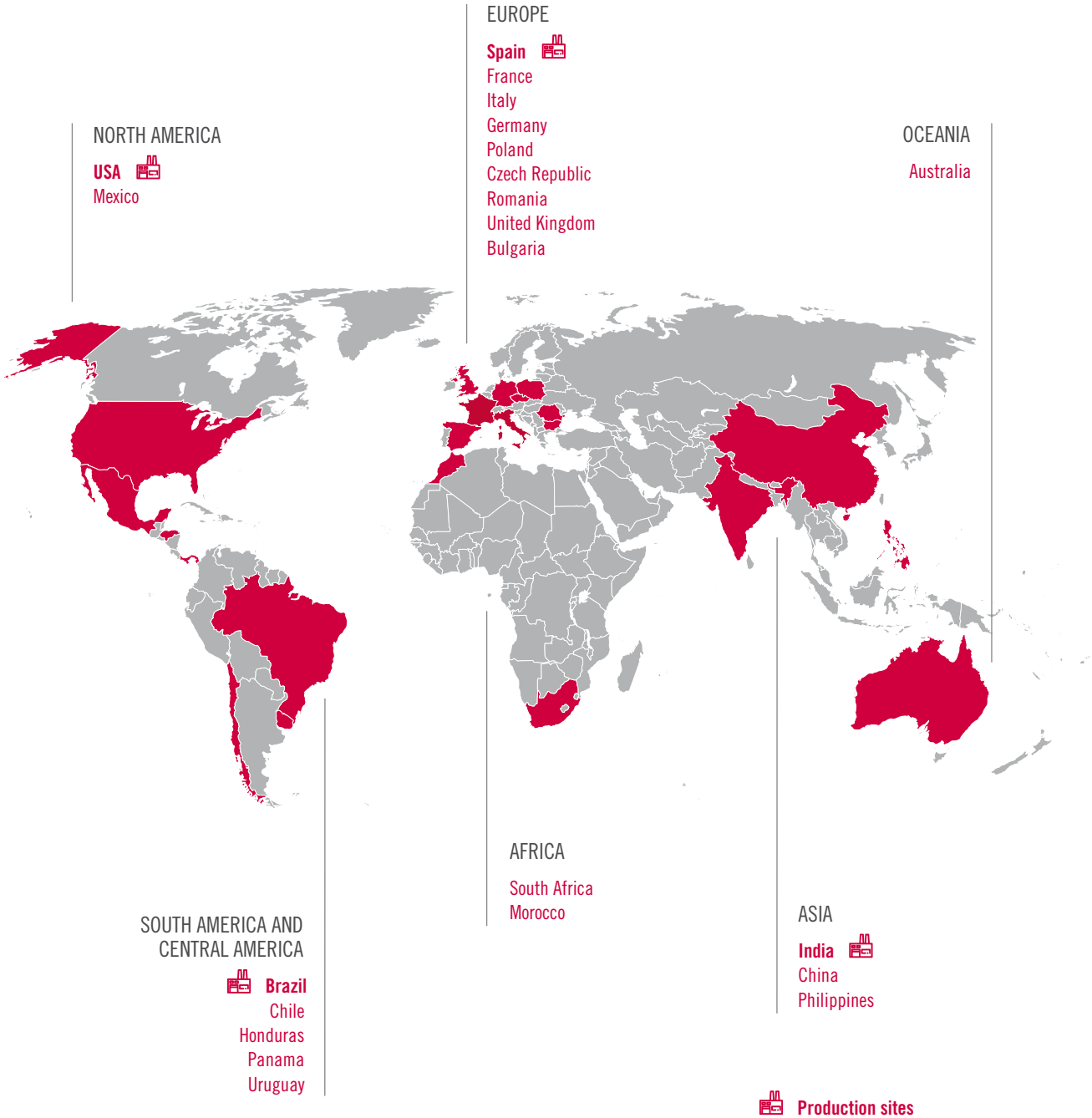
With more than 75 years of experience in the electrical sector, Ingeteam's 3,900 professionals are dedicated to engineering, project development and manufacturing. Ingeteam is dedicated to investing in innovation and committed to each project as the drivers of future growth.

Since 1990, the Energy division of Ingeteam is dedicated to supplying equipment for the renewable energies sector: wind, solar, hydropower, biomass,

geothermal, diesel and gas, integrated service of operation & maintenance.

Ingeteam is a complete solution provider. We design, develop, manufacture and provide a comprehensive range of electrical components for wind turbines, and also O&M services for a complete range of wind turbines, offering a tailored solution to meet every project's requirements.

GLOBAL FOOTPRINT



45 GW OF INSTALLED WIND POWER CAPACITY WORLDWIDE



24
YEARS OF
EXPERIENCE



45 GW
INSTALLED
WIND POWER
CAPACITY



5%
ANNUAL
INVESTMENT
OF TURNOVER
IN R&D



3,900
EMPLOYEES

WHY INGETEAM?

Ingeteam is an independent supplier of power converters, turbine controllers, Condition Monitoring Systems (CMS), Smart SCADA management systems and O&M services for wind turbines up to 15 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.

Ingeteam provides ongoing support throughout the entire product life cycle, from research and design to production and testing, commissioning and after-sales services, technical training and support.

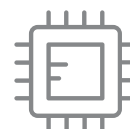
Since 1995, Ingeteam has commissioned over 28,000 wind power converters, accounting for more than 45 GW of installed wind power capacity worldwide. The company is the world's number one independent supplier of wind power converter and a leading O&M services provider with more than 8.6 GW maintained in the world.



8.6 GW
O&M
PROJECTS



28,000
POWER
CONVERTERS
SUPPLIED



8%
MARKET
SHARE



22
LOCATIONS



4
PRODUCTION
SITES

OUR VALUE PROPOSITION

R&D

We are committed to innovation and development of full in-house technology. Our Policy of Continuous Improvement is focused on reliability and cost effectiveness from a global point of view, optimizing the whole solution in terms of Levelized Cost of Energy.

FLEXIBILITY

We are flexible in designs and R&D solutions, operations, different business models or additional value-added services.

We work very closely with our clients, listening to them and anticipating their needs to be ready to satisfy their demands and requirements.

GLOBAL PRESENCE

We can supply equipment from any of our production facilities in Europe, Asia, North and South America, applying the same standards and know-how. We can also deliver the most efficient and specialized support and service to you from our sales and service centers strategically located all over the world.

EXPERIENCE

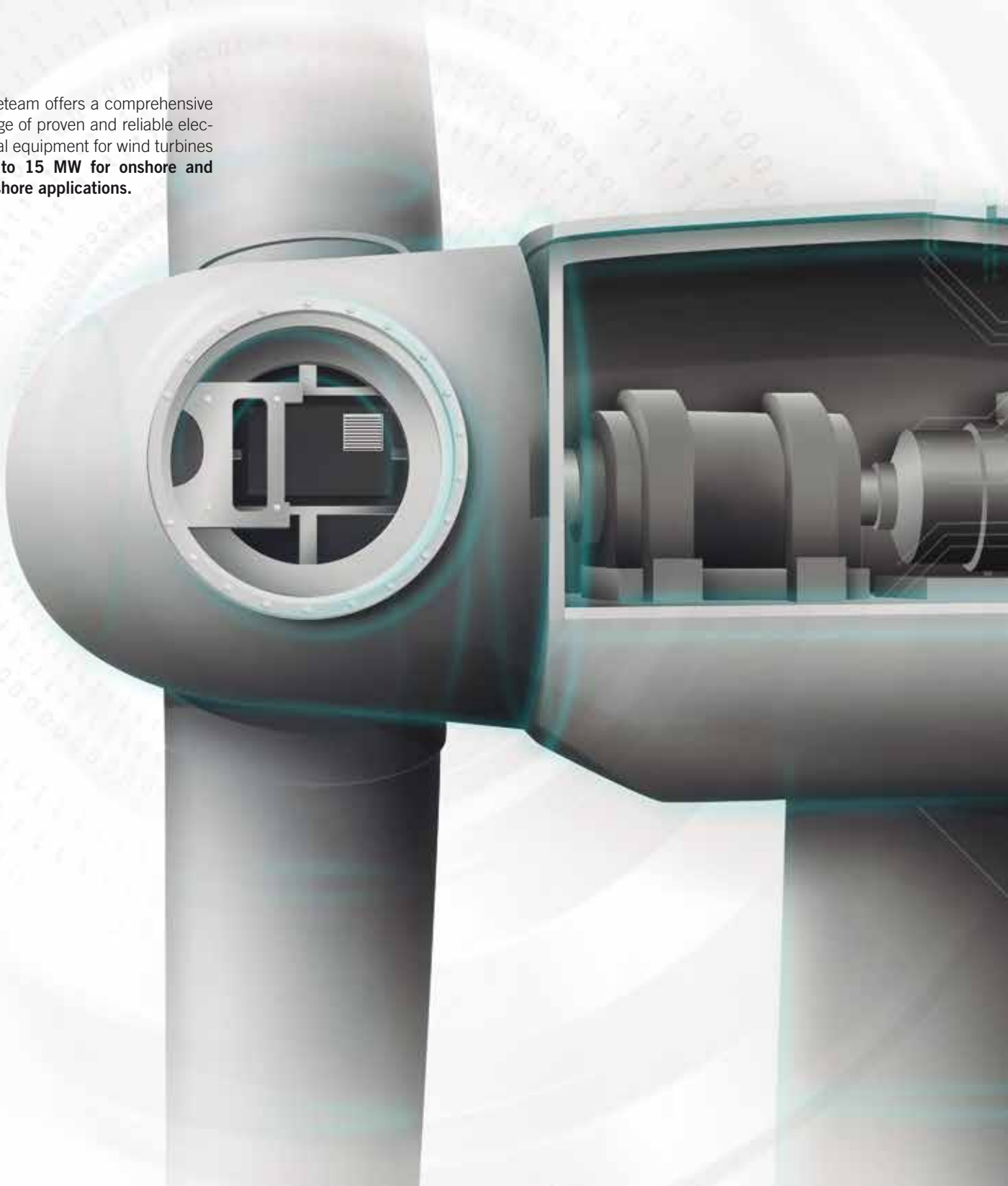
We are the world's number one independent supplier of wind power converters with 45 GW of installed wind power capacity worldwide and 24 years of experience in the industry.

PARTNERSHIP

We give active support for each specific project throughout the entire product life cycle.

A COMPREHENSIVE RANGE OF PRODUCTS AND TECHNOLOGIES

Ingeteam offers a comprehensive range of proven and reliable electrical equipment for wind turbines **up to 15 MW for onshore and offshore applications.**



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.

CONDITION MONITORING SYSTEMS (CMS)

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

POWER CONVERTERS

Low and medium voltage power converters, optimized for DFIG and FC topologies. Power converters specifically designed to fulfil the strictest grid codes. Air cooled, air/water cooled and full water cooled solutions for harsh environments. Up to 15 MW.



SMART SCADA MANAGEMENT SYSTEMS

Optimized operation & analytics for all renewable power plants (wind farms, solar, hydro) in a single system, regardless of the wind turbine manufacturers' platform and location.

O&M SERVICES

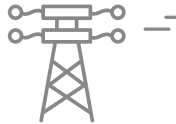
Ingeteam's extensive international network and multi-technology experience allow us to provide expert service throughout the entire product life cycle and based on the needs of the customer.

POWER CONVERTERS

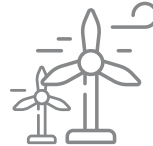
MAIN FEATURES



KIT OPTIONS & CUSTOMIZABLE DESIGNS FOR THE BEST LCoE



FLEXIBILITY TO ADAPT TO DIFFERENT GRIDS



INTEGRATION SUPPORT IN WIND TURBINES & WIND FARMS



ACTIVE LIFECYCLE PERFORMANCE OPTIMIZATION

INGECON® WIND Power converters are designed to increase reliability, boost efficiency and reduce maintenance costs.

The power converters are based on IGBT power semiconductors and are equipped with a web application service tool that allows monitoring and remote control.



	5 MW	10 MW	15 MW
DFIG			
Full Converter - LV			
Full Converter - MV			

DFIG POWER CONVERTERS

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

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

FULL POWER CONVERTERS

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

A technology used by many wind turbine manufacturers due to its operating flexibility, energy management advantages and high efficiency at low wind speeds.

DFIG

POWER CONVERTERS



3.6 MW DFIG Power Converter

POWER RANGES
UP TO 5 MW

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

General Data		
Rated power range	< 2 MW	2 MW - 5 MW
Converter type	Back to back	
Semiconductor type	IGBT	
Efficiency (at rated power)	> 96.5%	> 97%
Generator type	DFIG	
Application	Onshore	Onshore/Offshore
Product certification	CE (UL, CSA... on request)	
Electrical Data		
Output voltage	690 V	
Grid voltage range	±10%	
Frequency	50/60 Hz	
Power Quality		
Power converter THD (i)	< 3%	
Generator Filter		
dV/dt	< 1 kV/us	
FRT		
FRT compliance	Strictest grid codes (VDE & FGW, Q/GDW 392-2009, FERC 661-A, INDIAN CEA)	
Cooling		
Type	Air cooled (Ambient)	Water cooled (Liquid)
Temperature range	5°C to 50°C	5°C to 60°C
Derating 1.5 % each 1 C°	40°C to 50°C	55°C to 60°C
Cold/Hot climate version	On request	On request
Mechanical Data		
Protection degree (IP)	IP23/IP54	IP54
Corrosion class	C3H	C3H/C4H
Communication Protocols		
	All industry standards	



FULL POWER CONVERTERS



3.7 MW FC Power Converter

LOW VOLTAGE

POWER RANGES

UP TO 10 MW

Low voltage FC single power converter units up to 5 MW and parallelized power converters up to 10 MW. The power converters can be adapted to the generator technology and the environmental conditions.

General Data	
Rated power range	< 5 MW 5 MW - 10 MW
Conversion line	
Converter type	Back to back
Semiconductor type	IGBT
Efficiency (at rated power)	> 97%
Generator type	IG/EESG/PMG
Application	Onshore Onshore/Offshore
Product certification	CE (UL, CSA... on request)
Electrical Data	
Output voltage	690 V
Grid voltage range	±10%
Frequency	50/60 Hz
Grid Filter	
Power converter THD (i)	< 3%
Generator Filter	
dV/dt	< 1 kV/us
FRT	
FRT compliance	Strictest grid codes (EEG2009, EON2006, Q/GDW 392-2009, FERC 661-A)
Cooling	
Type	Air cooled Full water cooled (Liquid) Water cooled (Liquid)
Temperature range	5°C to 50°C
Derating 2% each 1 C°	50°C to 55°C
Cold/Hot climate version	On request
Mechanical Data	
Protection degree (IP)	IP54
Corrosion class	C3H
Mechanical Data	
	All industry standards



MEDIUM VOLTAGE

POWER RANGES

UP TO 15 MW

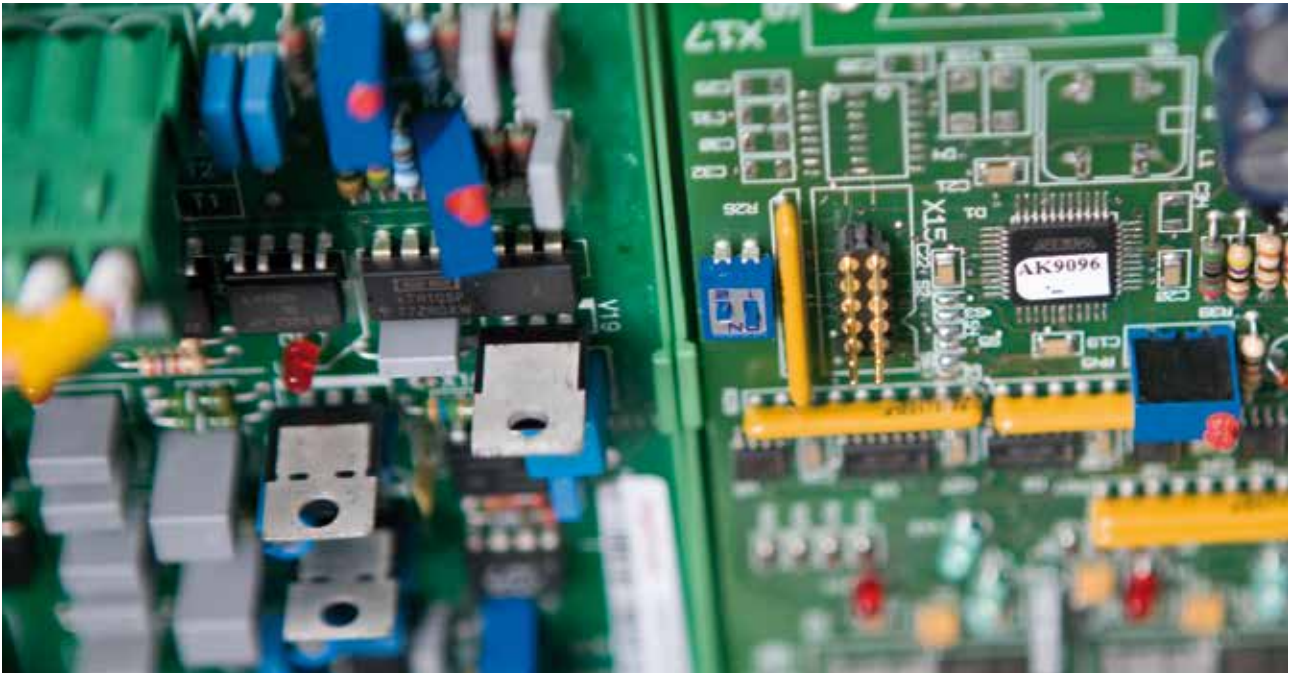
Medium voltage FC HV IGBT power converters up to 15 MW have been optimized for parallelized solutions in order to increase efficiency, minimize downtime and reduce the impact on overall cost.

10 MW FC Power Converter

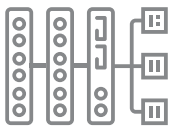
General Data	
Wind turbine rated power	< 7.5 MW 7.5 MW - 15 MW
Conversion line	
Converter type	Back to back
Semiconductor type	HV-IGBT
Efficiency (at rated power)	> 97.8%
Generator type	IG/EESG/PMG
Application	Onshore/Offshore
Product certification	CE (UL, CSA... on request)
Electrical Data	
Output voltage	3,000 V
Grid voltage range	-10% to 20%
Frequency	50/60 Hz
Grid Filter	
Power converter THD (i)	< 5% (other values on request)
Generator Filter	
dV/dt	1.5 kV/us (other values on request)
FRT	
FRT compliance	Strictest grid codes (EEG2009, EON2006, Q/GDW 392-2009, FERC 661-A)
Cooling	
Type	Water cooled (Liquid)
Temperature range	-10°C to 55°C
Cold/Hot climate version	On request
Mechanical Data	
Protection degree (IP)	IP54
Corrosion class	C3H/C4H
Mechanical Data	
	All industry standards

AUTOMATION SYSTEMS

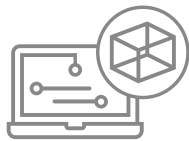
CONTROL & MONITORING
SOLUTIONS FOR WIND TURBINES



MAIN FEATURES



SCALABLE
MODULAR
SOLUTION



MAXIMUM
ROBUSTNESS
AND RELIABILITY



OPEN,
STANDARD-COMPLIANT
SYSTEM



ADVANCED
SOFTWARE
CONTROL TOOLS

Ingeteam offers a complete product portfolio to control and monitor your wind turbine such as turbine controllers, Condition Monitoring Systems (CMS) and Smart SCADA management systems.

All directed at offering a comprehensive automation solution.

All solutions are either all-inclusive or partial, and can be fully tailored to meet your project's requirements.

TURBINE CONTROLLERS

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.



CUTTING-EDGE TECHNOLOGY IN A COMPACT, ROBUST SYSTEM

FEATURES

Modular system with a distributed architecture and a wide range of processor units and I/O modules.

Real-time control with scan times from 250µs.

Redundant architectures for achieving maximum system availability.

Robust system adapted to wind industry requirements in terms of temperature, humidity and vibration.

Programming tools based on Codesys with support for 5 IEC 61131-3 languages.

Tool based on MATLAB®/Simulink® and C for performing advanced control algorithms.

Monitoring tools (Register and Data logger).

Built-in web services for monitoring and maintenance tasks.

Extensive connectivity: RS485, Profibus DP, CANopen, InterBus-S, TCN, Modbus TCP/IP Ethercat, etc. RTU functional feature (Modbus, IEC 61850, IEC 60870-5-101 /104, DNP 3.0, etc.).

Easy maintenance: Advanced error diagnostics, hot-swap, local or remote centralised updating via FTP, replication via USB, etc.

Highly robust and reliable due to strict compliance with international standards (CE, UL, EN50155).

CMS

CONDITION MONITORING SYSTEMS

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

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 graphics features for a deeper signal analysis: specific cursors, post-processing skills...

A ROTARY MACHINE CONDITION MONITORING SYSTEM

SMART SCADA MANAGEMENT SYSTEMS

The Smart SCADA management systems enable efficient portfolio operation, monitoring and optimization. All the relevant data (both real-time and offline data) are integrated into a single system, regardless of location or technology. Powerful algorithms, dashboards and reporting capabilities

allow asset managers to gain valuable insights and facts to support decisions that have an impact on overall performance. The company's platform harnesses Big Data and IoT technologies to achieve state of the art scalability and robustness. It has been developed and fine-tuned over 20 years of experience.

Ingeteam experience as a leader in O&M services and supplier of key WTG components (power converters, control systems, CMS, substation automation) has given us valuable experience in dealing with the challenges of wind assets optimization.



FEATURES

OPTIMIZED WIND
FARM OPERATION
& ANALYTICS.
DATA DRIVEN ASSET
OPTIMIZATION

Modular solution:

- **Industrial real-time and Monitoring:** high availability secure monitoring and operation of critical assets.
- **Analytics Studio:** gain insights to optimize the performance of assets and operations.

Open system: Full integration of WTGs, substations, forecasts, budgeting, energy counters, CMS, ERPs, work orders, spare parts, electricity market and other third-party systems.

Multi OEM, multi-device, multi generation technology (wind, solar, hydro).

Big Data Historian: Efficient storage and processing of large volumes of time series data.

Advanced Analytics: Custom availability calculations, failure analysis, advanced statistics, performance analysis and automatic KPI generation.

Power Control Management and Dispatch Center functions.

Customized for clients specific needs.

Complementary services: Data Health Check: complete review of wind turbine condition from existing third-party SCADA data.

Experience:

- **12,000 MW worldwide** (Europe, USA, Mexico, Chile, China, Korea, Australia...).
- **20 years.**

OPERATION & MAINTENANCE

LEADING O&M SERVICES PROVIDER WITH MORE THAN 5,600 WIND TURBINES MAINTAINED, WHICH HAVE AN INSTALLED CAPACITY OF 8.6 GW



We can meet your project needs through flexibility in designs and R&D solutions, operations, different business models or additional value-added services.

Ingeteam provides ongoing support and multi-technology experience throughout the entire product life cycle, 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.

SERVICES

COMMISSIONING,
INTEGRATED
MAINTENANCE
AND WIND FARM
MANAGEMENT &
OPERATIONS SUPPORT

On & offshore commissioning services.

Blade services.

Major corrective services.

Spares.

Retrofits and maintenance support.

Maintenance engineering and management.

Lifetime extension.

High voltage services.

External Audits and QC/QA.

INGESYS® CMS Condition monitoring system.

Ingeboards® tool for the advanced operation of wind farms.

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