

Wind
Energy



Ingeteam

At the forefront of technology

Ingeteam has been supplying high-tech products and systems for electrical and electronic applications since 1972.

Our leading-edge organisation comprising more than 25 companies has set some important global benchmarks in the industrial, ship-building, rail, and energy generation sectors.

Technological innovation and the development of our own products are key factors in our competitiveness strategy.

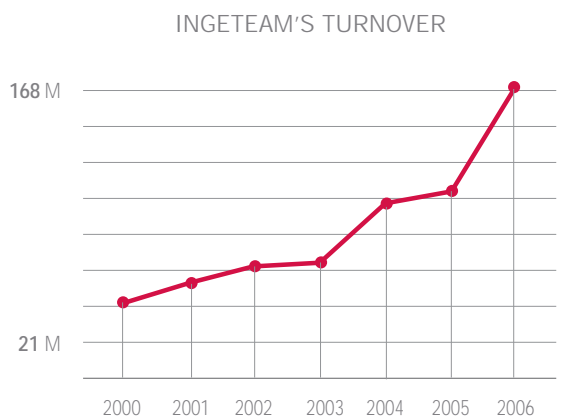


The Ingeteam Head-Office at the Zamudio Technology Park.

Renewable Energies

Ingeteam is the Group Company dedicated to developing and supplying equipment and services in the field of Renewable Energies since 1990. Specifically:

- Wind turbine electrical and electronic equipment (Ingecon® Wind).
- Photovoltaic inverters (Ingecon® Sun).
- Biomass and Biofuel plant Distributed Control Systems (DCS).
- Hydroelectric power station electrification and control (Ingecon® Hydro).
- Sistemas integrales de generación aislada (Ingecon® Wind).
- Telecontroles.
- Mantenimiento preventivo y correctivo de instalaciones.



Electronic design at TEAM.

In 2006, investment R&D accounted for 3% of turnover.

T E A M

Wind Power

In the field of Wind Power, Ingeteam offers wind turbine manufacturers different electrical and electronic products, adapted to their control and generation requirements.



INDAR factory.

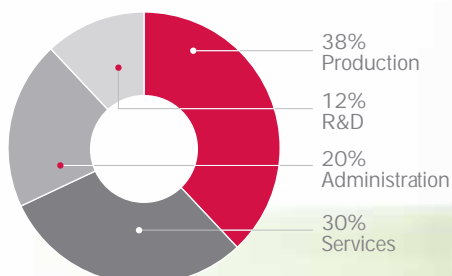
In its product range, Ingeteam applies its own wealth of experience and that of other Group companies, including:

- TEAM, developer and manufacturer of power and control electronics.
- INDAR, electric machine manufacturer since 1940.

The Group complements its products and systems with first-class customer service, based on continuous collaboration, commencing with the system design and continuing throughout the system life cycle.

The Ingeteam state-of-the-art production facilities and the firm commitment of company personnel to quality ensure the success of each development project and guarantee the excellence of the final product.

OUR WORKFORCE



This highly-qualified, dynamic workforce has an average age of 30 and more than 43% are engineers and university graduates.

Products

The Ingeteam Wind Power product range has been designed with cutting-edge technology and manufactured with top-quality components.

The machine's control and power electronics systems ensure optimum operating control for maximum power generating efficiency.

The innovative pitch control system uses electrical drives for total blade pitch control.

A Remote Control System ensures greater plant availability.

Electric Generators

Synchronous or asynchronous double fed machines (DFM), or squirrel cage.

Air or water cooling systems.

Designed for low or high voltages.



2 MW Generator.

Power Electronics Converters

Ingecon® Wind is the range of power electronics converters covering different configurations and technologies.

This range offers IGBT-based solutions with the latest DSP controllers and air or water cooling systems.



2.5 MW power electronics.

U C T S



Electronics for the pitch drive.

Electrical Pitch Regulators

Including drives and motors.

Intelligent control for high dynamics and precision.

Separate adjustment of each of the three blades.

Control Electronics

PLC systems with the latest features in terms of input/output requirements, and processing and communication capabilities to meet the demands of different wind turbine manufacturers.



Control electronics and the SITEM A PLC.



Examples of Remote control screens.

Remote Control Systems

Several Wind Farms from one single control station.

Uses multiple communication protocols and transmission methods.

Electric Generators

These machines are designed exclusively for wind power applications and in close cooperation with the wind turbine manufacturer so that they can be adapted to the technical and mechanical conditions of the system in question.



1.5 MW, 1,000 rpm,
12 kV generator.

There is a wide range of powers over 2 MW.

Synchronous or asynchronous double fed machines (DFM), or squirrel cage.

Permanent magnets.

For fixed- or variable-pitched turbines.

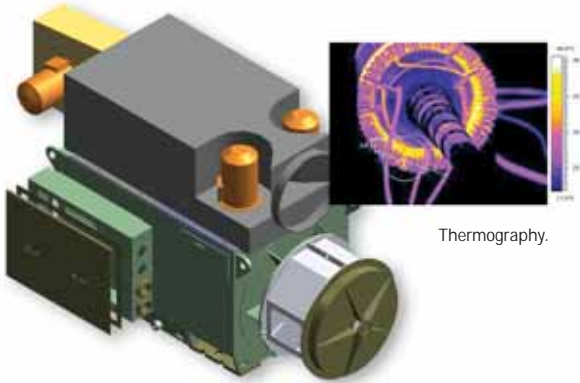
Different types of structures and air or water cooling options.



850 kW, 1,500 rpm, 690 V generator.



R A T O R S



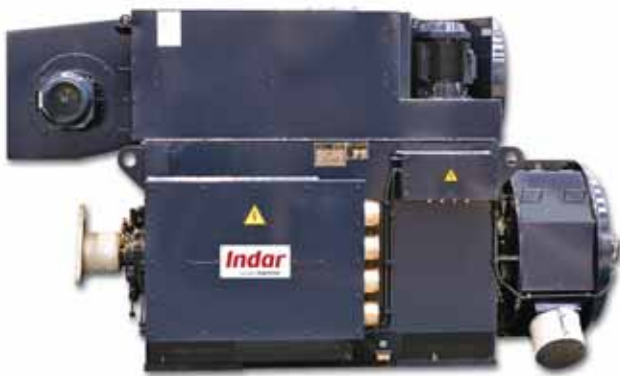
Thermography.

INDAR is the Group company responsible for the design and manufacture of all the electric generators.

Its R&D&I department is composed of highly-qualified staff and is equipped with the latest IT resources.



2.5 MW, 1,000 rpm, 690 V generator.



2 MW, 1,500 rpm, 690 V generator.

The generator development process involves the use of finite element and mechanical simulation software, electromagnetic flow, fluid dynamics, etc.

These generators are built in accordance with the principal international safety standards.



Power Electronics Converters

Ingeteam's Ingecon® Wind range consists of power electronics converters suitable for any wind power related application.

Ingecon® Wind power electronics converters optimally control the energy delivered to the grid through both synchronous and asynchronous electric generators.

Based on IGBT power semiconductors with DC buses with extremely low levels of inductance, they control energy by means of Pulse Width Modulation (PWM).

Equipped with the latest DSP microprocessors (32 bits in parallel multiprocessing) the converters include Advanced Vector Control algorithms on the PWM, for generator rotor and stator control.



2 MW converter.

Ingecon® Wind
Assembly .

Electronic design..

E R T E R S

Electronics cooled by water or air.

Synchronous generation and total control of P and Q.

Developed to work with generators up to 12 kV.

Delta-Star generator connection for extending the variable speed range.



1.5 MW power electronics.

All the power electronics converters are designed by TEAM, a Group company which applies its proven experience to the most demanding sectors.

The converters comply with the strictest standards in terms of harmonic distortion and electromagnetic compatibility.

According to the strictest grid connection requirements; E-ON, REE.

Unitary Testing.



Electrical Pitch Regulators

Adjustment of the blade pitch angle using electrical systems greatly simplifies maintenance tasks. These systems require less supervision and in terms of operation they offer greater response dynamics and positioning precision. The different types of communication available mean that they can be easily adapted to the control requirements of any wind turbine.

The absolute blade position control offered by the electric pitch regulators provides for maximum wind turbine versatility and environmental adaptability.

Equipped with all the safety elements required for maximum wind turbine reliability and robustness.

- Equipped with the MOTOCON DC controller.
- Separate control electronics for each blade.

The different types of communication available mean that they can be easily adapted to the control requirements of any wind turbine.

Stainless steel cabinets, with IP65 protection.



Pith control cabinet.

```
(* Speed calculation, blades test *)
CASE man_mode OF
  0:
    (* Initialitation *)
    blade_number_manual_pch := 0;
    t_sinus := 0;
    sa_pitch_man := -1;
    sign_ramp_incr := 1;
  1:
    blade_number_manual_pch :=
      man_pch_num_blade;
    (* Pitch Reference calculation *)
    ref_manual_pitch :=
      ref_manual_pitch
      +
      incremental;
```

A L P I T C H

- Digital speed regulator for the electrical motor, with a positioning resolution of 1°/1000.
- Equipped with a stand-alone back-up power system. With continuous condition monitoring.
- One drive per blade.

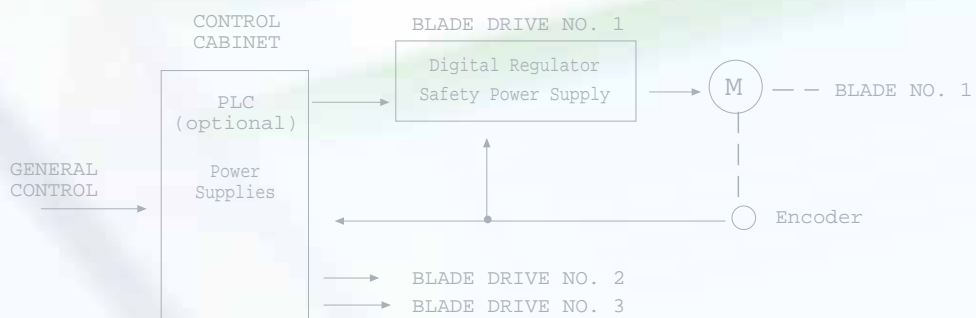


Electronics to drive each blade.

Option of running DC or AC motors.

Position sensing using digital systems for maximum noise immunity and enhanced positioning precision.

And always completely adapted to the needs of the wind turbine manufacturer for total functional and physical integration.



Control Electronics

To satisfy the wind turbine control requirements, Ingeteam offers the SISTEAM A programmable PLC range, designed and manufactured by TEAM. This is a medium/high range PLC with excellent features in terms of inputs/outputs and processing capabilities.



General control cabinet.

- Highly-powerful calculation features. Multi-task system.
- Excellent Connectivity. Standard CAN supraordinated bus. Subordinated CANOPEN bus for distributed Inputs/Outputs.
- Integratable. Standard Interbus-S, Profibus and CAN field buses, for integration with level zero systems and with CANOPEN equipment. Ethernet-TCP/IP with MODBUS protocol communication to facilitate integration with the Farm's network.
- Configurable. Start-up, programming, and diagnostics facilities using the Sisteam Servicer PC program, with programming languages based on the IEC61131-3 standard. Extensive technological functions library.
- Equipped with advanced encryption systems for software protection.
- Modular architecture extendable in local / distributed mode.

SISTEAM A PLC.

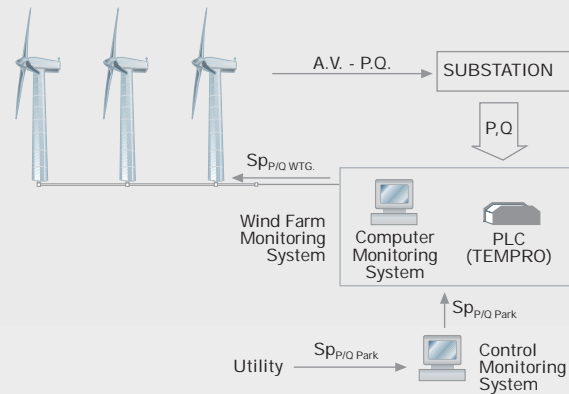
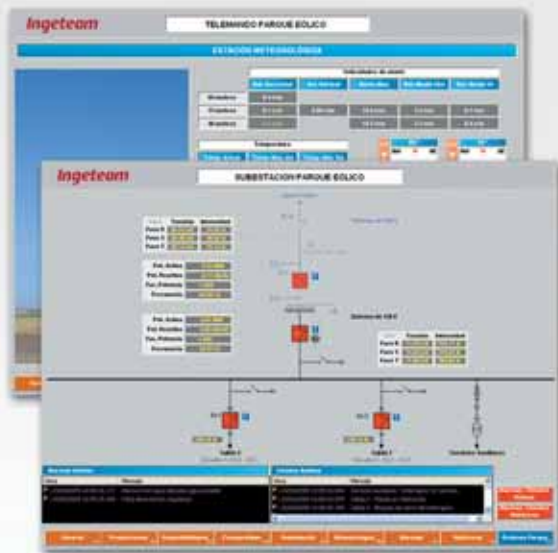


General Technical Information:

- Processor: Pentium® 233 MHz.
- 4 Mbytes Internal Flash Memory.
- RAM: 4 Mbytes.
- General, Logic, Mathematical, regulating and Communication Functions.
- Communications: Ethernet-TCP/IP, Interbus-S, Profibus-DP, CAN, RS-232 (3964, MODBUS, etc.), RS-485 (3964, MODBUS, etc.).
- CANOPEN for peripheral interconnection.
- Specific positioning modules for wind turbine control.
- CE, UL Standards.

Remote control systems

Remote Control is a vital tool for maximising the availability of each wind turbine.



Flexible

Based on SCADA modular architecture, it can be tailored to suit your own specific requirements with the possibility of incorporating new features.

It is also possible to communicate with meteorological stations and the transformer substation, as well as with any other equipment that can be monitored at the Farm.

Advanced Features

Capability to control the active and reactive power delivered to the grid in compliance with scheduled times.

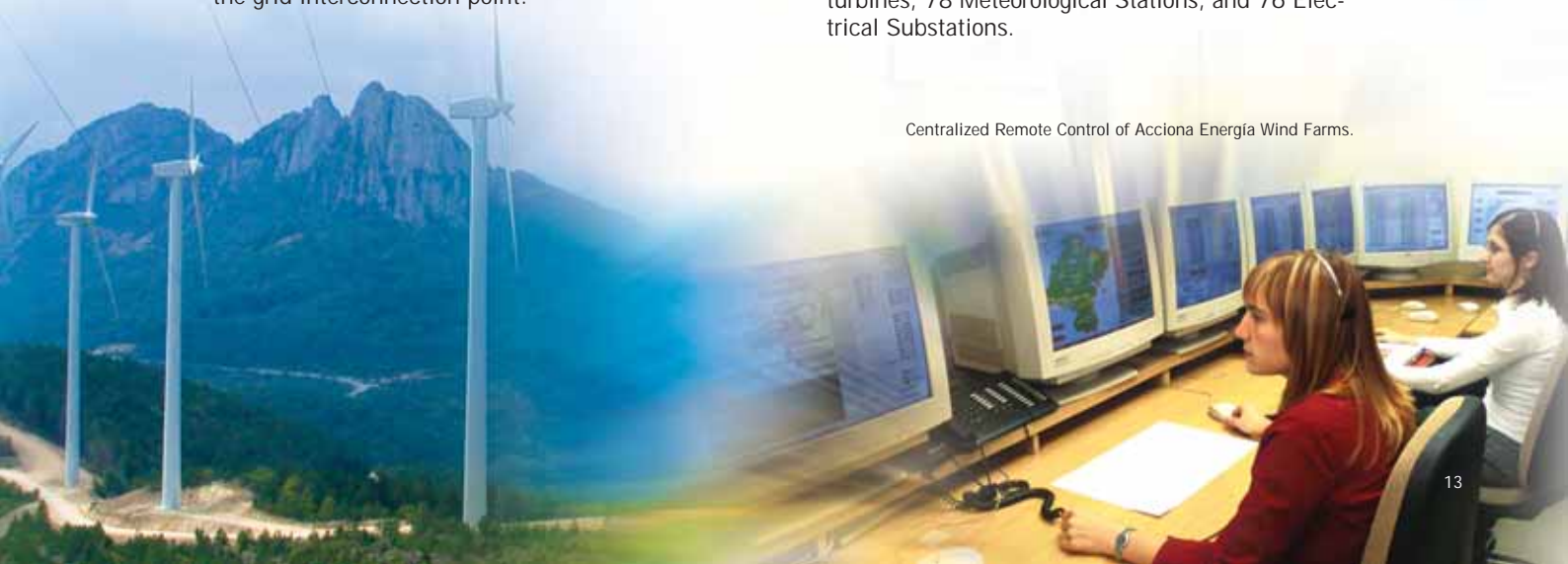
One or more Wind Farms can be controlled from one single control station to adapt the supply at the grid interconnection point.

Reliable

Ingeteam has been developing Wind Power Remote Control systems since 1995.

More than 156 Remote Control Systems have been installed in Spain, U.S.A., Portugal, Mexico, France, China, and Argentina, home to more than 4,800 turbines, 78 Meteorological Stations, and 76 Electrical Substations.

Centralized Remote Control of Acciona Energia Wind Farms.



Quality and Services

Ingeteam is firmly committed to applying Management Systems and Models that guarantee the maximum quality of both its product and services and respect for the environment.

Company Registration Certificate according to the UNE EN ISO 9001 and 14001 standards. Legal Audit of the Occupational Risk Prevention System.



All the products developed and manufactured by Ingeteam have the corresponding CE Marking, based on compliance with the applicable Directives and hence the respective harmonised standards.

Manufacturing process control procedures and the final unit tests on the equipment ensure that the resulting product complies with the most demanding specifications.

Ingeteam has a team of highly-qualified technical staff for the commissioning and after-sales service of the equipment supplied.

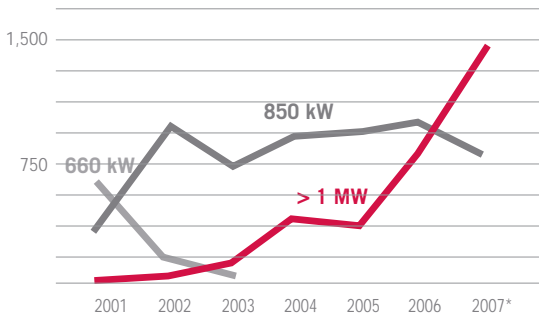
In the conditions of the contract, it is possible to specify and take advantage of this support after the corresponding warranty period has finished.



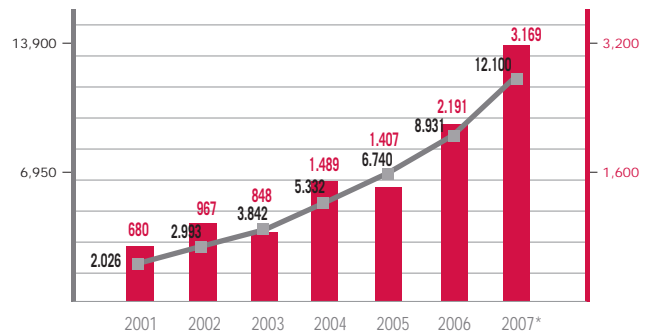
Electric generator design.

References

Ingecon® Wind systems have been adapted to the demands of wind turbines, whose powers are continuously increasing.



Equipment supplied.



■ Cumulative figures - MW

■ Installed - MW

* Firm orders

Ingeteam has supplied its clients with more than 10,000 Ingecon® Wind systems, amounting to a total installed power of more than 9,000 MW, 11% of the cumulative global market.

With a high manufacturing capacity of more than 3,000 Ingecon® Wind units a year Ingeteam can guarantee:

- a rapid response,
- a competitive price, and
- maximum efficiency and reliability.



Control cabinet cabling.



INGETEAM, S.A.
Avda. Ciudad de la Innovación, 13
31621 SARRIGUREN - ESPAÑA
Tel.: +34 948 28 80 00
Fax.: +34 948 28 80 01
e-mail: wind.energy@ingeteam.com

INGETEAM S.A. de C.V.
Dr. José Luna Ayala 204 - 1B
Colinas de San Jerónimo MONTERREY
NL MEXICO CP64640
Tel.: +52 81 8333 9313
Fax: +52 81 8333 9314
e-mail: northamerica@ingeteam.com

INGETEAM Ltda.
Av. Brigadeiro Luiz Antonio, 580
Bairro de Bela Vista
01006-303 SAO PAULO - BRAZIL
Tel.: +55 11 3101 3777
Fax.: +55 11 3101 2530
e-mail: brazil@ingeteam.com

INGETEAM SHANGHAI, S.A.
Shanghai Trade Square, 1105
188 Si Ping Road
200086 SHANGHAI - P.R. CHINA
Tel.: +86 21 65 07 76 36
Fax: +86 21 65 07 76 38
e-mail: shanghai@ingeteam.com

INGETEAM, A.S.
Technologická 371/1
70800 OSTRAVA - PUSTKOVEC
CZECH REPUBLIC
Tel.: +420 69 732 68 00
Fax.: +420 69 732 68 99
e-mail: czech@ingeteam.com

INGETEAM, GmbH
Stielerstrasse 3
80336 MUNICH - GERMANY
Tel.: +49 89 99 65 38 0
Fax.: +49 89 99 65 38 99
e-mail: deutschland@ingeteam.com

Ingeteam