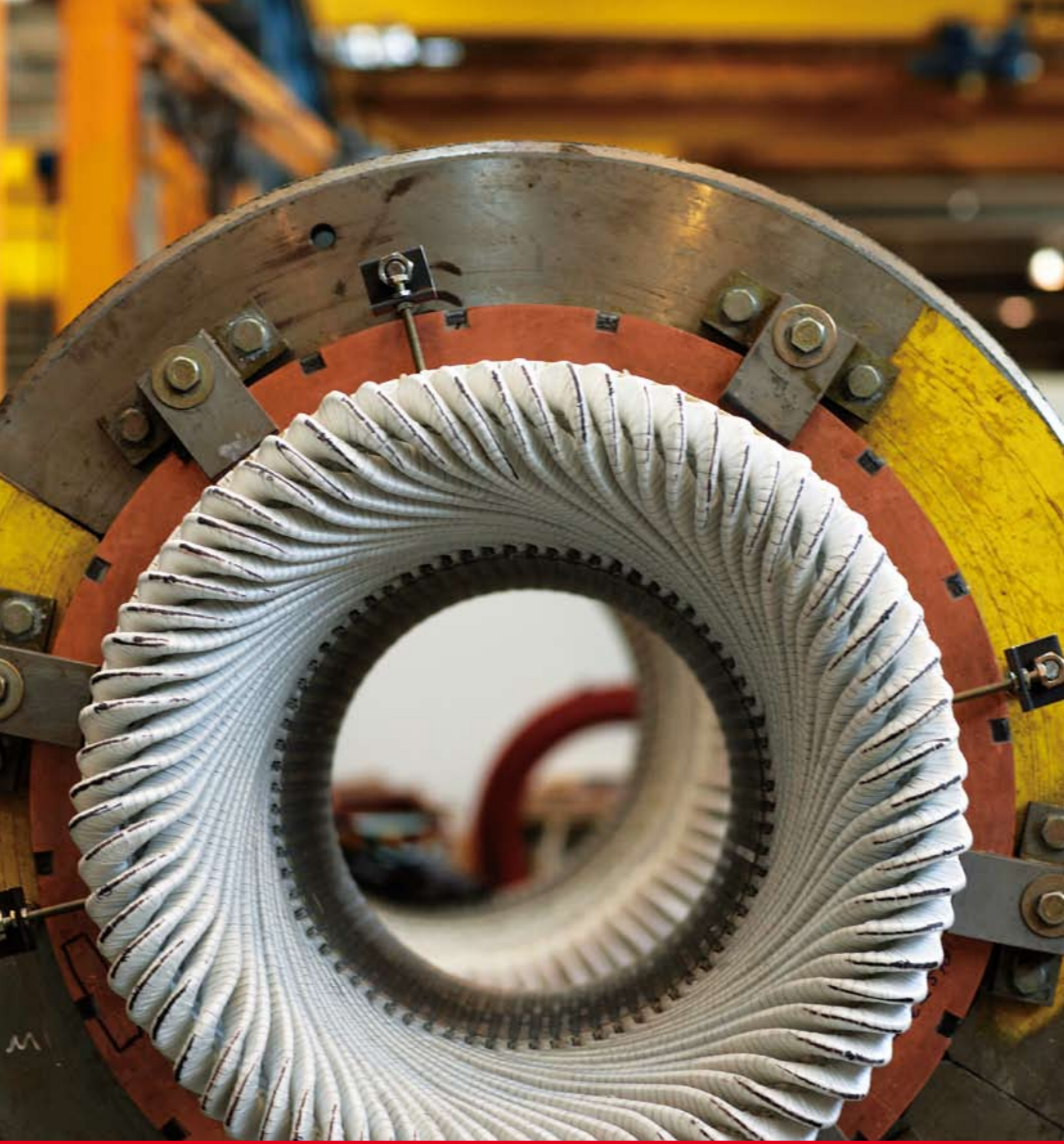


# The Worldwide Specialist in Power Conversion





## Your Partner for Power Conversion Solutions

With over a century of recognized experience, Converteam is a worldwide specialist in power conversion, providing engineered solutions and systems to convert power from mechanical to electrical or reversely, and from electrical to electrical.

These solutions are not only mission-critical to the customer's process; their value is far greater than their share in the customer's overall investment. Converteam's unique approach is based on an in-depth understanding of both processes and client needs, enabling us to offer the most optimized solutions while lowering environmental impact. Converteam solutions are built around three core components that are either manufactured or assembled in-house:

- electrical machines (motors and generators),
- power electronics equipment (variable speed drives and DC & AC conversion),
- process automation and controls.

### A worldwide coverage

As customers' projects are increasingly complex and global, Converteam has made geographical coverage a cornerstone of its strategy. It combines an industrial approach based on a global footprint for electrical machines, power electronics equipment, automation and controls on each continent where we are operating and a local presence in sales and service to better serve customers' needs. Converteam pays special attention to developing the best components at competitive cost, giving customers the benefit of its solid global presence. The company can thus call on skills or resources from any other Converteam entity as needed in order to implement an original engineering approach worldwide.

Converteam has facilities in more than 17 countries and confirms a worldwide position, with sales in more than 75 countries around the globe. The Group's main facilities and manufacturing units are located in Europe (France, Germany and the UK), in the Americas (USA, Canada and Brazil) and in Asia (China and India). In addition, the Group has offices in Korea, Singapore, the Middle East, Russia, North Africa and in the Nordic countries.



### Converteam—the world leader in electrical solutions

Converteam is an engineering company providing customized solutions and systems converting electrical energy into productive performance and reversely. Our offering ranges from design only to turnkey systems, installation and commissioning, and is backed by a wide choice of services.

Serving specialized segments as well as our core markets in marine, oil & gas and offshore, power generation, renewable energy and industry, our 5,000 experts and skilled workforce provide effective responses to customers around the globe.



In order to provide lifetime value to its customers, Converteam's solutions are backed by a full range of services, from initial design studies to production, installation and follow-up ensured by service teams. Available 24/7 at both local and global levels, our support service meets a broad range of customers' requests for technical assistance, maintenance, spare parts and other support. Converteam's offices, which all have in-depth technical knowledge of new and existing equipment—including superseded technologies—are available for maintenance, technical support or training.

**NORTH AMERICA**  
(USA & CANADA)

- Main office in Pittsburgh, PA
- Drives factory in Pittsburgh, PA
- Rotating Machines factory in Minneapolis, MN

**OFFICES:**

**USA**

- Charlotte, NC
- Dallas, TX
- Houma, LA
- Houston, TX
- Miami, FL
- Mobile, AL
- Philadelphia, PA
- Phoenix, AZ
- San Diego, CA
- Seattle, WA
- Washington, DC

**CANADA**

- Burlington, ON
- Edmonton, AB
- Vancouver, BC

**NORTHERN EUROPE**

- Main office in Rugby (UK)
- Drives, switchboards and PCB factories in Kidsgrove and Glasgow (UK)
- Rotating Machines factory in Rugby (UK)

**OFFICES:**

**UNITED KINGDOM**

- Gillingham
- Middlesbrough
- Sheffield
- Swansea

**NORWAY**

- Oslo

**DENMARK**

- Kolding

**SOUTHERN EUROPE, MIDDLE EAST & AFRICA**

- Main office in Massy (France)
- Drives and PCB factories in Palaiseau, Belfort and Ludres (France)
- Rotating Machines factory in Nancy (France)

**OFFICES:**

**FRANCE**

- Istres
- Lille
- Lyon
- Nantes
- St Julien les Metz

**EGYPT**

- Alexandria

**ITALY**

- Milan

**UNITED ARAB EMIRATES**

- Abu Dhabi

**CENTRAL, EASTERN EUROPE & RUSSIA**

- Main office in Berlin (Germany)
- Drives factory in Berlin (Germany)

**OFFICES:**

**GERMANY**

- Essen
- Frankfurt
- Hamburg
- Stuttgart

**AUSTRIA**

- Vienna

**RUSSIA**

- Moscow
- St Petersburg

**CHINA**

- Main office in Shanghai
- Drives factory in Shanghai
- Rotating Machines factory in Yantai

**OFFICES:**

- Wuhan
- Beijing

**KOREA**

- Busan
- Geoje

**SINGAPORE**

- Singapore

**INDIA**

- Main office in Delhi
- Engineering Development Center in Chennai

**OFFICES:**

- Mumbai
- Kolkata

**5,000 experts and skilled workforce at your service worldwide**

## Curbing CO<sub>2</sub> Emissions for a Better World

The accumulation of greenhouse gases is a major danger for the environment. Converteam's contribution to finding answers is twofold: we actively partner with our customers to propose solutions for clean energy production as a major industrial player and we commit to improving the energy efficiency of industrial installations while reducing CO<sub>2</sub> emissions.

A variety of directions can be taken to decarbonize the electricity sector, including the development of renewable sources of energy such as wind, solar and wet renewables where Converteam has a lasting commitment to becoming a partner of choice.

In addition, by using electrical motors, which are less polluting than conventional engines (no gas emission), the Group supplies power solutions with high efficiency and low environmental impact, thus actively contributing to the green energy challenge.

Converteam products and solutions advance the efficient use of energy at each stage of power generation and energy consumption, reducing costs and lowering environmental impact. Converteam also works towards sustainable solutions by actively encouraging the shift from gas turbine drivers to electric drivers, at the same time increasing the overall energy efficiency of the whole system.



Reducing energy consumption and pollution through a more efficient motor and drive system offers major opportunities.



## A Full Range of Solutions for Conventional Power Generation

Safe energy supply and improved productivity in conjunction with ever-increasing availability are requirements that modern power stations must meet.

### Power Generation

Conventional power generation is at the beginning of the power conversion chain converting nature-stored energy into electrical power. Converteam's contribution to the power industry market covers a large range of start-up frequency converters and static excitation systems that are used for turbine-driven generators and large synchronous machines as well as generators for gas, steam and hydro power plants. Our variable speed systems were, for example, implemented on the 1GW pumped-storage power plant in Goldisthal, Germany, one of the most advanced hydroelectric power plants in the world, and on the Linthal and the Nant de Drance hydroelectric plants in Switzerland (total 1,600MW).

A powerful range of low and medium voltage variable speed drives is available for variable speed pumped-storage plants, boiler feed pumps, circulation pumps, cooling water pumps, condensate pumps, exhaust and draught fans, conveyors, and other auxiliary drives.

Depending on the application, the variable speed drive solution can save up to 50% of energy consumption compared to fixed-speed solutions.

Every day, thousands of Converteam installations in power plants are in operation worldwide.



### Nuclear Energy

Pushed by the need to fight greenhouse effects and depletion of fossil fuels, the nuclear industry is experiencing strong momentum. Converteam has supported the nuclear sector for decades with generators, motors and power electronics. The Group equipped several nuclear plants, among them China's first EPR in Taishan.

As a supplier to the nuclear industry, Converteam also addresses the safe disposal of the radioactive waste produced and its storage in deep geological formations.



The growing need for finding sustainable alternatives to carbon-based fuels has led to a boom in the renewables market and power generation systems—a core field for Converteam’s products and systems engineering for decades.

### Wind Power

Converteam is a system supplier to the wind industry to which we provide a complete electrical range of low and medium voltage converters either for doubly-fed or fully-fed generators; “standard” speed Permanent Magnet Generators (PMG), low speed direct-drive generators or medium speed ones. Power quality, grid connection solutions and control systems complement the offer.

The trend towards more powerful wind turbines with maximum energy yield calls for variable speed generator systems that meet the highest demands in terms of availability, efficiency and grid stability. Converteam has a clear edge in this domain, with the first 5MW Hybrid Permanent Magnet Generator installed for Multibrid and the first 3.6MW Direct-Drive Permanent Magnet Generator commissioned for Siemens Wind Power in 2008.

Our successful implementation of the High Temperature Superconducting (HTS) generator offers promise for significant increases in power density and efficiency making it particularly suitable for the long term objectives of both offshore and onshore wind farms.

Converteam is the global market leader for low and medium voltage wind converters\* with a unique track record of more than 20GW of low and medium voltage converters delivered.



Converter dedicated to wind applications



\*“Global Outlook for Electric Drives in the Wind Power Industry”, Frost and Sullivan, November 2009

The photovoltaic market’s shift to bigger farms places Converteam in a strong position to propose power conversion solutions developed in Multi-MW applications. We are also involved in power generation from the sea (waves and tidal currents).



### Solar Energy

In the coming years, solar technology will represent a growing share of the power supply market. Converteam technology is perfectly suited for medium to large grid-connected photovoltaic plants. The high-end system solution covers central inverters, ready-to-connect medium voltage power stations or the complete electrical turnkey services. The inverters convert the direct current generated by the solar modules into alternating current for feeding the energy into the grid and are also actively involved in the grid safety management. Converteam solutions based on state-of-the-art power electronics meet the highest requirements in terms of availability, economic efficiency and grid stability.

### Wet Renewables

For this type of renewable energy, which is still at a relatively early development stage, Converteam is working in close cooperation with famous universities to speed up the development of innovative solutions. Converteam is involved in providing the complete power conversion solution, including the generator, the converter and the connection to the grid.

As an example, Converteam secured a contract with EDF for the new tidal farm off the coast at Paimpol in Brittany, France. The project will feature several electrical generators installed 40 meters below sea level. Generator turbines will enable water energy to be converted into mechanical energy, which will be transformed into electrical power. This CO<sub>2</sub>-free generated power will then be carried through a 15-km long link to an onshore station to be fed to the existing power grid in 2012.



Pelamis Wave Power system to generate renewable energy from ocean waves (Portugal)

## Complete Electrical Solutions for the Oil & Gas Market

Converteam is present throughout the value chain from upstream to downstream, from production and extraction (including onshore facilities, offshore fixed platforms, floating production, storage and offloading vessels, and subsea systems) to transport and storage (pipelines, LNG liquefaction and reliquefaction). Converteam also provides fully customized electrical system solutions for refining and petrochemical applications (crude refining, gas to liquids, ethylene and propylene).

Converteam solutions are based on Variable Speed Drive Systems (VSDS), a complete system from network to shaft end including transformer, frequency converter, electric motor and auxiliaries. Our scope of supply also includes Power Management Systems (PMS), induction and synchronous motors as well as generators for gas and steam turbines and diesel and gas engines.

### A pioneer in high-speed solutions

Converteam has in particular developed a range of motors to meet the most demanding speed and power requirements in compressor systems.



Converteam is the electrical supplier of the deep water compression station for the Norwegian gas field known as Ormen Lange situated 120km off shore and some 1000m under sea level.

The high-speed drive solution allows direct connection of the motor and the compressor, eliminating the need for a gearbox and therefore improving the overall drive system efficiency. With the capability to operate at very high speed, up to 20,000rpm, the weight and footprint of the full compression train are significantly reduced. In addition, magnetic bearings eliminate the need for oil lubrication systems, therefore lowering maintenance costs.

Converteam has been a pioneer in extending its solutions into new challenges such as subsea processing for gas compression and oil pumping systems dedicated to production in deep water.

Converteam occupies a unique position in the provision of products and integrated systems for highly specialized offshore vessels such as drilling vessels, diving vessels, support vessels, and for other vessel types such as cable and pipelayers and FPSOs. Our broad expertise encompasses skills in the design, manufacturing, commissioning and lifetime support of integrated electric propulsion, Vessel Control Systems (VCS) and Dynamic Position (DP) control system solutions.

This unrivalled capability enables us to add value to projects by ensuring that the complex interfaces between such systems are identified, coordinated and managed at a single point from the outset. Converteam engineering and project management skills represent a major advantage to monitor costs and delays.

Constantly striving for improvements, Converteam is at the cutting-edge of research and development initiatives, as typified by our highly fuel efficient dual active front end configurations for variable speed drive propulsion solutions and by our class leading fuel saving facilities embedded within our DP control systems.

## Proven Expertise in Naval and Merchant Shipping Applications

Converteam offers electric propulsion and automation systems that harness the latest technology for merchant shipping (cruise liners—including Queen Mary 2 and several MSC world-class cruise ships—, LNG tankers, etc.). Converteam's solutions cover two types of propulsion, either inboard (motor inside the ship) or outboard (podded solutions).

Converteam is the only supplier to satisfy every aspect of inboard electrical requirements such as electric distribution, control and monitoring systems, automation and dynamic position systems. The objective is to enable customers both to optimize their costs and benefit from best performances and higher equipment reliability.

For naval ships (aircraft carriers, submarines, frigates and destroyers, etc.), Converteam's solutions are mainly based on the same systems developed for commercial applications but are often augmented to meet the special requirements for military conditions such as increased shock resistance and electroacoustic tolerance.

Converteam is a major supplier of the propulsion and power systems to the Royal Navy of the UK, and has also been chosen to supply electrical systems to the French Navy's BPC ships and to the US Navy's destroyer program, DDG1000. Recently, the Korean and Dutch navies have also selected Converteam as their electrical propulsion provider.



US Navy's USS Makin Island (LHD 8)

A new propulsion solution designed for both merchant and naval sectors is based on induction motors combined with PWM press-pack IGBT converters. It increases availability and efficiency, reduces operating and maintenance costs, resulting in size and weight savings and lower noise and vibration levels.



Leveraging its acknowledged experience in project management and system integration, Converteam provides the power and control for industrial processes worldwide, applying advanced technologies in high power motors and generators, drives and automation systems. Our know-how and large installed base enable us to offer innovative solutions in all parts of the world.

## Production and processing of steel, aluminum and other metals

Converteam's offering covers every stage in metals production from smelting to finishing. Capabilities range from facility modernizations to greenfield installations and from specific engineering services to turnkey responsibility. With solutions based on high-performance power electronics, automation and advanced software tools for production and supply chain management, Converteam provides innovative solutions to improve throughput, product quality, plant availability and process efficiency for its clients.

## Material handling

Converteam provides complete electrical solutions for all kinds of cranes from container handling to bulk operations, from heavy-lifts to the handling of general cargo. Typical applications are drives for cranes at ports, shipyards, power stations and steelworks where expertise in automation gives us a clear edge. Experience, proven reliability and constant innovation are good reasons for choosing our comprehensive solutions. Optimized energy consumption, reduced heat emission, low space requirement, high flexibility and maintenance-friendliness are features of the new drive technology, as developed for the new offshore crane market and for mobile cranes at ports.

## Test benches

Constant innovation and exchange of experience with Converteam's customers form the basis of the company's success. Test benches are used to test equipment under extreme speed, torque and dynamic response conditions in order to ensure that it withstands its normal lifetime without failure. In addition to testing platforms for automotive and

aerospace industry and wind tunnels, Converteam supplies innovative solutions for the booming wind market. More specifically, Converteam is a world leader in providing wind turbine OEMs with test bench equipment for their gearbox, generators, converters and full nacelle. Tests in this area include vibration testing as well as simulation of fluctuating wind exposure.

## Mining

Converteam has more than 100 years' pedigree and hundreds of references in this industry. We deliver solutions for winders, crushers and grinding mills, mine ventilation systems, and conveyor systems. Converteam's offer starts from product solutions based on our range of motors and drives, through fully integrated turnkey projects utilizing our experience in automation, Supervisory Control and Data Acquisition (SCADA), Human Machine Interface (HMI), control PLCs, electronic speed distance monitoring and supervisory systems, brake controllers, safety cubicles and communications.



Because innovation is key to making our customers more competitive in the future, we always put it at the heart of our strategic positioning. At Converteam, the extension of the solutions offering is stimulated by the product development process resulting from "market pull" (identification of market needs) and "technology push" (technology trends and innovation).

## High Temperature Superconducting (HTS) generators

The advent of High Temperature Superconductivity has created the opportunity for significantly improving the efficiency and capacity of industrial electrical machines. The HTS technology is a key asset for use in pumps, compressors, blowers and belt drives requiring continuous operation under various mechanical and environmental constraints. HTS further expands the attractiveness of electric propulsion systems in transportation applications too, in particular for electric naval ships, cruise and merchant vessels where efficiency, footprint and weight savings contribute to increasing ship design flexibility and overall energy efficiency, and reducing greenhouse gas emissions.

Copper coils in HTS machines are replaced by a superconducting wire at a temperature ranging from  $-196^{\circ}\text{C}$  to  $-243^{\circ}\text{C}$  using cryogenic equipment designed as part of the customized HTS solution in order to provide the highest level of integration, reliability and cost efficiency. The benefits of the HTS technology applied to a motor or a generator are as follows: size and weight savings, improved performance with almost zero losses, dramatically increased power density, significantly reduced noise and vibration levels, reduced maintenance.

Converteam is currently working on a three-year project funded by the UK Department of Trade and Industry to turn Converteam superconducting direct-drive generator concept into an operational 8MW wind turbine generator for offshore wind farms. Renewables and marine applications will be among the first to benefit from the advantages of this technology.

As part of the HYDROGENIE program, Converteam delivered a 1.7MW 214rpm HTS generator in 2010 for a hydro power plant located in Germany. With

its smaller mass and footprint, this generator will deliver 30% additional output power compared to existing operating units. This project is a perfect illustration of Converteam technology strategy and ability to provide robust HTS solutions to industrial plants.



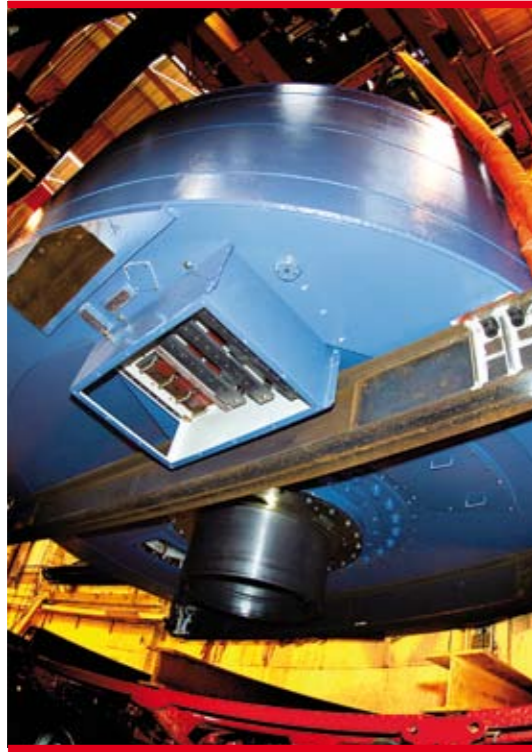
HTS generator of HYDROGENIE project

## Full range of Permanent Magnet Generators for wind energy

The Direct-Drive Permanent Magnet Generator for wind energy allows direct connection of the turbine to the generator without any intermediate gearbox, thus deriving subsequent increase in reliability, especially appropriate for offshore installations where access to the wind turbine is limited by weather and sea conditions. A first prototype was delivered and tested as early as 2008, and several other generators have been ordered to Converteam ever since.

Converteam is also present in a number of other market segments: water (including desalination), pulp & paper, fibers & plastics and cement industries...

Since the late 1990's Converteam has been investing R&D resources in HTS technology



Direct-Drive Permanent Magnet Generator

An alternative solution of Permanent Magnet Generator (PMG) for one-stage gearbox wind turbine has also been designed, manufactured and fully tested by a customer. The output power of 5MW makes this product well-adapted to address the latest generation of wind turbines. Converteam has also designed and built a standard speed PMG for the wind market. With these designs, Converteam offers the wind business highly efficient and cost-effective generators that can be associated with our low and medium voltage drives.

### Active Stator and Pole Shoe Stator

Active Stator technology is a patented concept allowing the harmonious fusion of electrical machine technology with power electronics. It takes the best from DC machine concepts and AC machine reliability, allowing significant torque increase in similar mass and footprint.

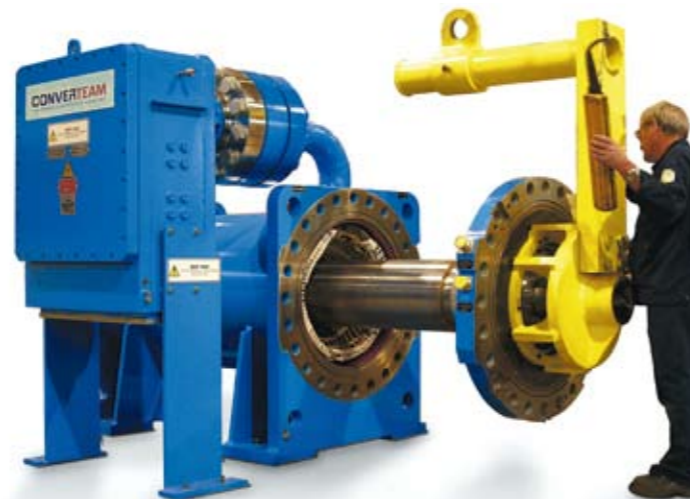
A first prototype of electrical machine using Active Stator technology was manufactured and tested in 2009, showing exceptional performance and paving the way for larger machines which are already under design.

Similarly to the Active Stator, the Pole Shoe Stator is a new patented Converteam topology, which offers higher power density while increasing overall reliability and facilitating the maintenance of electrical machines. This unique design with no winding end and removable concentric windings is particularly suitable for solutions operating in harsh environments, subsea or offshore operations. It is particularly well-suited for offshore wind turbines.

### High-speed motor applications

High-speed motors for oil & gas compression but also for water pumps and air-or CO<sub>2</sub>- related processes are providing customers with high efficient, low footprint solutions together with low maintenance costs thanks to the gearless coupling. Converteam is working on an enlarged range of solutions to cope with higher power, up to 35MW, 7,500rpm, and also low power solutions below 5MW and up to 19,000rpm.

In 2010, Converteam launched the MV3 permanent magnet technology for high-speed motors. This technology offers an overall better efficiency (98.5%), the possibility to reduce motor footprint, the opportunity to reach higher speed (lower size of rotating parts) and increase the resistance to corrosive gases in case of integrated motor-compressors or pumps.



High-speed motor

### Posei2don project: towards a totally "green" ship

In 2008, Converteam was awarded a major research and development project from the European Union to enable "clean" full-electric propulsion systems to become more viable across a much greater range of vessels.

The Posei2don ("Power Optimized Ship for Environment with Electric Innovative Designs ON board") project aims to combine the benefits of Converteam's new generation of superconducting motors and generators with new advanced DC architecture which achieve substantial reductions in equipment size and weight and open up full-electric propulsion to much smaller vessels than is possible today. A land-based demonstrator of the system will be built and demonstrated within the course of the project.

The anticipated exceptional high levels of efficiency and flexibility of operation will reduce fuel consumption as well as the levels of greenhouse gases produced by shipping.

### Power Management System

The global optimization of energy systems is crucial to reducing greenhouse gas emission in a substantial and cost-effective way. It is also of major economic interest in the merchant marine sector, for example.

Taking this consideration into account and based on the array of innovative and renewable sources of energy, Converteam has developed advanced power management concepts aiming at proposing a breakthrough energy management system for ships, FPSOs, and refineries. The proposed architecture gathers data in real-time and will be able to anticipate and optimize energy needs for each operational configuration considering risk levels while systematically favoring less polluting and cost-effective sources of energy.

### Remote Monitoring

Remote Monitoring enables availability to be increased and overall performance of the system to be improved while significantly reducing maintenance costs.

Converteam complete Remote Monitoring package is available on Converteam's drive technologies, for example on the MV7000 drive. It provides access to a broad range of data including electric and thermal values, speed and torque of electrical machines, grid status as well as many other configurable parameters upon needs. A secure DMZ architecture coupled to specific user's rights makes it possible to control and change real-time parameters from remote locations in order to optimize process performances.



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