

# insider



## Powering the digital age

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Efficiency at its best

ABB is protecting the power supply of factories making semiconductors and touch panel LCD displays for smart phones and tablet PCs, helping to drive the digital age.



# 1|13 Insider



**Amina Hamidi**  
Product Group Manager  
Power Protection

We have made so much progress that I find it hard to believe it was just one year ago that ABB acquired Newave Energy.

The past 12 months have seen a very successful consolidation of our UPS businesses. Being a part of ABB has given us a tremendous opportunity to expand out of our traditional European markets and offer our products world-wide, and we have already seen very positive results from this.

ABB's position in the power control and power quality market has been strengthened by our synergy too.

An invaluable contribution is made by our colleagues in New Zealand, who are world leaders in the supply of voltage conditioners and large scale single conversion UPS products. These are ideal for industrial plant protection. By combining our talents in these two locations, ABB

can now provide both commercial and industrial customers with a UPS solution that is exactly right for them.

At this year's CeBIT we will be providing a particular focus on demonstrating how our commercial UPS products can benefit customers who operate datacenters.

CeBIT will take place in Hannover from 5th to 9th of March (we will be in hall 11, stand D12) and ABB will exhibit its entire range of innovative UPS systems. Of particular interest to datacenter customers will be our range of scalable, modular and standalone UPS systems that have a maximum power capacity of up to several megawatts.

We will also be proudly showing our rack-independent UPS systems with 10 and 20 kW modules that can be accommodated in any 19" cabinet regardless of the rack's manufacturer.

Our Decentralized Parallel Architecture (DPA) modular systems – in which units are free of single points of failure – maximize our system's mean time between failures. Quick and simple repair by safe-swapping modules while the UPS is online minimizes the system's mean time to repair and is a significant benefit to facility operators. This ease of use, zero downtime and low energy consumption (and thus low CO<sub>2</sub> footprint) mean these UPSs have a low cost of ownership – a very significant factor for all our customers.

We will be announcing new UPS systems at this year's CeBIT – in particular new products suitable for medium-sized and large data cen-

ters needing up to several MWs. This new product offering quickly follows the very exciting recent announcement of our new DPA UPSscale ST 200.

The PCS100 Napier based team has also been busy and is about to release the PCS100 RPC (Reactive Power Conditioner). This is ideal for correction of reactive power problems, including the imbalance, harmonics and leading power factor, often found in datacenters.

Our goal is to be among the top tier UPS companies globally as we gain traction from the strategic and operational advantages this gives us. These new products, coupled with our outstanding existing power protection products, will certainly help us on our way!

The UPS market is huge and is growing rapidly, so we find ourselves in an exciting and promising area. I look forward to working with you in the rest of 2013, and beyond, to seize the opportunities that have been presented to us.



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 ABB provides an electronics manufacturer with the first PCS100 UPS-I/ RPC project located in Malaysia

**07** **Protecting a mega investment**  
 ABB provides 22 x 1.5 MVA PCS100 UPS-Is to protect the front end process for the world's largest manufacturer of memory chips

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# ABB provides leading edge technology to protect a manufacturer of electronic products in Malaysia

ABB have provided a manufacturer of electronics with a unique solution combining the first PCS100 UPS-I/PCS100 RPC (Reactive power Conditioner) product to protect the polyimide film manufacturing line from voltage outages, sags and swells. This power protection package is a milestone for ABB in that the combination of the two PCS100 products enables sags and swells to be eliminated (via the UPS-I), whilst at the same time increasing the power factor of the load above 0.90 (via the RPC, which is a product derived from the PCS100 STATCOM development). In addition to dynamic power factor control, the PCS100 RPC also provides filtering of low order harmonics, further improving power quality. This value added concept was key, as protection of vital assets was essential to continuous output.



Polyimide materials are lightweight, flexible and resistant to heat and chemicals. They are typically used as a flexible printed circuit board, often called copper clad laminate. These properties are perfect for telecommunication devices such as cell phones, HDD wireless suspensions and optical pick-ups. ABB's customer uses their manufacturing line to supply polyimide film to the electronics world, and a power outage to this manufacturing process could result in huge recovery costs and production downtime.

ABB's solution was a 1050 kVA PCS100 UPS-I and a 323 kVAR PCS100 RPC. This turn-key solution meant that, if a power out-

## Combining the PCS100 UPS-I and PCS100 RPC was a milestone for ABB.

age occurred, the PCS100 UPS-I would disconnect the load from the utility and supply the manufacturing line with full power for five minutes. Simultaneously, the PCS100 RPC would provide power factor control above 0.90. The company's expectations were that with a power outage, the UPS-I would supply power to the load of 1000 kVA. ABB's PCS100 UPS-I was able to go beyond that expectation and supply 1050 kVA to protect the load should a shutdown occur.

### PCS100 UPS-I

After the manufacturing company had evaluated transition times, the PCS100 UPS-I passed their expectations. The PCS100 UPS-I also included a static switch, meaning that a faster transfer to stabilize the power flow would occur if an outage prevailed. After further evaluations were undertaken, the company found that no other competing products could provide this. The final deciding factor related to system efficiency, as the manufacturer was able to save a large amount on air-conditioning requirements, due to low heat loss from the PCS100 UPS-I. Along with the PCS100 UPS-I having an efficiency rate of 99 percent, it also provides a small footprint.

### PCS100 RPC

The PCS100 RPC technology is a hybrid solution that not only provides dynamic reactive power conditioning but also filtering of low order harmonics, all based on ABB's PCS100 inverter technology. Compared with other technologies, the PCS100 RPC has a number of benefits, including imbalance correction, fast dynamic power factor, and active filtering of harmonic currents. One of its silent characteristics is its modular construction, which makes the platform very reliable. If one of the power modules fails, the system will not trip, but will continue to operate at reduced capacity. Because the granularity is small, the manufacturer can get full redundancy at very small cost and this level of reliability at such low cost is unique in the industry.

With the features of the PCS100 UPS-I and RPC, plus the added benefit of ABB's global presence, the electronic products manufacturer can utilize this offering at any time.

To see further technology information please visit: [www.abb.com/powerquality](http://www.abb.com/powerquality)



# ABB's PCS100 UPS-I protects a mega-investment in China

The world's largest maker of memory chips has ordered 22 x 1.5 MVA PCS100 UPS-I units for its latest mega-investment in China – the \$7 billion NAND flash plant in Xi'an. The facility will have a monthly output of 100,000 nanometer chips and is expected to become fully operational towards the end of 2013. NAND chips are used primarily in memory cards, USB flash drives, solid-state drives, and similar products for data storage and transfer.

The Power Electronics teams in New Zealand and China have secured an order to supply an electronics giant with 22 x 1.5 MVA PCS100 UPS-I's, featuring ultra capacitors for energy storage, to protect their "front end" process – building microchips onto silicon wafers. This is a significant project for ABB as this is the largest order value for a single project to date. It also represents the growing demand for power protection that leading electronics companies require to ensure their manufacturing lines are free from voltage sags and swells.

### Integrated circuits (ICs)

Integrated circuits, or "microchips" are found in virtually all electronic equipment and have revolutionized the world of electronics. A microchip is a complex device that forms the brains of every computing device. To the naked eye, a microchip appears flat, however they are three-dimensional structures and may include as many as 30 layers of complex circuitry.

Microchips are fabricated as die in batches of wafers (called silicon wafers) in clean rooms thousands of times cleaner than hospital operating theaters. The silicon wafers are made by purifying the silicon, which is then melted and cooled to form an ingot. This is then sliced into discs called wafers. Microchips are built simultaneously in a grid formation on the wafer surface in a fabrication facility. Super chips can be used for super computers and other large scale products. On a smaller scale, microchips can be integrated into cell phones, flash drives and memory cards. The electronics industry is reliant on leading electronics companies to supply the growing demand for electronic devices to the tech age generation. Investments in these manufacturing plants are therefore given priority by corporates and leaders in the electronics world.

### Reliable performance

ABB's customer required protection for the manufacturing process from voltage power quality issues such as voltage swells, voltage sags and microcuts. The previous track record of ABB's PCS100 UPS-I in their factories, where no production losses had been experienced due to faults or issues in the UPS-I, meant that they could rely on the same performance for this new billion dollar factory. The company's plant, their biggest ever overseas investment in western China, will produce 10-20 nanometer chips, mainly used in smartphones and tablet PCs. End user benefits such as a high efficiency rate coupled with past experience, meant that they could rely on ABB's technology. The global support offered by ABB also ensured their expectations would be achieved.

To date, ABB have supplied power protection to the company amounting to a total of 116 MVA – the equivalent electricity required to power an estimated 33,000 households.

### ABB's technology

The PCS100 UPS-I is an offline UPS with an ultra-capacitor energy storage system coupled to a back-up inverter system to allow the downstream load to remain operational through short power outages and very deep voltage sags. Among the many differentiating features of the solution are:

- Short payback time, typically less than 18 months (depending on weather conditions and the severity of sags and swells, it can be 12 months)
- Large low voltage power capacity of 1.5 MVA at 220 V (most other solutions require medium voltage systems for this capacity)
- Ultra-fast transfer time of less than 2 milliseconds
- Exceptionally small footprint – 50 percent smaller than competing solutions
- Long and more economical operating life of 15 years compared to the 3-5 years of



The PCS100 UPS-I has a 99 percent efficiency rate making it a reliable option for the electronics world

- most UPS batteries
- Comprehensive customer support
- 99 percent efficiency rate

Based around modular redundant inverter technology with a centralized industrially rated static bypass switch and additional electromechanical fail safe bypass, the UPS-I is highly reliable and serviceable. The heavily rated thyristors in the utility disconnect also mean that the overloads, current distortion and fault levels commonly found in industrial applications can be handled with ease. The PCS100 UPS-I has two battery storage options. They come in the form of ultracapacitors and supercapacitors, both providing a small footprint in storage. Reduced cost of ownership is also a major advantage of the single conversion UPS-I topology. This means significant energy savings when compared to many alternative power protection technologies.

To see PCS100 UPS-I technology information please visit: [www.abb.com/powerquality](http://www.abb.com/powerquality)





# Powering up the datacenter world

ABB Switzerland supplies six Conceptpower DPA units to the City of Zurich.



OIZ Hagenholz: Organization and Information Technology Center for the city of Zurich

**Our digital world demands top-quality, completely uninterrupted power. This is a requirement which cannot always be fulfilled by a normal power supply. In order to protect their critical business, datacenters such as the OIZ Organization and Information Technology Center in Zurich rely on high-performance uninterruptible power supply systems (UPS).**

#### The challenge for the customer

The OIZ Hagenholz Organization and Information Technology Center for the city of Zurich pursues a consolidation and standardization strategy in order to provide the prerequisites for cloud computing services. In this process, the IT infrastructure of the OIZ was reduced from the previous operating centers to two central datacenters. Both new sites, the OIZ Albis and the OIZ Hagenholz, came into service at the same time. The two new OIZ buildings are certified for energy efficiency in datacenters by TÜViT in accordance with the Trusted Site eEfficiency (TSe2) program and have been built based on the latest standards of energy efficiency. This means that, both in structural terms and in terms of IT infrastructure and server management, the focus is on great energy efficiency. From the perspective of optimum energy efficiency and supply reliability, the UPS systems were one of the components which formed part of a public invitation to tender.

#### ABB's solution

The effort to increase efficiency, flexibility and availability is the key to the development and introduction of modular UPS solutions. The scalability of the modular architecture can significantly reduce the high levels of power consumption and CO<sub>2</sub> emissions, thus helping the planners to produce flexible scenarios for power and space requirements for the immediate and changing future requirements. ABB provided the best solution to the demanding requirements for the OIZ Hagenholz and installed six compact and modular Conceptpower DPA (Decentralised Parallel Architecture) systems, each with 5 × 50 kVA/40 kW modules in the OIZ datacenter. The battery packs were fitted separately. This makes sense, as the cooler the batteries



Installation of six Conceptpower DPA systems, each with 5 × 50 kVA/40 kW modules in the OIZ datacenter

are kept, the longer they last. Performance density of 200 kVA for a footprint of 0.6 square meters is outstanding and only possible as ABB works with extremely high levels of efficiency (up to 96 percent).

The modular UPS market is currently the fastest-growing segment in the three-phase UPS market. Unlike other systems, the Decentralized Parallel Architecture system from ABB does not have shared components. This means that all the hardware and software is included separately in each single module. The real benefit of this DPA system is the very high performance availability. Each UPS module has a separate independent static bypass, rectifier and frequency converter, control element, control panel and battery charger. As all the critical components are redundant, potential single points of failure can be eliminated. At the same time, the system operating time is maximized by the modularity of the system.

A reliable power supply is the lifeblood of any organization. In the case of the Information Technology Center of the City of Zurich, with ABB's Conceptpower DPA at its heart, critical power supplies can be sustained. The modular UPSs are particularly suitable for this datacenter environment because of their high performance availability and maintainability.

To see further technology information please visit:

[www.abb.com/UPS](http://www.abb.com/UPS)



# DPA UPScale ST range of UPSs

ABB develops the world's most compact true modular UPS.

ABB have launched an extension to the DPA UPScale ST range of uninterruptible power supplies (UPSs). The DPA UPScale ST 200 extends power capability from 120 kW up to 200 kW, while keeping a footprint of just 0.42 m<sup>2</sup>. This makes the new product the most compact true modular UPS in the world.

The DPA UPScale ST 200 is a modular UPS system for organizations that aim for zero downtime and low cost of ownership. The DPA UPScale ST 200 now extends the power capability of this range of ABB UPSs up to 200 kW, opening up new market segments.

Designed for medium-power applications, this new UPS delivers true modular power protection from 10 to 200 kW (in 10 or 20 kW steps) in a single, industry-standard frame. Its flexible design provides a "pay as you grow" model, ideal in situations where requirements change quickly and unpredictably. This scalability means that there is no need to over-specify the original configuration as power modules can simply be added, as needed, without any footprint penalty. Servicing is easy as modules can be replaced without powering down.

The DPA UPScale ST 200 enables cost reduction through a best-in-class efficiency of up to 96.5 percent across a wide load range and near-unity input power factor at partial and full loading (PF of >0.99 at 100 percent load). The UPS's high performance, efficient implementation and easy maintenance and servicing result in extremely low overall operating costs.

The modular DPA UPScale ST 200 is based on ABB's unique and proven Decentralized Parallel Architecture (DPA™). With DPA, each UPS module contains all the hardware and software required for full system operation. Modules share no common components, and, as a result, system uptime is maximized. Thanks to its unique and compact design, the modules only weight 18.6 kg (10 kW) and 21.5 kg (20 kW).

With a footprint of only 0.42 m<sup>2</sup>, the DPA UPScale ST 200 takes up less floor space than alternative UPS solutions, while still, at up to 472 kW/m<sup>2</sup>, providing unparalleled maximum power density as well as all the benefits of a modular DPA UPS solution.

ABB develops, manufactures and markets technologically advanced UPS Systems for critical electronic devices and systems.



# ABB's PCS100 innovation in power protection

## PCS100 AVC (Active Voltage Conditioner)

- Protects sensitive loads from the most common disturbances in utility supplies
- Sags, surges, unbalance, flicker and poor regulation are corrected within a few milliseconds
- Rated 160 kVA - 30 MVA
- High power and performance inverter based system
- Operating efficiency 97-99 percent (model dependent)
- Very small footprint due to no storage to operate

## PCS100 UPS-I (Industrial UPS)

- The PCS100 UPS-I is the ideal solution where very deep sags or short term power outages are a problem
- The PCS100 UPS-I uses energy storage coupled through an inverter to allow the downstream load to ride through very deep sags and short term outages
- The PCS100 UPS-I is an offline system. It is inactive unless the voltage increases by 10 percent or falls by 10 - 13 percent. This enables it to be very efficient, up to 99 percent



## PCS100 RPC (Reactive Power Conditioner)

- ABB's PCS100 RPC is specifically designed to condition the current drawn by industrial and commercial loads. The PCS100 RPC uses leading edge power electronic conversion to inject current into supply, correcting for common problems such as:
  - Unbalanced load current
  - Fast varying current causing voltage flicker
  - Low order harmonic currents
  - Power factor problems including leading power factor
  - Load current induced voltage drop
- As a purely static device, the PCS100 RPC provides extremely fast correction. Its modular redundant design makes it a very reliable, scalable and serviceable product, backed by ABB's global support network. Packed with new features to suit industrial and commercial applications.



# Energy storage taking off

ABB and Prudent Energy working together to provide grid stability.

Prudent Energy, together with ABB, have provided countless grid stabilization solutions to the renewable energy industry. From Slovakia to China, ABB and Prudent Energy are applying technological “know how” to provide the opportunity to store energy from the electricity grid and return it when required. This offers a range of options to strengthen and enhance the performance, quality and reliability of smart electricity grids.

To maintain efficient transmission and distribution, the active and reactive power balance in a system needs to be controlled. Inadequate active and reactive power management can result in high network losses, equipment overloading, unacceptable voltage levels, voltage instability and even outages. ABB and Prudent Energy have provided a turnkey solution incorporating ABB’s 100 kW PCS100 ESS, PLC (programmable logic controller) system, transformer and circuit breaker with Prudent Energy’s specialized VRB battery to a pioneering microgrid customer in Slovakia. Prudent Energy is the designer, manufacturer and integrator of the patented Vanadium Redox Battery (VRB®) Energy Storage System – a long-life, environmentally friendly “flow battery” system. Prudent’s technology integrates smoothly with ABB’s PCS100 ESS as it works by charging the VRB battery and regulating the power flow by discharging power to the grid when wind and solar energy output varies, and during unstable events, such as extreme weather conditions. After many tests, ABB’s power protection team in China provided a new solution for Prudent’s VRB battery to solve the problem of initial charge. The end result was an improved solution based on past projects with



The complete solution of ABB’s PCS100 ESS paired with Prudent’s VRB Energy Storage System

Prudent using their VRB battery system, which is smaller sized, lower cost and easier to operate.

China’s energy demand is growing rapidly and renewable sources are a key part of the country’s new energy strategy. To gain more knowledge and test the available technology in certain areas, China State Grid (SGCC) initiated the “Golden sun demonstration project” in Zhangbai county, Hebei province. The project involves 100 MW windpower, 50 MW solar and 20 MVA energy storage systems, split into smaller slices and supplied by different technologies and manufacturers. This is to allow SGCC evaluation and the benchmarking of the different concepts and technologies and also to test system performance for different applications.

Prudent Energy and ABB delivered a 2 MVA Energy Storage System based on Prudent’s VRB Vanadium Redoxflow battery and ABB’s PCS100 ESS power converter technology integrated with transformer, switchgear and control (PLC). The system will be used for multiple application tasks like smoothing renewable energy output, peak shaving and frequency regulation. At that time it was also the first Megawatt class installation in China for ABB and Prudent Energy.

Prudent’s VRB is an energy battery offering supply over many



ABB’s 2 MW PCS100 ESS that will help complete the energy storage function with Prudent Energy

hours and therefore perfectly suited for smoothing or shifting renewable generation.

Wind and solar energy are sustainable, clean sources of energy that have the potential to make a significant contribution to today’s economy. About 16 percent of global final energy consumption comes from renewable resources. While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas, such as islands, where energy is often crucial in human development. ABB have provided a 100 kW PCS100 ESS to Prudent Energy to work in conjunction with their VRB battery system. This solution has been installed in a laboratory on Jeju Island, which contains wind turbines and solar cells.

In 2006 Korea established the “Energy Basic Law” which created a suite of incentive and support programs to encourage a

shift towards a more sustainable energy generation base. These programs included such things as the building of 100,000 green homes, special financing tools and tax models for local governments utilizing green technology, and mandatory use of renewable energy in new public buildings.

Jeju Island, situated on the southern tip of Korean Peninsula, is the biggest island in Korea. The regional government is keen to utilize a high percentage of renewable power generation for the island. A number of projects for wind and solar farms are underway or already in operation. The focus is to create an infrastructure that is capable of supplying the island, even with the HVDC link to the mainland disconnected. A number of institutes are working on this strategy. With a high portion of renewable energy, grid stabilization and energy smoothing support is vital.

ABB's PCS100 Energy Storage System (ESS) is grid code compliant and allows increased penetration of wind and solar power.



ABB's PCS100 ESS and Prudent's VRB Energy Storage System that has been installed on Jeju Island located in between Korea and Japan



ABB team in China L-R: Leo-Yan Zhang, Pan Gao, Fanshi Kong, DeDi Li, Hongzhang Sun, Luping Qi, Bettey-Yuhua Lu, Amanda-Wei Li and Guang Bai

This is a typical application for energy storage systems. ABB's PCS100 ESS converter technology is able to establish a grid on its own, similar to a synchronous generator, therefore allowing renewable energy to connect to the grid. This puts the PCS100 ESS in a good position to be considered as one of the core technologies. Together with Prudent's VRB, a small demonstration and test system was installed at the island's laboratory to investigate the best power system topology and control strategies. The project is significant to ABB, as it is the first battery energy storage system in Korea. This combined solution has helped Prudent's VRB battery achieve stable storage and release according to the grid's requirement. For the grid, PCS100 ESS is like a synchronous generator, but it is more flexible to operate and faster to respond to grid instability. It supports the voltage even if the grid power is off, and has black start capability. Black start capability means you can start the system without the grid, purely from the battery.

Therefore, the PCS100 ESS is providing the overall system with the capacity for storage or release of 200 kWh of energy to help grid stabilization on the island. The PCS100 also provides a pre-charge before the system connects to the grid for use.

In this application it was desirable to keep sections of load supplied, so the PCS100 ESS system can also be set to operate

in island mode where the system disconnects from the main grid but continues to supply local loads. When the grid returns, the systems will automatically resynchronize and return to grid connect mode. Based on the success of the Indonesian and State Grid Corporation of China projects, Prudent trusted ABB's advanced technology and the excellent service that is offered globally. ABB's PCS100 ESS has the added advantage of providing grid code compliance – vital in today's wind and solar market. ABB accomplished the Factory Acceptance Test, and delivered the solution to Prudent Energy on time.

For further information please visit: [www.abb.com/energystorageandgridstabilization](http://www.abb.com/energystorageandgridstabilization)



### About Prudent Energy

Prudent Energy is the designer, manufacturer and integrator of the patented Vanadium Redox Battery (VRB®) Energy Storage System – a long-life, environmentally friendly “flow battery” system. Founded in 2007, the Prudent Energy group of companies maintains corporate offices in Bethesda, Maryland, and Beijing, China, with research, development, and assembly facilities in the United States, Canada and Asia.

ABB and Prudent Energy have worked closely together to design leading edge technology to ensure grid stability is achieved. Recent projects have been in Indonesia, Slovakia, China and Korea.



# Setting efficiency records

How the highest efficiency wind generator-converter package was designed and tested.





Two ABB medium speed permanent magnet generators in the back-to-back test set-up

**Medium speed permanent magnet generators (MS PMGs) deliver more than 98 percent efficiency – the highest of any commercial wind generator design. Efficiency is also high at partial loads in low wind conditions, enabling the optimum annual production of kWh. This article spotlights the design and testing effort behind ABB's multi-MW medium speed and medium voltage generator-converter package.**

Since MS PMGs were launched in 2011, they have attracted a lot of attention in various markets. The major benefits of the medium speed design include high reliability for large offshore power, and compact size and lower weight, which enables low turbine top head mass and easier logistics. MS PMGs can be used with the full converter concept to provide total control and an advanced grid compliance strategy.

MS generators are available for multi-megawatt requirements up to 7 MW and more, and can be implemented in three different ways. In the fully integrated design, the gearbox and generator share the same frame, bearings and shaft. The semi-integrated design has the generator and gearbox integrated via a supporting flange, while in the modular design the generator is a separate unit which is mounted independently of the gearbox.

Multi-megawatt wind turbines aim for a low nacelle head weight and a minimum cabling effort between the generator, converters and transformer. As a result, medium voltage (most commonly 3.3 kV) is often the optimum choice of system voltage, because it uses significantly lower currents than low voltage solutions, and therefore reduces losses in the power conversion components (electrical drivetrain) and long cable runs.

#### Specify - design - test

When the customer, a leading wind turbine manufacturer, commissioned ABB to supply an MS PMG generator-converter package, the first step was to determine the basic design specifications for

the generator. The nominal speed was set at 400 rpm in conjunction with the gearbox supplier and customer. The nominal electrical power was set at 7.35 MW with an efficiency of >98 percent. Additional boundary conditions for the design were water cooling with an inlet water temperature of 50 °C, and weight and dimension limits.

Once the basic specifications had been settled, the design work – including a large number of simulations, optimizations, calculations, and analyses – began. After it had been established that an 18 pole design was optimal, the best pole shape and pole shoe design were determined through a major analysis effort that included hundreds of finite element iterations. Attention was also paid to the switching frequency, in order to avoid excitation frequencies that could cause resonances, not only in rotating parts but also in the frame and cooler components. This work paved the way for real testing of prototypes, as this is the only way to effectively evaluate how the generator and converter interact.

The choice of converter was ABB's PCS 6000 – a medium voltage full power IGCT (Integrated Gate Commutated Thyristor) based converter. Its low-loss, high reliability design allows operation with a moderate switching frequency while providing good harmonic performance in the output voltage. The low-loss design and reduced component count also mean that the cost of energy is reduced over the whole lifetime of the turbine. A further advantage is that the converter's modularity allows a tailored mechanical arrangement of the components, depending on whether it is placed in the tower, nacelle or a separate container outside the turbine. The converter also incorporates a number of features to ensure grid code compliance.

#### Back-to-back integration tests

The integration tests were performed using a back-to-back set up at ABB's generator plant in Helsinki, Finland. Two generators were mechanically coupled and both were connected to the grid through

ABB's compact PCS 6000 represents a quantum leap in high power technology, particularly in terms of technical performance and economic operation. Furthermore the high efficiency and low maintenance lead to low operational costs.



Teamwork of generators and converters

a frequency converter. One converter drove its generator as a motor, which drove the other generator. This generated power back to the grid through its own converter. As a result, only the losses of the whole system had to be covered from the grid. The set up allowed the generator to be run at nominal active power.

The tests confirmed that almost all of the design specifications had been met or exceeded. The generator temperature rise was class B, as calculated, and the final temperatures of the converter components remained below the relevant limits. The three phase short circuit test after temperature rise showed that the design target of protecting the generator magnets against demagnetization had been realized. The generator vibration and emitted noise levels were well below the relevant IEC criteria. The generator's efficiency at the nominal point was 98.17 percent, and it exceeded expectations at other loading points.

#### Optimizing the switching frequency

A vibration acceleration sensor was fixed at the axial middle of the stator yoke in order to measure the yoke vibration response to switching frequency. The switching frequency and/or its side bands can excite the stator natural mode, and this might lead to resonance. The switching frequency over the whole speed range in different modulation modes was tested. The best results were achieved with a fixed switching frequency over the whole speed range, asynchronous mode, equal to or higher than 720 Hz. Asynchronous mode provided favorable results because neither the switching frequency nor its side bands coincided with dangerous resonance points at any rotation speed.

The back-to-back tests of the electrical drivetrain therefore showed that the generator-converter package met the customer's specifications and IEC requirements. This solution's combination of medium speed and medium voltage now provides many significant benefits, not only for the customer, the turbine manufacturer, but also for the wind farm operator and end-customer. MS PMGs pro-



Test engineers in the Helenski test field

vide unbeatable efficiency with compact size and low weight. MV systems enable low current solutions that minimize system and cable losses, make generator design easier and allow the use of extremely robust MV converters with high availability.

#### Convincing customer benefits

MS PMGs represent a very compact, slower speed solution offering the highest efficiency with low maintenance needs. ABB produced the world's first MS PMG Multibrid-type design in 2000 – this has the turbine main bearing and PM generator integrated with a single-stage gearbox.

- Compact size with low turbine top-head mass
- For multi-MW requirements up to 7 MW and more
- Highest efficiency levels (over 98 %) at all turbine speeds
- Cost-efficient with low magnet mass

For further information please visit:

[www.abb.com/windpower](http://www.abb.com/windpower)



# PCS100 Product training 2013

Register your interest now for 12-14 March 2013



Enhance your technical ability and knowledge in the PCS100 product range. Receive the benefit of interactive practical training with real devices for demonstration purposes and functional exercises.

### Product training

#### Products, applications, markets and technical basics

- Power protection
- Frequency conversion
- Grid connect interfaces

#### Marketing

- PCS100 tools and support

#### Hardware

- Power modules, aux.module, interfaces

#### Control modes, interfaces, options

- Power protection
- Frequency conversion
- Grid connect interfaces

#### Order handling process

- PCS100 sizing and pricing

#### PCS100 outlook

- Ongoing and future developments

### Who should attend?

ABB channel partner sales and service engineers.

### Training locations

ABB's low voltage power converter product training is conducted in our well equipped manufacturing and R&D facility in Napier, New Zealand, by highly qualified engineers and instructors.

### Enrolments

Register your interest for any one of our courses via email to: [pq.supportline.nz@nz.abb.com](mailto:pq.supportline.nz@nz.abb.com)

### Confirmation

Confirmation of acceptance and course information will be sent approximately two weeks before the start of the course. We will inform you by email or phone if there are no vacant places.

### Course program

The course program and all related information about the course times and venue are sent to the participants with the confirmation. The course normally runs from 9.00 a.m. - 4.00 p.m. over a three day period.

### Reservations

We reserve the right to change any course schedules, programs and their contents. A course could be cancelled due to minimal enrolment. The maximum number of students varies between 10 - 12 persons.

### Cancellation

In the case of cancellation, inform us as soon as possible. This will allow another applicant to attend the course. Your place on a course can be transferred to another person in your company or department.

### Training schedule 2013

Course	Day one	Day two	Day three
One	12 March	13 March	14 March
Two	14 May	15 May	16 May
Three	13 August	14 August	15 August
Four	12 November	13 November	14 November
<b>Agenda</b> a.m.	PCS100 product platform overview	PCS100 frequency conversion	PCS100 sizing and pricing tools
<b>Agenda</b> p.m.	PCS100 power protection	PCS100 grid connection	Outlook /future developments

# Service and commissioning training 2013

Register your interest now for 19-21 March 2013

### Your knowledge. Your power.

ABB is a leading supplier of power electronic systems. This extensive experience and history of innovation helps customers around the world to improve plant performance and production.

Our customer awareness means that we are committed to supporting customers globally in their plans for growth. ABB offers a wide range of professional training courses adapted to meet the needs of customers and partner channels.

### Benefits of the training

Service and commissioning training courses give valuable support to increase return on investment, reduce costs in down time and improve skills and motivation of personnel.

Training participants profit from our extensive experience and modern training infrastructures which enable them to:

- efficiently operate and maintain ABB's PCS100 low voltage power converter systems
- extend the lifetime of the product

### Training locations

ABB's low voltage power converter product training is conducted in our well equipped manufacturing and R&D facility in Napier, New Zealand, by highly qualified engineers and instructors.

### Course profile

Our service and commissioning training courses are aimed at qualifying maintenance engineers to undergo unsupervised first level support of ABB's PCS100 applications. The main goal of the course is to learn how to operate, troubleshoot and maintain the system.

Upon completion of the course, maintenance engineers will be able to locate and identify hardware components, download fault loggers and important information for first analyses by support personnel, replace parts and perform preventative maintenance. Trainees will gain practical experience using available tools and techniques through organised practical exercises.

### Who should attend?

ABB partner channel and customer service engineers.

### Confirmation

Confirmation, reservation details, and all related course information including schedule and venue details will be sent approximately four weeks before the start of the course.



### Enrolments

Register your interest for upcoming courses via email to: [pq.supportline.nz@nz.abb.com](mailto:pq.supportline.nz@nz.abb.com)

### Training schedule 2013

Course	Day one	Day two	Day three
One	19 March	20 March	21 March
Two	21 May	22 May	23 May
Three	20 August	21 August	22 August
Four	19 November	20 November	21 November
<b>Agenda</b> a.m.	PCS100 platform service introduction	PCS100 service power protection	PCS100 service grid interconnection
<b>Agenda</b> p.m.	PCS100 platform service detailed	PCS100 service frequency conversion	Outlook / future developments

# Renewable energy



### Project feature

**6. Environmentally sustainable**  
ABB provide a grid stabilizing solution to Whitlee wind farm in Great Britain

### Project completion

**8. Fakken wind farm**  
ABB and Vestas provide a complete package for an onshore wind farm

**10. Limitless power protection**  
Successful installation for the semiconductor industry

### Industry watch

**12. Connecting to the grid**  
Reducing pollution at a shipyard in Bahrain

### Newave feature

**14. Critical IT infrastructure**  
Authentic UPS systems

# Power protection



### Power protection

**6. The power package**  
ABB provides a complete solution to commercial and industrial applications

**8. Vital protection**  
ABB's Modular UPS installed at Aareon's datacenter in Germany

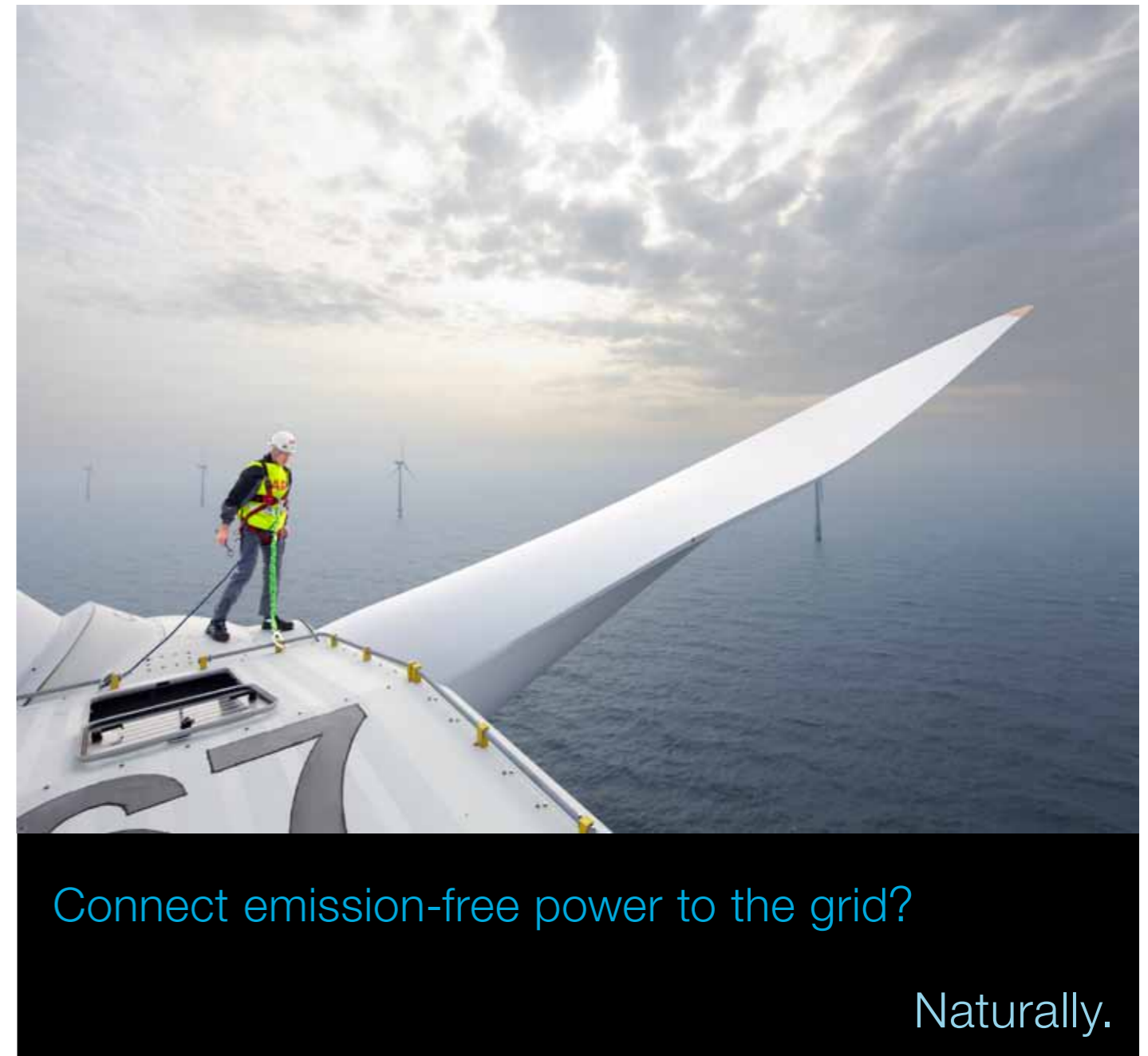
**12. Astronomical power**  
PCS100 UPS-I protecting a major LCD plant in China

### Project completion

**14. Unleash the battery power**  
China's first PCS100 ESS to be shipped to Indonesia

### MV PCS

**20. Wind power**  
AREVA Wind and ABB provide a way to harness wind energy



Connect emission-free power to the grid?

Naturally.



Renewable energy plays a vital role when it comes to balancing the need for more power with minimum environmental impact. By choosing from ABB's PCS100 STATCOM and Energy Storage System range, you are selecting from a unique line up of advanced technology that addresses the challenges of intermittent supply and connection in remote locations. This comprehensive line up of low voltage power converter solutions offers superior value in improved energy efficiency, grid stabilization and reduction in peak generation costs. For more information please visit us at [www.abb.com/powerelectronics](http://www.abb.com/powerelectronics)

