

# Case Study

## Renewable Applications

### Problem:

How to protect wind turbine control systems against power problems when operating in Mongolia and other remote regions in China, where daytime temperatures reach 55°C (131°F) and the night plunges to ice-cold conditions.

### Solution:

Falcon's SSG Wide-Temperature UPS was successfully integrated with the Wind Turbine Control System using military-grade batteries.

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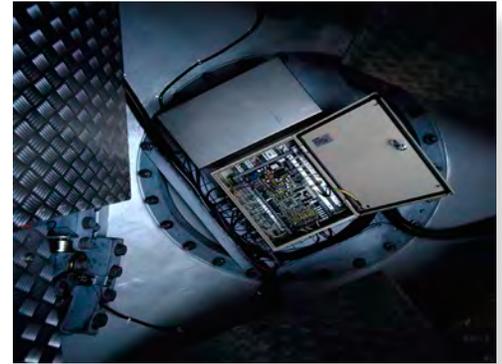
## Falcon High-Temperature UPS Helps Wind Turbine Handle Extreme Conditions

Wind turbines have been gaining popularity as rising fuel costs and environmental initiatives to decrease our carbon footprint become center stage.

Control systems are a key component in wind turbines. One key player in this area is kk-electronic a/s ([www.kk-electronic.com](http://www.kk-electronic.com)). Founded in 1981, this Ikast-Denmark-based company has been developing and producing complete turnkey wind turbine control systems for leading wind turbine manufacturers for nearly three decades. kk-electronic control systems currently can be found in more than 15,000 wind turbines operating worldwide, including major wind farms like King Mountain in Texas, and for established offshore wind farms in Middelgrunden, Copenhagen and Nysted, Denmark.

kk-electronic's control systems for these wind turbines range from simple control elements to state-of-the-art complex systems that have the high reliability needed for what are frequently rough weather conditions, and include built-in remote monitoring and reporting.

Recently, kk-electronic entered into a joint venture with Qianwei Chongqing Qianwei Instrument & Meter Factory of China to market and manufacture control panels. kk-electronic has also completed a new two-million-dollar plant in Ikast, Denmark for the production of electronic control circuits. kk-electronic's contribution will include its newest Wind Turbine Control System (WTC), named "Commander," as a turn-key solution for wind turbine control.



*kk-electronic's wind turbine control panel*

This system consists of a combination of pre-engineered control elements with modular add-ons, and will facilitate a reliable control solution that can be implemented rapidly, providing the ideal basis for a successful wind turbine project.

Between the control, generation and other aspects of a wind turbine, there are a wide number of electrical and electronic components to ensure a safe and reliable generation of electricity including:

- Main computer, I/O modules, relays and components for monitoring and control of the wind turbine
- Continuous conditioning & monitoring of wind turbine operation
- Hub computer to control pitching of blades
- Frequency converter, yaw motor protection etc., for the soft yaw system
- Terminal box in the top of the tower, - e.g. to connect the aluminum cables in the tower to the flexible copper cables from the generator.
- Power converter (full or dual fed), filter, phase compensation etc.
- High-temperature UPS, I/O modules, interface computer, operating panel, network components and SCADA-interface
- High voltage, medium voltage and low voltage distribution boards.

The most important task in wind turbine control is continuous control of wind turbine blade pitch and braking during short term grid failure or utility loss. This is essential for safe operation, since failure to assure this control can result in mechanical stress of the drive train and its tower in addition to the possibility of loss of life. To stop the turbine blades from turning, the angle of every blade (pitch) is adjusted so the edges of the blades are in line with the wind. Eliminating the force of the wind against the blades will decrease the rotor speed. Next, the brakes are applied stopping and holding the rotor. Should the brakes be applied before the rotor speed is below allowed braking speed, the brakes will be damaged.

To eliminate single-point-of-failure in braking control, kk-electronic uses two separate control sub-systems dedicated to the monitoring and control of the turbine blade pitch control and braking.

Because the turbine facilities can be subjected to extreme temperatures swings, the control systems must be able to continue working in these conditions. For control systems that offer the uptime numbers needed to achieve an ROI within their turbines' targeted time frame, Qianwei evaluated wind turbine controls from several vendors, and selected kk-electronic.

As these computers are only as reliable as their power source, kk-electronic realized that both systems needed to have their own sources of backup power in addition to the utility power source, namely, uninterruptible power supplies (UPSs). Since wind turbine systems are intended to be installed in worldwide locations that have a wide range of temperatures, it was also critical to find a high-temperature rated UPS.

"I contacted Falcon while the Qianwei project was in its infancy because our wind turbine control systems were slated to be operating in Mongolia and other remote regions in China, where the daytime temperature reaches 55°C (131°F) and the night plunges to ice-cold conditions," says kk-electronic's engineer Claus Damgaard.

"The cold problem was solved easily enough by adding heating elements to the control cabin. In the case of a utility loss, the temperature can drop to -40°C, but the high ambient heat was an issue," reports Damgaard. "I searched the Internet for high-temp industrial UPS and found that Falcon Electric offered the only UL-rated UPS for 55°C. Falcon's engineer Mike Stout told me Falcon had supplied industrial UPSs for companies like GE, Siemens, Johnson Controls and that GE used Falcon's UPS to power their WTC's, so I was even more confident. More importantly, since the Falcon SSG Series wide-temperature UPS was too deep for the tray we had designed for the UPS, Falcon accepted my request to integrate the UPS electronics only, and let kk-electronic source military-grade high-temperature batteries. The fact that Falcon was willing to customize their UPS, then spend time ensuring our battery pack worked with these batteries, was fantastic. In my experience, UPS companies will not even consider offering this level of customization and support, especially for a quantity of 50 or 100 units."

Currently, kk-Qianwei is testing the initial wind turbine in Mongolia, where it has been operating for several months. Plans call for kk-Qianwei to bring over one hundred additional turbines on-line.



### SSG Series Industrial-Grade UPS (1.5kVA to 3kVA)

#### Advanced Features:

- True Double-Conversion Online Sinewave Design
- UL, cUL and CE Listed for -20°C to 55°C Operation
- Hot-Swappable, 10-Year Rated Batteries in 25°C
- Rack/tower or tower models, 120 & 230Vac
- LCD Display with Advanced Monitoring
- Load Segment Control
- Input Power Factor Correction
- Wide Input Voltage Window
- Programmable 50/60Hz Frequency Conversion
- UPSilon® UPS Monitoring & Management Software
- Two-Year Warranty

