



CASE STUDY

Challicum Hills Wind Farm Grid-Connected Reactive Power Correction System



Figure 1: Challicum Hills Wind Farm, Victoria, Australia

The 52.5MW Challicum Hills Wind Farm, shown in Figure 1, was Australia's largest wind farm when completed in August 2003. Located on private farming land just east of Ararat in western Victoria, the wind farm generates enough clean electricity to supply 26,000 Victoria homes every year.

Installation and Functionality

The Challicum Hills Wind Farm is connected to the national electrical grid at 66kV. The 52.5MW wind farm is comprised of 35 wind turbine generators (WTGs), each with a capacity of 1.5MW. Four individual 2.1MVAR Elspec EQUALIZER-W real-time, transient-free, reactive power correction systems, as seen in Figure 2, were installed for central power correction. The systems are connected to the wind farm's 22kV distribution lines using step-up transformers. Each system uses a separate measurement reference point within the wind farm, shown in Figure 3, to make the necessary calculations for proper compensation.

The connection and disconnection of capacitors is controlled at 690V. The 22kV measurements are taken directly by the Elspec EQUALIZER-W controller at each cycle, while the

wind farm SCADA (Supervisory Control and Data Acquisition) system periodically updates the 66kV voltage information at the controller through serial communication. The SCADA system also allows wind farm personnel complete control of the Elspec EQUALIZER-W, including all setup parameters and performance monitoring from the main wind farm control station, either on-site or remote.

Each Elspec EQUALIZER-W connects or disconnects steps based on sophisticated control algorithms which consider four separate parameters: power factor (PF), reactive power (kVAR), voltage at 22kV distribution and power utility transmission voltage of 66kV. The PF and reactive power are monitored and used for reactive power compensation, while the voltage measurements are used for voltage control functions.

Voltage control consists of two simultaneous operational modes: voltage regulation and voltage ride-through. The former is used to continuously adjust the wind farm voltage output, according to the measured voltage at 66kV, while the latter is used to support the wind farm network in case of short circuit or other significant voltage drop. A third voltage control function uses a safe voltage value that disconnects all capacitors in the system if a potentially unsafe 'high' voltage is measured.



Figure 2: Elspec EQUALIZER-W Systems

Elspec EQUALIZER-W Performance

The systems were commissioned by Elspec personnel in August 2003. The commissioning report and documentation, signed and authorized by the customer, summarizes the performance and functionality of the Elspec EQUALIZER-W system as follows:

Results of the Reactive Power Correction Performance Test:

"The fast and accurate compensation response of the EQUALIZER-W system was observed during all monitored conditions. The system showed an immediate reaction to all changes in reactive energy within the resolution and power compensation limits."

In This Document

Read how the Elspec EQUALIZER-W:

- Successfully performs during the control mode sequence and all load conditions in a 35 wind turbine generator system
- Provides benefits to the wind farm owners

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Results of the Voltage Control Performance Test:

"The voltage control functionality of the EQUALIZER-W system has shown ability to maintain the voltage levels under desired limits during all monitoring conditions."

Espec EQUALIZER-W Benefits

Pacific Hydro Limited, who owns this wind farm, benefits from Elspec's EQUALIZER-W reactive power correction system in the following ways:

- Cycle-by-cycle reactive energy correction based on either PF or reactive power target values.
- Stabilization of the wind farm's voltage output to meet utility requirements.
- Transient-free correction, which provides longer system life expectancy and extends the lifetime of ancillary equipment.
- Network/grid voltage support in the event of sudden and significant drops in supply voltage.
- Over-voltage protection through the ability of the Elspec EQUALIZER-W to disconnect all capacitors in case this potentially dangerous condition develops.
- Remote system management, control and monitoring through integration with the wind farm's SCADA system.
- Automatic notification of any system malfunction. An email and/or SMS (Short Message Service) message is automatically sent to three continents: the farm operator in Australia, the WTG manufacturer in Denmark and the Elspec Support Division in Israel.

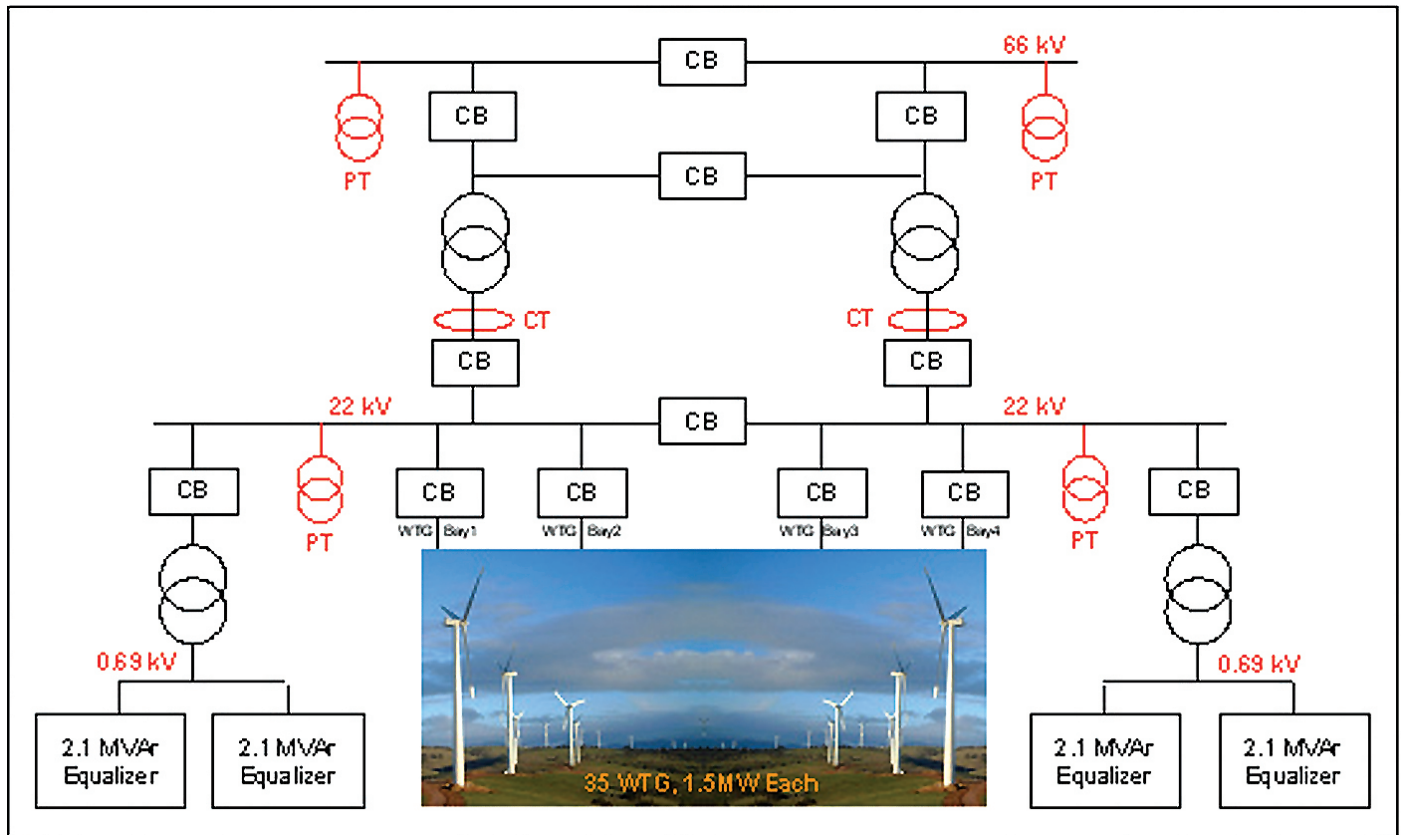


Figure 3: Challicum Hills Wind Farm EQUALIZER-W System Diagram

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