

ELSPEC EQUALIZER CONTROLS 3 VOLTAGE LEVELS AND 4 DIFFERENT PARAMETERS

The 52.5 megawatt Challicum Hills Wind Farm 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 Victorian homes every year.

Pacific Hydro Limited, who owns this farm, benefits from Elspec's Equalizers as follows:

- Cycle-by-Cycle Reactive energy compensation based on either PF or kVAR targets.
- Stabilizing the farm's voltage output, to meet utility requirements.
- Transient-free compensation, which provides long system and other equipment lifetime.
- Support in case of a significant voltage drop in the network.
- Disconnection of all capacitors in case of over voltage.
- Remote system management and control.



Figure 1: Challicum Hills' Elspec Equalizers



Figure 2: Challicum Hills Wind Farm

The systems were commissioned on August 2003. The commissioning certificate, which was signed by the customer during the commissioning, summarizes:

Results of the Reactive Power Compensation Performance Test: "The fast and accurate compensation response was observed during all monitored conditions. The system showed an immediate reaction to all changes in reactive energy within the resolution and the compensation power limits". Results of the Voltage Control Performance Test: "The voltage control functionality has shown ability to maintain the voltage levels under desired limits during all monitoring conditions".

It was required to control the farm's 66kV output voltage, especially since the farm is close to a connection into the National Electricity Grid. The farm consists of 35 Wind Turbine Generators (WTG) with a capacity of 1.5 MW each. Four 2.1 MVAR Elspec Equalizer real-time transient-free compensation systems were installed for central compensation (Figure 1).

The Equalizers were connected using step-up transformers to the 22kV line with different measurement points (Figure 3). The capacitors connection and disconnection were controlled at 690V. The 22kV measurements were directly measured by the Equalizer controller every cycle, while the wind farm SCADA system periodically updates the 66kV voltage at the controller through serial communication. The SCADA system also completely controls the Equalizer, including all setup parameters and monitoring of performance.

Each Equalizer connects or disconnects steps based on sophisticated algorithm which considers 4 different parameters: Power Factor, kVAR, volts at 22kV and volts at 66kV. The PF and kVAR are used for reactive energy compensation, while the voltages are used for the voltage control algorithm. The controller is capable of controlling 5th parameter – kW – though it was not required in this installation (kW compensation is used for compensating upstream transformer's reactive energy).

The Voltage Control consists of two simultaneous operation modes: Voltage regulation and voltage ride-through. The former is used to adjust the wind farm voltage output continuously, according to the measured voltage at 66kV, while the latter is used to support the network in case of short circuit or other significant voltage drop. It is measured at 22kV to benefit from the controller's ultra high speed measurement. A safe voltage level is also included, thus if the voltage is too-high all capacitors are immediately disconnected.

In case of any system malfunction, an email and/or SMS message is automatically sent to three continents: the farm operator in Australia, the WTG manufacturer in Denmark and to Elspec Support Division in Israel.

Major Benefits:

- ☑ Cycle-by-Cycle PF/kVAR compensation
- ☑ Stabilizing the farm's voltage output
- ☑ Transient-free compensation
- ☑ Support in case of a voltage drop

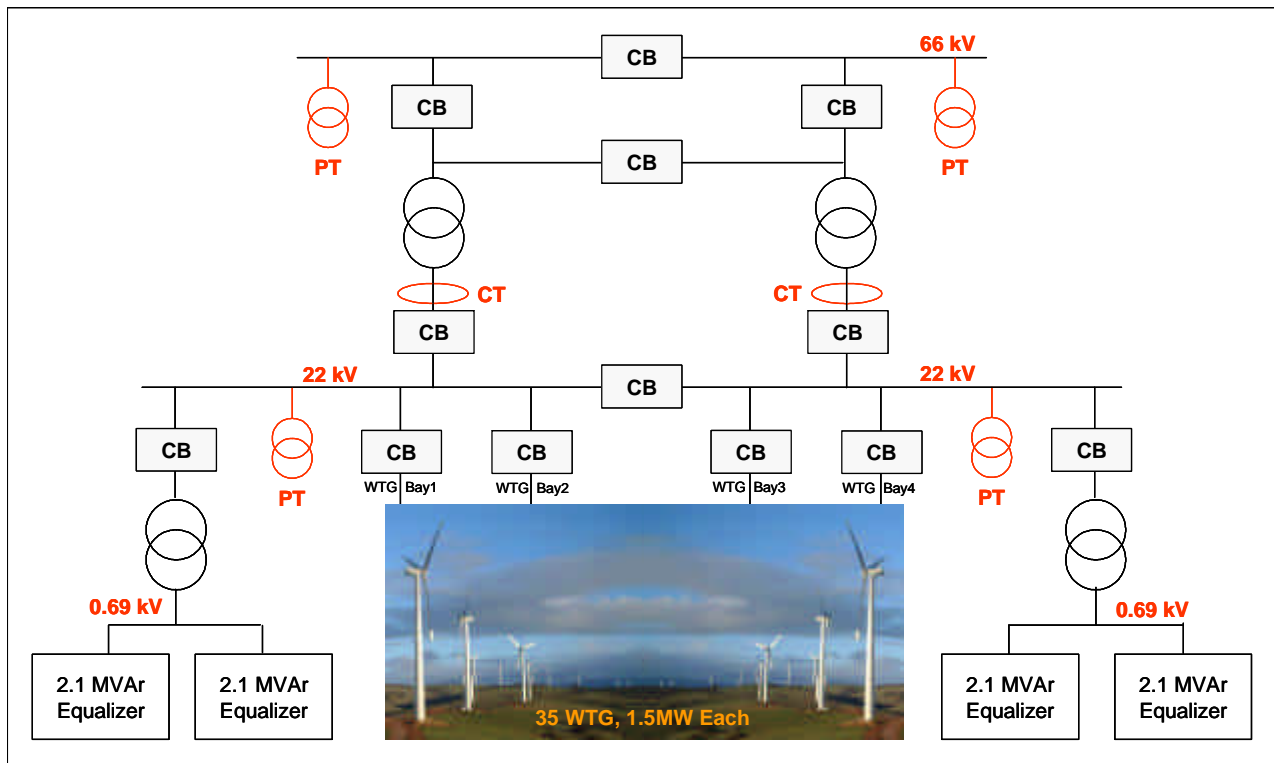


Figure 3: General Diagram