

Case Study

Improving Power Factor & Voltage Stabilization In Wind Turbines



As global fossil fuel reserves dwindle, power utilities are doing their best to meet the ever-growing demand for electrical energy. Producing electrical energy from wind power is the fastest-growing form of green power generation, despite the challenges of feeding a national grid with wind-generated electricity.

The problems inherent in generating a high-quality alternating current, drawn from inconsistent winds, were overcome by early engineering feats. Electrical power utilities have since demanded not only to meet the local grid code, but also to aid in grid reactive power balancing.

Commissioned in 2006 and being one of the largest wind power farms in the world, the Emu Downs wind farm in Australia uploads 132kV to the national grid.

48 turbines of 1.65MW each produce a total generated power of 80MW – enough for up to 50,000 households. The Emu Downs power station has to meet the national grid power quality code. Grid operators must be able to control the station's voltage, as well as rely on the station's donations to centralized reactive energy control.

The Elspec [Equalizer system](#) was chosen to monitor and control the Emu Downs's voltage and reactive energy. Within ¼ cycle or less, 32MVAR of reactive energy is available to grid operators to control uploaded power voltage and deliver reactive energy, when required. In addition, the Equalizer supports plant operation with transient-free power factor correction, voltage flicker correction, and voltage sag ride-through.

The Equalizer System Includes:

- ▶ 8 units of 4MVAR Elspec Equalizers at 690V (two cabinets each)
- ▶ 8 step-up transformers, 0.69/22kV, 4.5kVA
- ▶ 2 Elspec G4400 Power Quality Analyzers

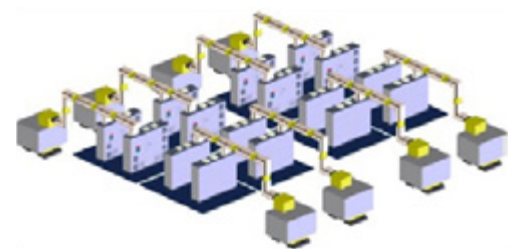


Figure 1: System Overall Diagram

The MV application consists of LV capacitors and a step-up transformer instead of MV capacitors, due to a better cost-to-performance ratio.

Figure 1 illustrates the Equalizer system single-line diagram.

The Equalizer – Real Time Reactive Power Compensation System

The Equalizer is a real-time high performance power quality solution for dynamic load compensation for substantial energy efficiency.

Elspec's all in one Equalizer is a highly accurate real time power quality solution to compensate reactive power, eliminate voltage drops, harmonics filtration, reduce voltage flickering & fluctuations, enhance machinery life time, and improves production quality. The Equalizer offers multiple features in one simple solution. This is a unique system that compensates low to medium voltage loads in real time.



32MVAR Equalizer System installation at the substation



Windmill Power Generator and Transformer Station

The Equalizer's Role In The Wind Turbine Industry

Elspec Equalizer systems offer energy efficiency and voltage control to electricity suppliers and consumers alike.

The EQUALIZER-W is designed specifically for the wind energy market. It complies with utility stable voltage requirements, supplies reactive energy to the network, and supports network failures with voltage control. The EQUALIZER-W features communication protocols that match its controller to world-leading wind turbine manufacturer algorithms.

Before choosing the Equalizer, The Emu Downs power station checked for SVC and DVAR solutions. Compared to alternatives, the Equalizer provided less losses, shorter delivery time, proven experience, and all the benefits of the world's fastest Thyristor Switched Capacitor bank.

The Ultimate Solution For Wind Energy Power Quality Requirements

Elspec Equalizer ticks all the boxes for wind turbine applications. Its main benefits for wind turbine generation are:

- Grid Code requirement compliance: voltage flickering, voltage control, ride-through
- Production capacity enhancement
- Cycle-by-cycle reactive power compensation (total acquisition time of 5- 20msec)
- Transient-free solid-state capacitors switching
- Current and voltage drop reduction at startup
- Local and central compensation support
- Capacitor-to-network resonance prevention
- Improved reliability and reduced maintenance costs
- Remote operation from wind farm control and/or grid control centers
- Excessive reactive energy supply option
- A proprietary protocol to communicate with leading turbine manufacturers
- Full customization for customer special requirements
- Hundreds of installations worldwide



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