

El Toqui wind/hydro/diesel power system concept Southern Chile

ABB was contracted to provide engineering services for Nyrstar, which generates the energy for its El Toqui zinc-gold mine (formally owned by Breakwater Resources Ltd) in southern Chile. The company wanted to create a power system concept design that would solve frequency and power stability issues in its combined wind/diesel/hydro power system.

The primary focus was on maximizing energy from the installed wind farm capacity while maintaining system stability, as well as adding a planned hydro plant extension to the existing power system.

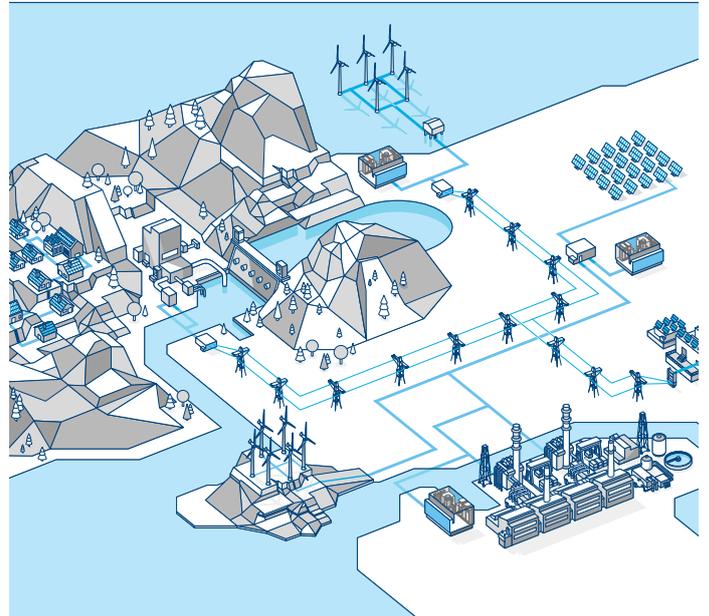
The existing system was not connected to the main distribution network. Power was provided by four diesel generators (5.6 megawatts (MW) in total), six small wind turbines (1.5 MW in total), and two hydropower generators (2.3 MW in total), plus a planned additional hydro generator (1.9 MW).

Operationally, there is no automated dispatch control; station operators control the system. The goal of the concept design was to maximize energy production from the wind farm and the planned hydro plant, to overcome the stability issues and to meet performance requirements. Nyrstar rejected full automation of the system, but agreed some level of automation was necessary.

In 2010, a wind farm with six wind turbine generators was commissioned near the mine which introduced stability issues into the system, caused by power output fluctuations. Cyclical variance of up to 800 kilowatts (kW) equalled 50 percent of the system load during low demand periods. The fluctuations were causing large frequency variations, and power dispatch issues due to generator over- and under-loading. The diesel generators and hydropower turbine generators could not cope with the rapid changes in power output.

To avoid stability issues wind power was limited to 1.3 MW, and wind turbines had to be switched offline occasionally, resulting in a large amount of excess energy not being utilized, which led to increased fuel consumption. To improve power system performance and reliability, ABB considered various control systems/methodologies to determine the best integration concept.

Without additional hydro plant, a 1 megavolt ampere (MVA) PowerStore grid stabilizing system together with a PowerStore controller was the proposed solution, to smooth wind power fluctuations causing stability issues. It was estimated a PowerStore system would increase the energy



yield from the wind farm by about 7 percent.

With additional hydro plant, the renewable microgrid controller (RMC 600) was needed to solve fluctuation issues by managing the control and dispatch of the wind/diesel/hydro power system. The RMC 600 combined with the PowerStore enables the system to operate without any diesel generators online. If diesel power is required, the RMC 600 minimizes the input to ensure the renewable contribution is maximized, while maintaining system stability. Estimates found the energy yield from the wind farm and additional hydro plant could be increased by about 29 percent with a PowerStore and a RMC 600.

Project Information

Title: El Toqui wind/diesel/hydro PowerStore concept design
Region: Southern Chile
Customer: Nyrstar
Commissioned:
Power System Type: wind/diesel/hydro
Supply Voltage: 400/230 V
Transmission Voltage: 23 kV
Frequency: 50 Hz
Installed Generation Capacity: 9.4 MW
6 x wind turbine generators (type 1) 1.5 MW
4 x diesel generators 5.6 MW
2 x hydro generators 2.3 MW
1 x planned hydro generator 1.9 MW
Minimum Demand: 1.4 MW
Maximum Demand: 4.5 MW

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