



## POWER QUALITY AND EQUIPMENT MONITORING IN DISTRIBUTED GENERATION OF MULTIPLE WIND FARM SITES FOR HYDRO-QUÉBEC

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For a number of years now, Hydro-Québec has been working with private producers to implement sizeable wind farm generating sites. Currently, Hydro-Québec has 1,400 MW of wind generation either on-line or coming on-line by 2012 at the latest. Also, within the next few months of 2008, Hydro-Québec will be signing with private producers for an additional 2,000 MW to come from renewable energy—in this case, from wind farms. With all of this renewable and private power generation, Hydro-Québec developed new tools and new approaches in the management and modeling of these non-continuous generating sites. Because the wind sector will soon represent an appreciable portion of their distributed power, Hydro-Québec required better visibility on the private wind production sites and an increase in the quantity of data coming from the field in their prediction model of production.

Connecting a wind site to the power network requires many complex real-time or semi-real-time calculations. Wind conditions are always changing and production must be balanced by alternate sources if the wind falls. Implementing these calculations at a control center uses up a lot of communications bandwidth and is a challenge to implement in real-

time; therefore, while there are many advantages in performing the calculations locally, there was no obvious way to do this. To implement their requirements—after having tested the limits of the SCADA systems that were already in place in the few wind farm projects that were under operation—the private producers decided to turn to the use of advanced intelligent Cybectec SMP Gateways to perform the required data calculations and data transfers necessary for their operations and meeting Hydro-Québec requirements.

### Advanced Intelligent Data Acquisition

This article presents the results of the implementation of advanced intelligent data acquisition solutions to perform specific computations on the power, the wind, and the turbine status information. These calculations include specific algorithms and statistical and real-time computations to provide valuable information on the operation and prediction of wind farms.

Hydro-Québec developed a list of requirements and criteria for the treatment and the transfer of the data coming from the turbine manufacturer's SCADA, the substation SCADA, and the meteorological towers. These requirements cover several points such

as the identification of the required information of each group of data, the sampling rates, the time latency of each type of data to be received, the protocol configuration, the specific algorithms of some calculations, and the type of data (statistical, resolution, sign), as well as the quality information of this data.

This specific situation consists of distributed generation from wind farm sites—each containing an average of 70 generating turbines of 1.5 MW—for a typical 100 MW generating capacity per site. The principal goal was to centralize all the information coming from the different systems on the sites into the Cybectec SMP Gateways and then apply some calculations and send the required information to Hydro-Québec's control center. This information contains some specific algorithms of calculation required to be performed on the raw data that was available from the turbines before being sent to Hydro-Québec in the required format. The production information had to be correlated to the number of available turbines as well as to the wind characteristics. All this important information on wind, production, and turbine status data could then be used by the private producers for real-time evaluation as well as for short- and long-term planning of the generating facilities' operations and maintenance.



**By using Cybectec SMP Gateways to centralize the collection of important information on wind, production, and turbine status, this data could then be used by the private producers for real-time evaluation as well as for short- and long-term planning of the generating facilities' operations and maintenance.**

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In addition, Hydro-Québec required all the real-time information on the status of the sites' substations. They also required that the production information be available for the private producers' remote control centers as well as to their operating personnel, working on-site or, in some cases, remotely.

One of Hydro-Québec's objectives was to reduce the uncertainty related to the planning of the production from the other generating assets. This objective was achieved with the use of the Cybectec SMP Gateways via the higher quality of information about the sites' availability for production. This approach has also enabled securing the sites per cybersecurity standards while providing the required real-time information for the operations of the sites. This last feature was a requirement for both the private producers and Hydro-Québec, who are sharing the equipment via two accesses.

It is well understood that for statistical computations to be meaningful an important volume of sample data is required. Data quality must be monitored, taking into account the possibility of questionable data (unfit to use in statistical computations). If not identified, the impact of incorrect data could invalidate a whole sampling period. Also important is the capability to process the information in a timely fashion—ideally in real time for Hydro-Québec's implementation.

They required sampling of the data at a 200 ms rate to be used in the statistical calculations based on a 10-minute period.

As mentioned earlier, Hydro-Québec also developed criteria for the required information coming from the statistical data. First is the wind direction information—which is of primary importance in wind farm power generation. Also, due to the northern climate, the temperature with the indication of ice buildup is also of primary importance for operation of the turbines.

### **Cybectec SMP Gateway Benefits**

Since the application was implemented using a commercially available communication Cybectec SMP Gateway, this allowed a number of direct and indirect benefits—such as use of the available communication bandwidth—to provide critical information both at the remote control centers and locally at the generating sites.

With the implementation of a scalable environment, these concepts can now also be used in other sectors of distributed generation such as hydro, wind, or other types of power production. This allows facility owners to centralize their data, transform it into the most valuable format or equation to derive a

maximum of benefits, and make the sum of all this information the most useful for them. The Cybectec SMP Gateway provides a toolbox to understand the detailed relationships between the different types of information available from all these systems—relating them to the power production and its overall quality. The Cybectec SMP Gateway is designed to process and concentrate data at the substation level. Acting as a data concentrator, it ties in all the data sources and can easily be used to perform complex real-time or semi-real-time calculations locally—freeing up both time and resources. ■