Expert report

SCADA 2014 systems for wind
Exploring the latest developments in supervisory control and data acquisition software, and trends to enhance the commercial viability of wind

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Scada for wind 2014

The growing sophistication of data-gathering software

Scada, or supervisory control and data acquisition, is a data-gathering system to provide real-time and historical information for supervision and remote and local control of individual or multiple wind turbines.

The system is accessed through a web-based application, or software on computers at the wind farm itself or anywhere where internet connection using transmission control protocol (TCP) or internet protocol (IP) is possible. Increasingly, there is a move towards using other displays such as smartphones.

Scada data was originally used primarily for simple monitoring and control of turbines, but is now serving a growing number of purposes far beyond the basic needs of reducing downtime and increasing availability.

Generally, each turbine manufacturer has a proprietary Scada system. Other software is therefore needed in order, for example, to compare the performance of and to control different turbine types.
Tracking key turbine and wind-farm performance parameters and comparing these with historical data and set values is another process based on Scada data that can greatly benefit wind-energy economics. Reliability and availability of turbines can be improved, increasing their output and decreasing the cost of electricity generated. Intelligent Scada systems combined with turbine control systems can also manage power consumption requirements and turbine efficiency. Prediction and forward-planning of maintenance cycles using Scada input can reduce costs for equipment, human resources and stock material.

**Market demand**

Standard Scada systems are now universally available for turbines and wind farms. Market demand is now increasingly focused on closer coupling of technical operation with commercial operations, for instance dovetailing wind plant revenue data into energy company’s overall financial outlook and investment planning. Technical data gathered by Scada is processed and fed through to commercial operations, often in real-time, where it is analysed to provide commercial and financial feedback.

Customers and operators are also seeking greater transparency, ranging from provision of additional data points to delivering real-time values directly from the controls system.

**Drivers for ongoing development**

This market demand means interfaces are needed between the wind-farm software and other software programmes used for asset management. Processing and analysis of the wind data has to be integrated into often-mature company software architecture, such as enterprise resource planning (ERP) software, used by operators to gain an integrated real-time view of core business processes; and customer resource management (CRM) for service suppliers, a system for storing and handling customer and client information.

Exchange of key data, such as turbine availability, between programmes or specific programme modules is becoming very important. Displaying processed data in diagram form for at-a-glance interpretation of, for example, its financial significance, is also vital.

Also increasingly relevant is absolute coherence in data throughput under browser operation, without limitations through individual plug-ins such as Java or Silverlight through the use of different screen sizes. There is a need for sophisticated visualisation without loss of quality when scaling up or down, even for smartphone displays.

**Security challenges**

Scada systems should be open, flexible and adaptable. Ideally based on the standard data interface structure as set out by IEC61400-25 (see box, page 5), Scada should provide a common communication structure in a wind farm independently of turbine type, help clients reduce the number of systems used and increase data acquisition and transparency of the complete wind farm.

But although the IEC 61400-25 interface is helpful, the fact that it allows more open access raises data protection and data security issues. This could lead to wind software suppliers increasingly using the external services of certifiers in the software sector.

Some systems, according to third party provider Bachmann Electronic, can assign different access permissions – be it simply for viewing data or to perform changes – with user management at the controller system level, which specifies exactly when and from where access is allowed.
The Scada department at end user Dong Energy’s wind power business – which aims to grow its offshore wind fleet to 6.5GW by 2020 – agrees that a key challenge is to standardise solutions at all levels, from backbone layout to protocol type for data transfer. Dong also stresses that security levels have to be maintained throughout the chain, from integrated communications systems to IT systems. This also means “defining the right level of redundancy in the systems at the right places and establishing alternative data highways in case of errors”.

Another tricky issue is deciding who has access to all Scada data. Manufacturers say their turbines have around 3,000 sensors that can deliver information. But they do not divulge all this data via Scada to energy-company operators, for reasons that include protecting technology and know-how. Even in the current turbine buyers’ market, where buyers can put pressure on suppliers on terms and conditions, resistance to delivering more data remains strong.

### Technology forecast

In Germany, the increasing importance of direct marketing of wind-generated electricity in the wholesale market requires a powerful automated machine interface that not only collects wind-farm data, but can also control active and reactive power production according to schedules set by the power producers choosing to sell their output directly on to the wholesale electricity market rather than to a transmission system operator through the feed-in tariff system, says turbine manufacturer Senvion.

These schedules vary depending on conditions in the wholesale electricity market, production conditions at the wind farm, wind forecasts, service schedules and other factors. So quick, reliable data exchange with the wind farm and individual turbines is needed. But the local controls also have to be able to respond to external signals speedily and adequately, which entails all external control processes in every turbine being recorded, processed for analysis and made available or further use.

At the same time, network stability has to be maintained at all times so the needs of the
high- and low-voltage transmission system operators will become ever more exacting. To what extent wind energy can be used to supply reserve and balancing power is also a current topic that could lead to even greater demands on wind turbines.

Data-mining in databases for knowledge discovery is another important area of development. Regular characteristic statistical patterns for individual turbine types are extracted from the data to help identify irregularities and allow early fault recognition.

Along these lines, pitch-fault prognosis being investigated with a so called ‘adaptive neuro-fuzzy inference system’ from a starting point of Scada data was the subject of a paper given by authors from Durham University at the European Wind energy conference in Vienna in February 2013. There is likely to be increasing interest in such predictive maintenance but, for secure use, the data will need unified security definitions and industry standards as well as an independent controlling body.

Scada experts say upcoming technology advances lie in four main areas.

- Wider use of modular integrated communications systems in both capacity and function, designed to work together through open standards.
- Web-enabled communication for all critical components in the remote turbines and substation to facilitate remote state monitoring diagnostics.
- Distributed intelligence in components to enable reduced functionality in the event of errors.
- A “seamless and location-independent IT and communication network” from the operator’s point of view.

### STANDARDISING THE SCADA INTERFACE

One of the biggest innovations – which goes back to around 2006 but is only now being widely implemented – is the IEC 61400-25 standard for wind turbines. The IEC (International Electrical Commission) and the wind industry worked to create the communications standard for monitoring and control of wind power plants. Explaining its need in 2006, the Danish Risø National Laboratory pointed to a large Danish turbine owner whose control room needed seven different Scada applications, some of which could not even be installed on the same computer.

Senvion (formerly Repower Systems) was one of the first manufacturers to include this standard in its Scada solutions, named REguard Interface B IEC 61400-25 and introduced in 2011. The standard IEC 61400-25 interface is likely to be very important for energy companies such as Dong Energy and Vattenfall, which have a large portfolio of turbines built by different manufacturers, and availability of this interface looks increasingly like an argument for buying a certain type of turbine.

In Germany, the so-called direct marketing of wind power – selling intermittent generation in the wholesale market – means turbine manufacturers must create ‘open’ Scada systems with standardised interfaces, so that other Scada systems can be connected to wind farms without problems. The inclusion of different types of renewable energies in the overall portfolio makes this essential.

The wind industry situation seems fairly anarchic as it alone encompasses a variety of only loosely standardised data interfaces, as well as proprietary technical solutions developed by the various manufacturers, operators, component and service providers, and companies contracted by wind-farm owners to directly market the energy they produce on the wholesale electricity market.
The Scada interface needs to be the single interface to the turbine, stresses Bachmann Electronic in its outlook for the coming years. All information and controls should be described in this one system, both local and remote. Integrated condition monitoring functions, turbine and farm-control settings, and failure and alarm handling will all be included and configurable. The web-based access to the turbine and substation, using standard web-browser interfaces will be based on highest security standards, up to secure sockets layer (SSL) encryption, to protect both data and the system.

Conclusion
Clearly Scada has come a long way in recent years but the sophisticated advances in the pipeline will make a further contributions to integrating wind farms into electricity supply systems and the energy business worldwide within the foreseeable future.

A SELECTION OF CURRENT SCADA PRODUCTS

<table>
<thead>
<tr>
<th>Company</th>
<th>Scada product</th>
<th>Key features</th>
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<tbody>
<tr>
<td>AMSC</td>
<td>wtScada</td>
<td>Designed to work with AMSC’s condition monitoring system wtCMS and wind-farm controller wtWPC</td>
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<tr>
<td>Bachmann Electronic</td>
<td>wind power scada</td>
<td>Based on atvise® scada, a visualisation with web-only technology. Available on all mobile and static terminals, offering plant and single turbine visualisation</td>
</tr>
<tr>
<td>DNV GL</td>
<td>WindHelm Scada</td>
<td>Features include validated comparison of actual to expected energy and revenue output using DNV GL WindFarmer</td>
</tr>
<tr>
<td>DEIF Wind Power Technology</td>
<td>Scada system</td>
<td>Features include turbine/plant overview and control, log viewer and report generation</td>
</tr>
<tr>
<td>InduSoft Web Studio</td>
<td>Scada systems</td>
<td>Remote monitoring of key parameters such as power output, battery status, shaft vibration, pitch and yaw settings</td>
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<tr>
<td>ITS</td>
<td>Iconics’ wind farm</td>
<td>Allows for integration of equipment, process and business data into a single plant operations’ view to control operation</td>
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<tr>
<td>Mita-Teknik</td>
<td>Gateway MiScout Web</td>
<td>Complete information access, performance and availability monitoring. MiScout Web is a cloud solution for Gateway</td>
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<tr>
<td>natcon7</td>
<td>Scada services</td>
<td>Supervisory wind-farm control, automated and staggered turbine shutdown and startup, meteorological data acquisition system</td>
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<tr>
<td>SCADA Solutions (SSI)</td>
<td>WindCapture</td>
<td>Open-source platform facilitating upgrades, revisions, troubleshooting and customisation</td>
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<tr>
<td>WindSystem</td>
<td>Psion-Scada</td>
<td>Capabilities include ice build-up alert system, and easy recognition of who has been logged on to the system and what they were doing</td>
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