SCADA - Supervisory Control And Data Acquisition

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Abstract: SCADA system as an important component of off-shore wind farm. Requirements and structure of a SCADA system. The main functions of a SCADA system. SCADA applications supplied by Vestas.

Keywords: SCADA, offshore wind farm, Vestas applications

1. SCADA – PRINCIPLES AND ARCHITECTURE

A vital element of an off shore wind farm is the SCADA system. This system acts as a 'nerve centre' for the project. The SCADA system provides you with the "handles" you need and is a very important component for efficient operation of a professional wind power plant.

With the SCADA system you control and acquire data from your wind farm and is thereby your main interface for operating the wind power plant.

It connects the individual turbines, the substation and meteorological stations to a central computer. This computer and the associated communication system allow the operator to supervise the behavior of all wind turbines and also of the wind farm as a whole. It keeps a record of all the activity and allows the operator to determine what corrective action, needs to be taken. It also records energy output, availability and error signals, which will act as a basis for any warranty calculations and claims. The SCADA system also has to implement any requirements in the connection agreement to control active and reactive power production, to contribute to network voltage or frequency control, or to limit power output in response to instructions from the network operator.

The SCADA computer communicates with the turbines via a communications network, which almost always uses optical fibers.

The SCADA system is usually provided by the turbine supplier, for contractual simplicity. There is also a market for SCADA systems from independent suppliers. The major advantages of this route are claimed to be:

- Identical data reporting and analysis formats, irrespective of turbine type; this is important for wind farm owners or operators who have projects using different wind turbines;

- Transparency of calculation of availability and other possible warranty issues.

In addition to the essential equipment needed for a functioning wind farm, it is also advisable, if the project size can warrant the investment, to install some permanent meteorological instrumentation on met masts. This equipment allows the performance of the wind farm to be carefully monitored and understood. If the wind farm is not performing according to its budget it will be important to determine whether this is due to poor mechanical performance or less-than-expected wind resource. In the absence of good quality wind data on the site it will not be possible to make this determination. Large wind farms therefore usually contain one or more permanent meteorological masts, which are installed at the same time as the wind farm.

SCADA – *Supervisory Control And Data Acquisition.*
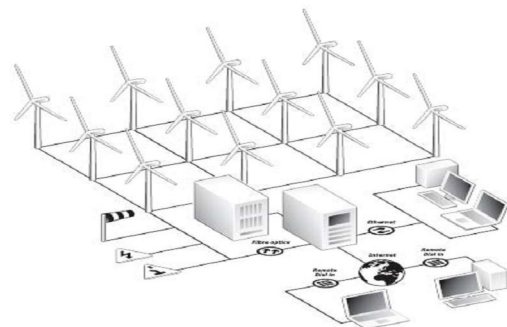
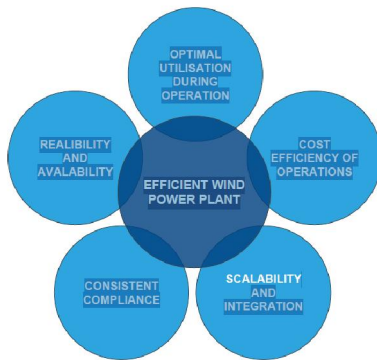**Figure 1.1 Structure of a SCADA system**

Market developments emphasizes the need for achieving high and consistent output and control of your wind power plant

2. REQUIREMENTS OF SCADA SYSTEMS

The SCADA system should provide you with:

- **Consistent compliance** with grid and other regulatory requirement;
- Increased **reliability and availability** of your wind park through advanced monitoring, analysis, reporting and preventive action;
- **Optimal utilization of your plant during operation** through intelligent plant control;
- **Cost efficiency of operations** through improved remote and secure access;
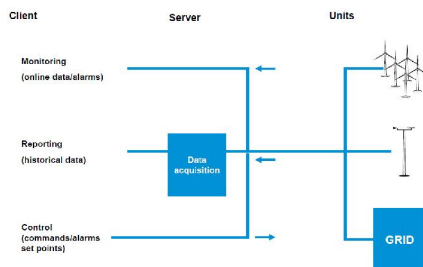
- **Scalability and integration** of your operation through modular approach of the SCADA system.

Figure 2.1 Requirements of SCADA systems

3.   STRUCTURE OF SCADA SYSTEMS

The basic layout of a SCADA system consists of the following elements:

Figure 3.1 Structure of a SCADA system

4. FUNCTIONS OF SCADA SYSTEMS

The main functions of a SCADA system are:

- Monitoring and data acquisition
- Reporting and diagnostics
- Integration and customer enablement
- Compliance and control
- System reliability & security

4.1.1   Monitoring and data acquisition

Monitoring and data acquisition gathers a variety of operational data providing you with the strongest possible control of your plant:
- integration of the monitoring of turbines, met mast and substation into the operation centre;

- allows simple integration of wind turbines and plant control functionality into control centre (or 2nd level system);
- supports easy interface to 3rd party forecasting service (ftp);
- monitoring views contain: Online production view, event view, alarm notification and PCC measurement

What is important?
- sufficient online and historical signals for correct and detailed monitoring and analysis;
- well-integrated systems;
- easy to use interface and overview;
- real-time data easily integrated and accessible online;

event and alarm handling and fast notifications.Data sources and flow:
- sensor signals and calculated data points (scada signals);
- wind speed/direction air pressure/density precipitation/humidity;
- temperature 24 hrs ups backup (vestas met tower);
- power production at point of common coupling (**vestasgridpanel**).

VestasOnline® provides visual aids that make real time monitoring actionable and gives site managers the best possible site control.
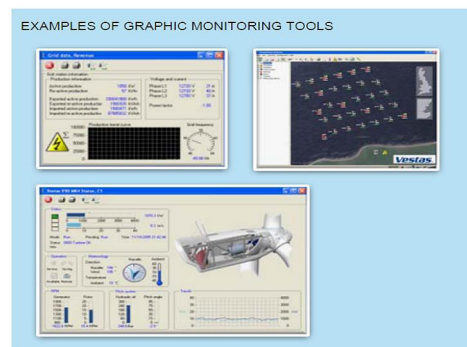
Figure 4.1 Graphical monitoring tools

Monitoring capabilities include:

- customer mimics (customization);
- online product view;
- event view and alarm notification;
- ppc measurements.

4.2   Reporting and diagnostics

Reporting evolves around three key categories and provides full information for financial reporting and power curve verification.

4.2.1 Avalability

- Time-based availability
- Shadow data correction
- Calculates values based on service and availability agreement
- Site/contractually-specific
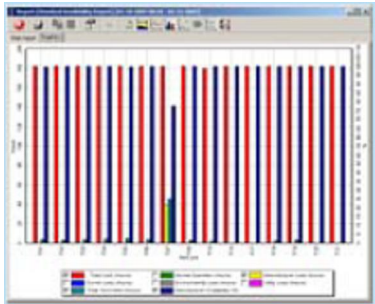
4.2.2 Production

- Shows production over a custom period;
- Looks at neighbouring turbines and neighbouring met station in case of missing data;
- Calculates lost production at curtailment;
- Additional data can be added to show correlation. (Example: wind /production).
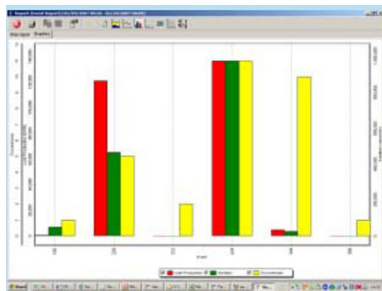
4.2.3 Performance

- Overview to show profit and loss (for Vestas and customer)
- Power curves (wind and power distribution; exclusion of sectors; periods with rain, periods with curtailment; air density correction, etc.)
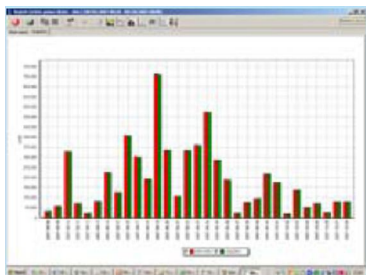
VestasOnline®provides leading-edge, high-frequency information sets as well as diagnostic tools (e.g.

VDFtracks and troubleshooting tool) that enable the operational staff to efficiently analyse operations and realise lower OPEX through prediction and planning.

4.3 Integration and customer enablement

VestasOnline® can also import data from other external sources to make your reporting and analysis even more detailed.

Typical input sources for integration
- fog horns;
- aviation lights;
- circuit breaker status;
- general communication status;
- power forecasting/trading systems (curtailment).

VestasOnline® is designed to integrate smoothly with all plant components and a wide range of other systems giving you full control of your business.

VestasOnline® Business is designed to integrate smoothly with all other plant components, VestasOnline® Power Plant Controller, VestasMETPanel or supported third party components.

VestasOnline® provides standard international communication protocols, so you can integrate your power plant data with your ERP or other second-level systems, and get better overall control of your total business.
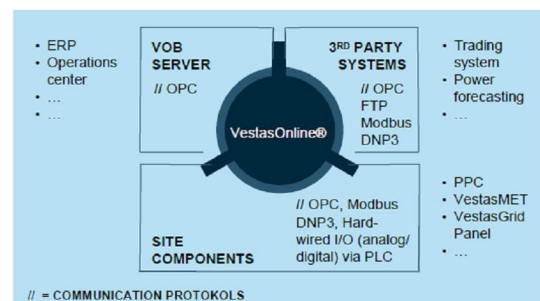

Examples

Customer operation centre - Monitoring and data control
Customer reporting centre - Direct read-only access to database
Meteorological forecasting centre - FTP and email containing turbine operational data
Service personnel - Email and text with turbine events

Customer management - Production data and other reports in PDF or CSV format via email or FTP Integration and customer enablement- Integrates with Vestas support systems to support your plant in the most optimal way.
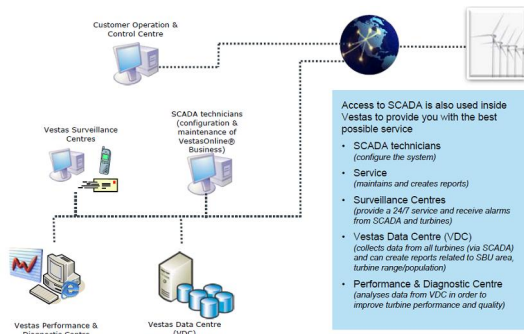
Access to SCADA is also used inside Vestas to provide you with the best possible service

- SCADA technicians *(configure the system)*
- Service *(maintains and creates reports)*
- Surveillance Centres *(provide a 24/7 service and receive alarms from SCADA and turbines)*
- Vestas Data Centre (VDC) *(collects data from all turbines (via SCADA) and can create reports related to SBU area, turbine range/population)*
- Performance & Diagnostic Centre *(analyses data from VDC in order to improve turbine performance and quality)*
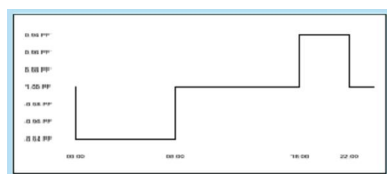
4.4 Compliance and control

VestasOnline® Power Plant Controller (PPC) offers advanced wind power plant control and ensures compliance.

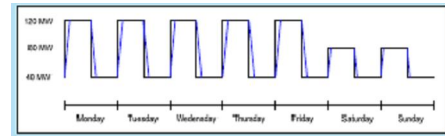VestasOnline® offers advanced wind power plant control

- Ramp up/down features which can be controlled separately.
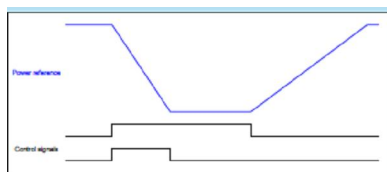
- Power Factor regulation according to a timetable

- Hourly, daily or weekly scheduled derating

VestasOnline® offers worldwide grid compliance

Many countries are tightening their grid codes to ensure that wind power plants can support the grid throughout their operation. VestasOnline® Business can be tailored to the grid code requirements of any country, ensuring compliance for all known grid codes worldwide.
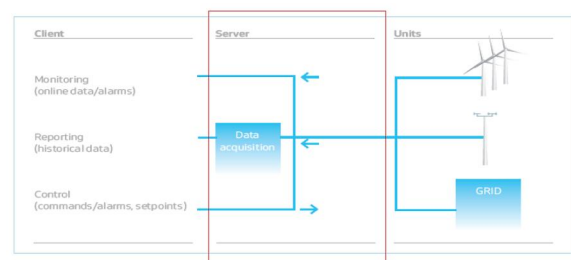
VestasOnline® ensures grid compliance worldwide together with Vestas turbine and substation equipment.

The gain by using intelligent power regulation
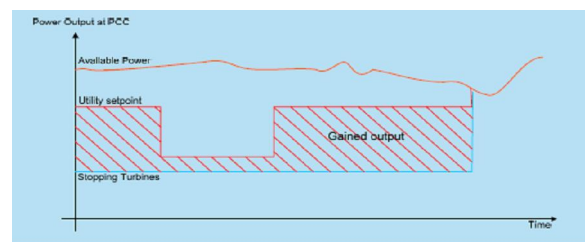
4.5 System reliability and security

VestasOnline® provides a high level of reliability by focusing on the following critical features in the SCADA architecture.


- Best-in-class system uptime - enabling reliable control and data acquisition on Redundant hard disk storage (Raid)
- Scheduled backups
- High-grade server
- Redundant communication network
- Redundant/fault tolerant FO communication
- Redundant power supply
- Redundant UPS power
- Time-synchronised solution

5. SCADA APPLICATIONS DELIVERED BY VESTAS

SCADA systems offered by Vestas consist of two product offerings: VestasOnline® Business and VestasOnline® Compact II

5.1 VestasOnline®Compact II (VOCII)
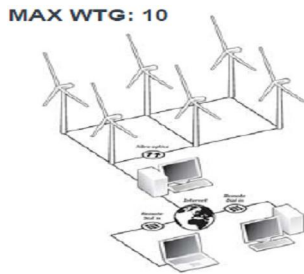
Features

- Plant PC central unit based
- Park overview and control
- Basic reporting facilities
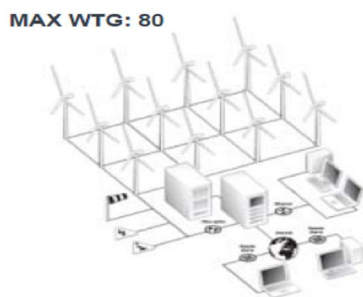- Client remote access
- Alarm and status messages by email

Advantages

- Easy installation and configuration of Plant PC
- Cost-effective solution

Limitations

- Maximum of 10 turbines or 12 MW, whichever comes first
- Met stations are not supported
- Data export jobs limited to one daily job
- Maximum two simultaneous client connections
- Only limited logging of data

5.2 VestasOnline®Business (VOB)

Features

- Plant server central unit based
- Park overview and control
- Advanced reporting facilities
- Client remote access
- Alarm and status messages by email & SMS

Advantages

- Customisable solution for customer and Vestas needs
- Scalable solution

Limitations

…your imagination!

6. CONCLUSIONS

Offshore and onshore wind farms with SEN having connection solutions to grid with "optimized integrated approach" requires mandatory SCADA systems. Using the integrated control system maximizes the use of wind assets, cross-border trade, and increased ability to balance and reduces environmental impact.

7. REFERENCES

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