Management of wind parks and photovoltaic farms with zenon

Content

Management of wind parks and photovoltaic farms with zenon

This white paper is designed to provide ideas for a farm management system that benefits from the whole zenon product family. In doing so, all areas are considered, from the energy generation device through to a supra-regional evaluation system.

COPA-DATA, an independent provider of automation software makes it possible, with the zenon product family, to implement a system throughout that offers individual, tailor-made solutions from the PLC through to reporting.

The role of wind energy and photovoltaics in the context of renewable energies

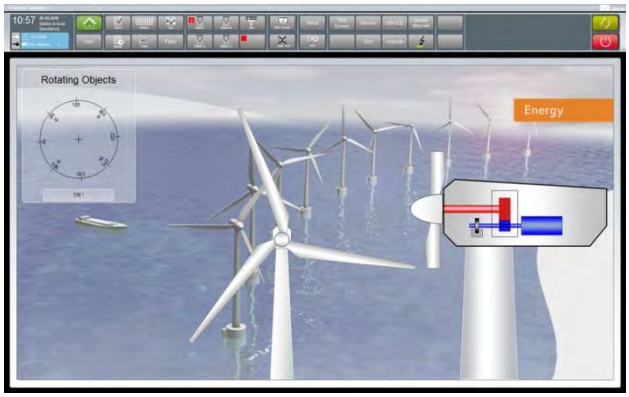
With renewable energies, we think mainly of wind energy, photovoltaic equipment, hydro-electric power stations and biomass power stations. As a result of history and the structures that have been developed, hydro-electric power stations have been integrated very well into operators' control systems and the potential for optimized use has largely been exhausted. The situation is similar for the biomass power stations, which are mostly operated privately and are less likely to be operated in a network. Furthermore, the installed electrical output of biomass power stations is less than that of other types of renewable energy sources.

For this reason, this white paper concentrates on the combination of farms for wind and photovoltaics, although only wind power equipment components are mentioned below. These are to be considered the same as photovoltaic equipment components in this context however. A wind turbine can be considered equivalent to one or more photovoltaic string(s) that is/are connected to a power inverter. A complete wind farm can in turn be compared to a photovoltaics farm.

In the following chapters, we look at the units that generate energy, the SCADA system for online monitoring and the portal for evaluation and analysis of historical data.

The wind turbine

When constructing a wind power facility, the products of one of the many manufacturers of wind turbines are used. The wind turbine usually comes with a pre-installed control unit, the HMI (human machine interface) of which is an integral component of this unit. The tasks of the HMI are relatively simple and thus solutions that the manufacturer has developed in-house are usually utilized here. However, this is the perfect location for the use of zenon Operator and zenon Logic from COPA-DATA. zenon Operator is used as the HMI and zenon Logic is used as an IEC 61131-3 PLC with comprehensive communication properties. zenon Operator and zenon Logic can be easily installed and used, based on platforms that use Windows Embedded as the operating system.



zenon Operator offers all HMI functions that are required in a wind turbine, such as communication to the PLC, display of the current status, archiving of events and alarms and on-site operation of the turbines.

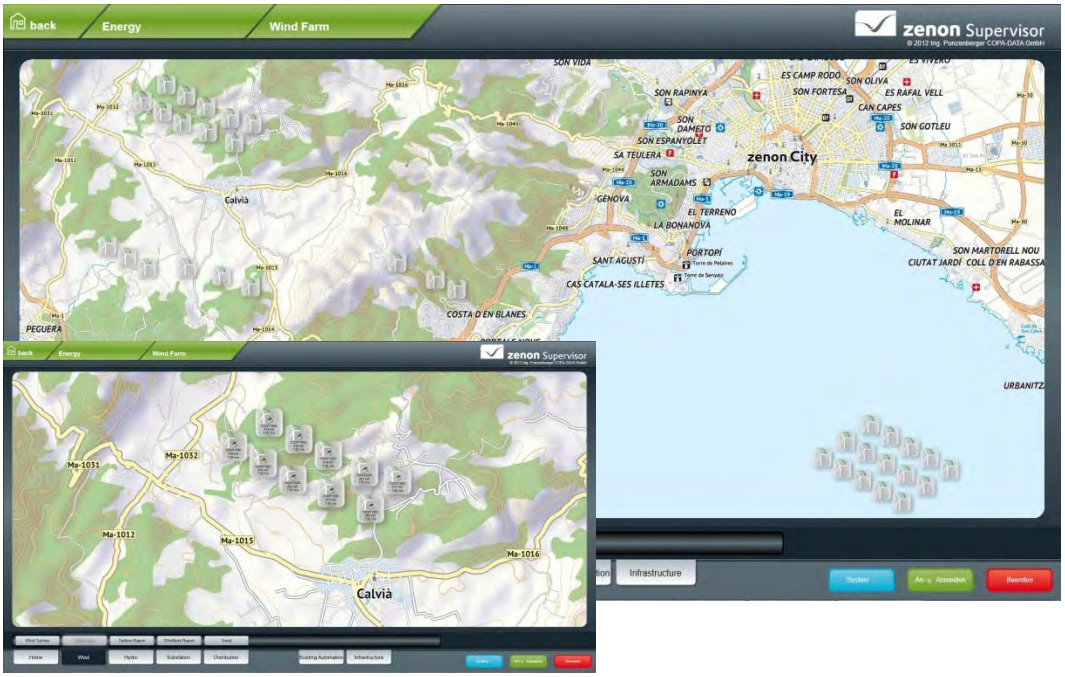
zenon Logic takes on the automation for automatic starting/stopping, condition monitoring and all other parts of the turbine including communication in accordance with IEC 61400-25. zenon Logic can be configured in accordance with IEC 61850-6 easily and efficiently using its integrated IED Editor. If IEC 61400-25 is not the right solution here, then zenon Logic can also provide the data using DNP3, Modbus or IEC 60870-5-101/-104.

Data concentration and remote data transmission

The data is not usually sent directly from the wind turbine to the next operative unit such as the network operator or central SCADA system, but several wind turbines from a whole wind farm are summarized, concentrated and then forwarded. Furthermore, the high-voltage and medium-voltage switchgear that the wind turbines use to connect to the electrical network are logged and controlled. Remote terminal units (RTU) are used for this. Such units can be implemented with zenon Logic. As already stated, zenon Logic is characterized by its multiple possibilities for communication. For maximum availability and security, zenon Logic can also be constructed redundantly or in parallel and the data can be transmitted with the above-mentioned protocols.

The data from several wind parks is concentrated by several RTUs and transmitted to a central, often supra-regional SCADA system.

Central SCADA system



For centralized, real-time operation, a system is needed that offers:

- An overview of the current operating status of the wind turbines,
- The possibility of remote operation of the wind turbines and switchgear,
- Interfaces to the transmission system operators and
- An interface to the reporting and analysis system.

The overview is implemented in the form of a matrix (Figure *1*) or GIS-supported illustrations (GIS = geographic information system). The data displayed here provides a current image of the equipment. This can be used to quickly react to problems and abnormalities. In the GIS-supported display, it is usually sufficient to have a map as a background, on which the individual turbines are shown. This type of display also offers a good overview, especially if weather-related problems are displayed or weather-related shutdowns need to be carried out, because you have a better geographical overview. Furthermore, the switch settings of the high-voltage and medium-voltage switches are displayed in single-line diagrams and they can be operated using these. The primary switchgear is ideally monitored by switching-error protection algorithms.

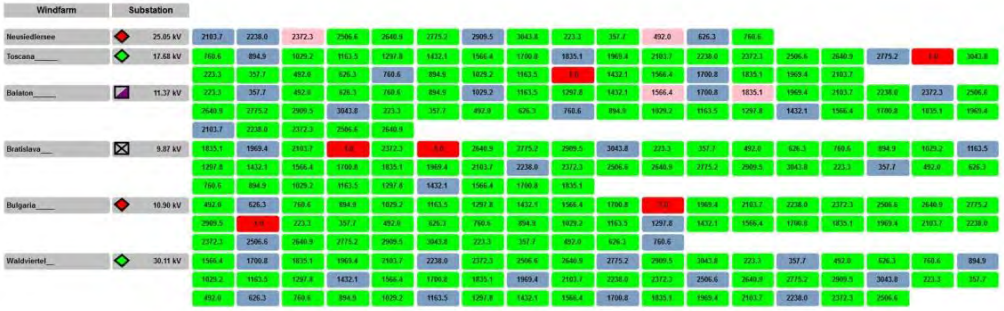
The interface to the transmission system operator serves to inform them of the current state of energy generation and the current switch settings that constitute the interface to the transmission system. The system operator could, for example, initiate a separation of the wind power equipment from the grid in the event of an emergency.

All these functions can be covered by zenon Energy Edition. zenon Energy Edition offers both the monitoring possibilities of a state-of-the-art SCADA

systems as well as control using an integrated switching-error protection algorithm. zenon Energy Edition is a Windows-based system that can run on both desktop operating systems (such as Windows 7) as well as on server operating systems (such as Windows Server 2008 R2 64 bit). Depending on requirements for availability and the division work, the system can be implemented with hot-standby redundancy and the tasks of communication, archiving and HMI can be distributed. zenon Energy Edition offers extreme flexibility for adaptation to individual requirements Because, in many cases, the information from the central SCADA systems is also needed at management level, the files must also be able to be called up with a web browser. zenon Webserver is used for this; it provides the equipment screens via the network without any further adaptation work being necessary.

Reporting and analysis

The reporting and analysis system is the next step in the data chain.
This is primarily a case of providing the necessary information, which helps to optimize the operation of the equipment. This happens due to the continuous improvement of availability and efficiency of the wind turbines and how they are used. In doing so, the operation model in a supra-regional context is to be maximized using transparent information. At the same time, it should be possible to evaluate the performance of the individual wind farms and also the performance of an individual wind turbine using centralized data. Lastly, a link between the physical performance capacity and the economic contribution can be made, in order to determine variances in relation to the ROI (return on investment).



As part of the zenon product family, zenon Analyzer can very easily access real-time data and historical data stored in the zenon archive. In addition, the zenon Analyzer can connect to third-party databases such as Oracle or Microsoft SQL Server. From there, data on energy tariffs or asset data, for example, can be integrated into the reports. Furthermore, zenon Analyzer also allows manual data entry, or Excel forms can be read in.

With zenon Analyzer, pre-prepared reports or individually-created reports can be used.

Availability reports

In the availability reports, you can find data on, for example, the aggregated availability of wind farms, allocated downtime and the highest number of the same problems. From this, measures to improve availability can be deduced very easily and it is possible to know exactly what to look at and which parts of the wind farm need to be optimized.

Efficiency reports

The efficiency reports provide information on how efficiently the wind farms are working. The analysis is either a global analysis, or a breakdown of the data from the individual wind turbines can be used. This allows the actual output curve to be compared to the one provided by the manufacturer or a reference curve that was made when the turbine was first put into operation to be made, in order to determine if the turbine can perform as promised, or if its effectiveness is no longer optimal due to impurities, such as icing of the rotor blades. In addition, different types of wind turbines can be compared to one another, assisting decisions for future acquisition.

System and efficiency reports

The most important KPIs (key performance indicators) are displayed in these reports. These reports range from individual performance indicators through to waterfall diagrams of wind farms down to wind turbine level. This allows monetary figures to be calculated, which in turn provide information on the efficiency and profit of a wind power facility.

Summary

The zenon product family offers a consistent solution, from the energy generation unit through to the level of operative and strategic decision makers. zenon from COPA-DATA can therefore contribute to making the operation of wind farms and photovoltaics farms more efficient and profitable.