SCADA OPTIMIZES SOLAR PV ENERGY GENERATION AND PERFORMANCE
Monitors, Controls and Delivers Data Analysis Down to the String Level

When looking at a solar electric photovoltaic (PV) system, employing a performance monitoring system is a must for being able to account in real-time the amount of energy produced by a system and to be sure the system overall conversion efficiency will remain intact over a period of time, acting immediately to any adverse event.

We are all familiar with our residential electric meter used by the utility company to record and bill us monthly the kilowatt-hours consumed. Over the course of a year, these bills can be compared to determine monthly consumption. While this scenario illustrates usage consumption, it is different for monitoring production with PV systems. A meter is also used to measure the energy produced but, instead of a monthly basis, we are interested in the amount of energy produced during short time intervals – perhaps every hour or every 5 minutes. The recording frequency requires more sophisticated meters than the residential ones called data loggers. Data loggers feed data into a memory system that can be archived for use at a later time. They also have communication interfaces, which allow a computer to connect to it and retrieve the data.

Most electric utilities in the United States have adopted standard criteria and guidelines for interconnection of distributed generation (DG) to their electric distribution systems. Photovoltaic system installations effectively reduce the customer load and, during minimum loading conditions, may export energy back to the utility in a transaction known as “net energy metering” (NEM). A set of guidelines (IEEE P1547.6) were recommended by the Institute of Electrical and Electronic Engineers (IEEE) to PV system integrators to support them designing systems operable in parallel with the utility systems.

Advanced SCADA (Supervisory Control and Data Acquisition) software find ideal application to support the operation of a electric utility. Automation sequences usually managed by means of SCADA system include: fault detection, localization, isolation, and load restoration (FDIR). These sequences will detect a fault, localize it to a segment of feeder, open the switches around the fault, and restore un-faulted sources via the substation and alternative sources as available. SCADA implemented algorithms work to safely minimize the fault duration and extent, significantly improving the SAIDI (system average interruption duration index) and SAIFI (system average interruption frequency index) performance metric for the customers on those feeders. An additional important sequence is the automatic check of equipment loading and thermal limits to determine whether load transfers can safely take place.

Modern SCADAs communicate using standard protocols like IP and secure Ethernet LAN system, which provides significant improvement over a serial system, including supporting peer-to-peer communications, multiple access to tie switches, and simplify remote access by communications and automation maintenance personnel.
Benefits to manage distributed generation include:
- higher efficiency;
- improved security of supply;
- improved demand-response capabilities;
- avoidance of overcapacity;
- better peak load management;
- reduction of grid losses;
- network infrastructure cost deferral;
- power quality support;
- improved reliability;
- and environmental monitoring.

SCADA based applications offers extraordinary value because they provides a flexible range of combinations and customizable configurations that provides a balance between cost and reliability.

Distributed generation is considered a more desirable generation asset because it is “closer” to the customer and is more economical than central station generation and its associated transmission infrastructure.

While the disadvantages of distributed generation are in the electric utility perspective awkward remote operation, fuel delivery logistic (for combustion engine based distributed generation), cost of connection, dispatching, and production forecasting (wind and solar related), the SCADA system helps to offset such costs through automation, remote, real time monitoring capabilities.

PV systems monitoring due to the volatility of solar radiation at ground level, which is mainly due to atmospheric turbulence, stress SCADA real time capabilities requiring a fast sampling pace (5 seconds or less) of main physical variables.

As designer of PV plants monitoring systems Staer Sistemi, conducted tests on many industrial SCADA meeting requirements as fast sampling speeds, flexibility, scalability and ease to use and programming, selecting PcVue of ARC Informatique. This choice allowed designers to be confident to effortless manage data streams in the range of several thousand measures per second and concentrate on the most specific aspects of the application. The finalized product provided PcVue promised capabilities allowing monitoring and controlling of all the various plant component and subsystems operations, including trackers, inverters, grid substations and meters. Since then PcVue was used in all Staer Sistemi’s flagship solutions controlling, among others application on Oil&Gas and Water, many PV plants exceeding 10 MWp (megawatt peak) and some larger multi-tenant, multi-site solar utilities Operation Control systems too.
Designed for the monitoring of the PV performance, the PcVue based system logs any problem and triggers alarms so that the engineering staff can fix or change components or fine-tune the process of plant operation.

The automatic comparison between the calculated and the real production figures (supplied by the already mentioned data logger) will give a precise indication of the plant performance or plant health every minute or less.

Today monitoring and performance analysis of solar PV plants has become extremely critical due to the increasing cost of operation and maintenance as well as reducing yield due to possible performance degradation during the lifecycle of the plant equipment. This means that the use of a monitoring system can become essential to ensure high performance, low downtime and fault detection of a solar PV power plant during the entire lifecycle.

From a technical point of view, it is interesting to understand how the overall data acquisition toward SCADA is performed starting from the DC level. Here, string combiner boxes designed for PV installations have in-built string probe units that measure the values of DC current and voltage and make those available through a serial RS485 port (different methods or wireless can be used) for communication to the SCADA via usually the industry standard ModBus protocol. For that purpose some RTUs (Remote Terminal Units) are installed at the field location connected to the string junction boxes on the already mentioned RS485 by means of multi-drop loops wiring.

At the AC level, inverters expose RS485, CAN or Ethernet ports to allow an easy connection. The native communication drivers from the SCADA (PcVue support a large collection of standard protocols to manage any kind of inverters).

All data collected are augmented by the SCADA system of time stamp for real-time processing: alarming and displaying, trend analysis and after storage for reporting activities. The SCADA capabilities are further used in monitoring of grid protection relays, energy meters, weather monitoring station/sensors, LT (low tension) and HT (according IEC high tension that starts from 1kV for AC and 1.5 kV for DC but high risks of electrocution start from 50 and 120V respectively) control panels, DC Switches, transformers and in general any devices capable of affecting - directly or indirectly- plant production.

Additionally, to make PV management applications as effective as possible, in order to support plant operation it's important take into consideration other aspects of the SCADA applications supported features. PcVue as an example provide dynamic configuration support, stand-alone and client-server and web configurations capabilities, redundancy support for data protection, historical and real-time trends analysis support as well as advanced alarm management. Looking further at compliance, the support of such protocols as IEC 61850 and DNP3 are considered an asset if you have to communicate with various electric substation devices, and your electrical utilities is engaged in Smart Grid implementation.

User-friendly graphical interface with 2D and 3D displays, scheduler, and an event-driven engine all make the management processes much smoother. Finally, web access capabilities providing all kinds of mobility and access to remote devices the application may need contribute to make PcVue a real SCADA champion in his category.
ABOUT US

Founded in 1981, ARC Informatique is a privately held company headquartered in Paris, France. The company manufactures and markets industrial software. Originally developed for the process industries, the company’s software is now also sold into infrastructure, utilities and building management systems applications. In 2008, ARC Informatique launched PcVue Solutions, offering software, hardware and application support as a global service to the infrastructure, HMI, OEM, building automation, power generation & distribution, airport, batch and continuous process markets.

Both ISO 9001 and ISO 14000 certified, the company is establishing an international presence through direct sales offices in the US, Europe and Asia. The company has OEM agreements allowing to ship versions of ARC Informatique’s HMI software under other brands. ARC Informatique also uses distributors as a sales channel.

PcVue Solutions is a suite of software and hardware for visualization, control, management and data analysis for industrial, building, infrastructure and utilities applications.

PcVue - HMI/SCADA software
WebVue - Web access solution
FrontVue - Graphical user interface
Dream Report - Reporting tool
IntraVue - Industrial Ethernet diagnosis software
Alert - Industrial on call management system
Moxa - Industrial Ethernet switches
TouchVue - Mobile application for smartphones and tablet computers

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