Case Study: Sotavento Alternative Energy Power Plant

Integrator Optomation Systems Implements Opto 22 SNAP PAC System for Multi-Vendor, Multi-Protocol Control and Data Integration

A Virtual Power Plant

The world economy's dependence on fossil fuels, their dwindling supply, and the environmental issues surrounding the combustion of these fuels has inspired the development of many alternative energy solutions. Among these, hydrogen represents one of the most viable choices because it offers an important environmental advantage—when burned, hydrogen produces no contaminating emissions. This fact has led to a growing interest in designing processes that utilize stored hydrogen as an energy source. Moreover, in cases where the hydrogen is produced by wind power or other renewable energy sources, the environmental impact is almost zero.

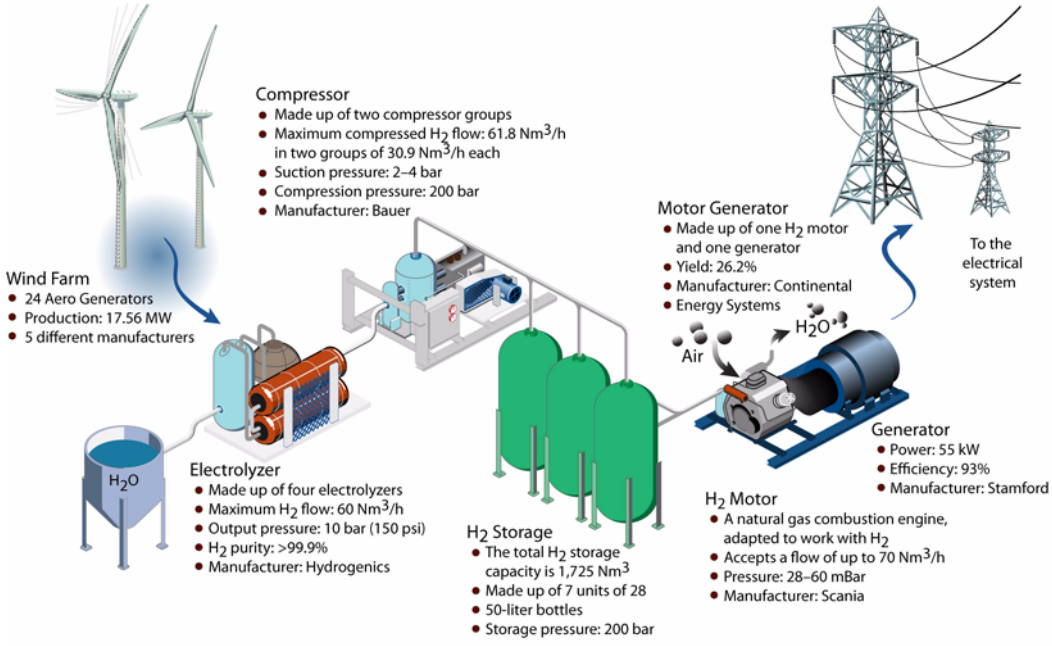
The Sotavento Virtual Power Plant in Galicia, Spain, was designed by Gas Natural SDG, Spain's leading energy company, in conjunction with the Galician Regional Government (Xunta) and the Sotavento Foundation. The plant's mission is to assess the suitability of hydrogen as a storable form of energy in its gas state. Combined with a wind power generation farm, the Sotavento Plant serves as a state-of-the-art showcase of energy efficiency.

Sotavento's objectives include:

- Commercial green energy production
- Demonstration of the various wind technologies present in Galicia
- Establishment of an education and training center
- Establishment of a conference center for related events
- General promotion of renewable energy

How the Plant Works

Electrolyzer units produce gaseous hydrogen and oxygen from water for two sets of compressors that pressurize the hydrogen before storage in an onsite tank farm. All electrical power for this particular process is supplied by wind-powered aero generators. The hydrogen is used to drive a motor generator that provides stability by "topping-up" (i.e., supplementing) the wind power production, which naturally varies with the weather. Combined, the hydrogen and wind provide a constant power level to the national electricity network.



How the Sotavento plant works

Sotavento's annual production of 38,500 MWh meets the domestic consumption of approximately 11,000 Spanish households and the use of clean wind and hydrogen, in place of fossil fuels, eliminates about 36,000 tons of carbon dioxide emissions into the atmosphere per year.

System Integration Issues

For large enterprises like power plants and water treatment facilities, it's quite common to find a myriad of disparate control systems. Different vendors, each with their own area of expertise, provide their own control equipment—often a simple programmable logic controller capable of operating the equipment, but with little additional functionality. Commonly, the operator interface takes the form of a local display panel with little or no connectivity to the rest of the enterprise. And in many cases, communication capability comes as an afterthought, after all facility equipment has been installed and commissioned. Most vendors offer little attention to the benefits of data integration and exploitation, and accessibility of production data is rarely considered during the design stage.

In these situations, the result for the end user is typically an unwieldy, expensive, and difficult to maintain amalgamation of automation equipment that creates a nightmare for operators, maintenance, and IT personnel alike.

For example, within a single control room, six different desktop computers (supplied by six different companies) may be running proprietary software over individual communication buses, with no clear way of connecting them, combining data, or controlling plant processes remotely.

Opto 22 Provides Consolidation on a Single Platform

The SNAP PAC System™ from Opto 22 provides an all-purpose solution for not only automation and control, but also data acquisition, enterprise connectivity, and communication to databases. This is due to the fact that the SNAP PAC System family includes powerful programmable automation controllers (PACs) that come with a mix of two Ethernet interfaces and up to four serial ports for RS-232, RS-422, RS-485 serial communication, plus PPP modem connections.

The SNAP PAC system

But what truly distinguishes Opto 22's SNAP PAC System is that while many hardware manufacturers essentially lock customers into a specific (often proprietary) communications protocol, Opto 22 specializes in providing connectivity via open, standard protocols and technologies, such as TCP/IP over Ethernet, SMTP (Simple Mail Transfer Protocol), SNMP (Simple Network Management Protocol), and FTP (File Transfer Protocol.) Furthermore, Opto 22, unlike most vendors, designed its system for interoperability and data integration from the outset by including support for many other communication protocols, such as Modbus® and Modbus/TCP, which allow communication with serial and Ethernet devices from Schneider Automation; DF1 and Data Highway, which enables serial interfaces to Allen-Bradley® hardware; Profibus®, which supports communication to Siemens®-brand equipment; and most recently, EtherNet/IP™, which allows communication to Ethernet-based control systems from Rockwell/Allen-Bradley, including their popular Control Logix™ and Compact Logix™ PLCs.

Additionally, the SNAP PAC System includes PAC Project™, a powerful control programming environment that also features PAC Display™—a Windows-based human-machine interface (HMI) development application used to create graphical interfaces that mimic a process. Also included in PAC Project is OptoDataLink, which provides a transparent bidirectional data transfer link between Opto 22 controllers and popular databases like Microsoft SQL Server, MySQL, and Access. OptoDataLink thus facilitates data archiving, warehousing, and enterprise connectivity with no extra programming and no costly middleware.

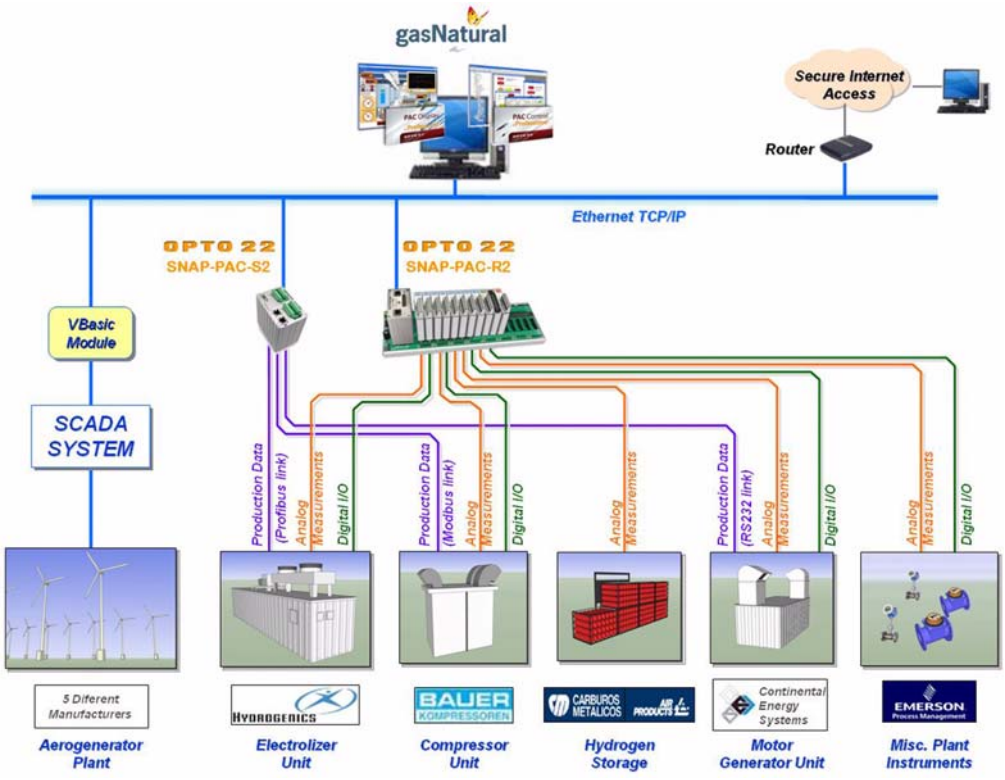
Optomation's Solution for Sotavento

Gas Natural contracted systems integrator Optomation Systems to design an integrated supervisory system for the Sotavento site, based on the Opto 22 SNAP PAC System platform. Optomation had previously provided integration solutions for Gas Natural for remote monitoring projects and possessed considerable expertise in this type of integration.

In consultation with Gas Natural, Optomation concluded that Sotavento's system would need to:

1. Serve as a common manageable platform for process monitoring, data acquisition, and auxiliary control
2. Provide complete supervision of electrolyzers, compressors, and hydrogen motor-generator units via a common operator interface
3. Access and Integrate data from the wind generator's existing SCADA system
4. Provide level and temperature monitoring in the hydrogen storage area (which is classified as explosive)
5. Enable remote monitoring of the installation, along with remote stop/start/shutdown capability over a secure Internet connection
6. Provide data storage in a commercial relational database
7. Export production data via the Internet

As indicated in the system architecture diagram, the SNAP PAC System was able to meet all of the Sotavento project's specifications. Through a mix of analog and digital I/O connections, SNAP PAC standalone and rack-mounted PACs connect to the electrolyzers, motor generator units, and other plant equipment and, as required, communicate with this equipment directly or otherwise interface with other SCADA systems. Disparate machinery, systems, and instrumentation from vendors such as Hydrogenics, Emerson, and Bauer Compressors are all linked to the Opto 22 controllers, which communicate to each subsystem or machine natively, that is, using the same protocol originally specified by the manufacturer. Specifically, these protocols include Profibus, for control and acquisition of production data from the electrolyzer units and Modbus, for control and acquisition of production data from the compressors. There is also an RS-232 serial link to the motor-generator units for taking analog measurements and digital readings. The SNAP PAC controllers aggregate all data and serve it to a Sotavento database that's accessible to select personnel via a secure Internet connection.



Setting the Ground Rules

As Fabio Alberini, one of Optomation Systems' Project Managers explains, the secret to successful implementation of projects like this rests in defining the protocols at the hardware purchase stage, well before writing the first line of code.

"The support of the end user is fundamental. If the customer fully understands and insists on the importance of data integration, suppliers will be obliged to include the necessary hardware interfaces and software support as part of their deliverables. Conversely, trying to design the communication links after the equipment is chosen and installed is more difficult, costly, and beyond the core competencies of the supplier."

Alberini continues by offering more advice on designing automation and data acquisition projects.

"Understand what communications options are possible and always try to standardize on protocols," he states.

And although he admits some of his competitors disagree, Alberini believes there is still no better standard than Modbus for moving data between industrial devices. "It requires no special hardware or software interfaces, and it 's royalty free and easy to implement. At the Ethernet level, Modbus/TCP is an even better alternative. Also, be aware that there are various 'flavors' of Modbus, but this is usually not a problem for us because the Opto 22 SNAP PAC System we prefer supports at least six of these."

"Finally, I would recommend getting a competent systems integrator involved very early in the project. Ensure that they have experience writing software for the hardware platform being used, as well as expertise integrating data. The longer you put this particular issue off, the more time consuming and costly it will be in the end."

About Optomation Systems

Working from its centralized offices in Madrid, Optomation Systems has been the exclusive distributor for Opto 22 for Spain, Portugal, and North Africa since 1996. The company is responsible for the commercialization, distribution, installation, and after-sales support of Opto 22 products in this area. Optomation has developed a complete support network, including integrators, consultants, and suppliers that offer services, local support, compatible technologies and products that complement those of Opto 22.

About Opto 22

Opto 22 develops and manufactures hardware and software for applications involving industrial automation and control, remote monitoring, and data acquisition. Opto 22 products use standard, commercially available networking and computer technologies, and have an established reputation worldwide for ease-of-use, innovation, quality, and reliability. Opto 22 products are used by automation end-users, OEMs, and information technology and operations personnel. The company was founded in 1974 and is privately held in Temecula, California, USA. Opto 22 products are available through a worldwide network of distributors and system integrators. For more information, contact Opto 22 headquarters at +1-951-695-3000 or visit www.opto22.com.

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