Acquedotto Pugliese SpA optimises its energy consumption thanks to PlantPAx™

Water supply company benefits from comprehensive platform of solutions including control, display, connectivity and energy analysis, which together form a monitoring system which maximises energy saving.

**Background**

Acquedotto Pugliese SpA (AQP) manages one of the largest drinking water supply infrastructures in Europe, spanning a network of 21,000km, serving 330 residential areas and a total of more than 4 million inhabitants. From its headquarters in the city of Bari, the public utility manages a complex and intricate water supply system, based on a system of interconnected aqueducts, which serve to convey water to various areas, according to requirements.

The Sinni water purification plant, located in Agro di Laterza in Puglia, is part of this network. It has a water treatment capacity of 4m³ a second and an average flow rate of 4,000 litres a second. The plant receives untreated water from the Lucano reservoir in Monte Cotugno, conveys it to a reserve tank, purifies it and gradually “lifts” it to the Parco del Marchese lifting plant pumping station. From there, it can be distributed partly to the region of Salento and partly to the province of Bari, thereby meeting most of the water supply needs of central and southern Puglia.

The Sinni water purification plant is equipped with six 1 MW lifting pumps, four of which run continuously, each with an average flow rate of 800 litres a second. The Sinni plant’s energy consumption is very high. This is due in particular to the continuous operation of the pumps required to guarantee the water can be mechanically lifted to the hydraulic.

**Solutions**

A Rockwell Automation PlantPAx process automation solution was installed, which included:

- 2 Allen-Bradley® ControlLogix® PACs in redundant configuration with hot backup
- 13 Allen-Bradley CompactLogix™ L45 PACs
- 13 Allen-Bradley PanelView™ Plus 6 x 10” HMI panels
- 19 Allen-Bradley PowerMonitor™ 1000 meters
- 1 Allen-Bradley PowerMonitor 3000 meter
- 15 Allen-Bradley Stratix 8000™ switch
- FactoryTalk® View
- FactoryTalk VantagePoint
- FactoryTalk Historian
- FactoryTalk EnergyMetrix™
- FactoryTalk View Studio SE and RSLogix™ 5000 development environments

**Results**

- Performance levels and KPIs can be viewed and analysed to control consumption levels and costs
- Possible to support operation simulations to create budgets for energy expenditure and balance sheet forecasts
- Constant control of power factor correction system
- Plant’s overall annual energy consumption reduced by 1% to 2%
distribution node, and also due to the long distances across which the water travels, through sharp differences in altitude – as is the case in Parco del Marchese – a distance of 84m in total.

Given the infrastructure's particular characteristics and supply, the major cost for AQP is the electrical energy required to convey the water across the network: For the Parco del Marchese plant alone, this costs €1.8 million a month, while the Sinni plant costs €900,000 a month.

**Challenge**

Now more than ever, AQP's key objective is to optimise electrical energy expenditure, by launching initiatives to recover energy in the lifting, transportation and purification operations; the utility aims to achieve this by improving the efficiency of its machines (motors, pumps, compressors), starting with those running in the plants with the highest energy consumption, such as the Sinni water purification plant.

These initiatives have led the utility to adopt increasingly sophisticated control, monitoring and analysis tools. "The critical challenge for us now is to save more energy on machines which are already highly efficient and located in plants which are already highly automated," stated Gianluigi Fiori, Head of Operations at AQP. "We could pursue this objective by increasing overall managerial efficiency through one-off monitoring of consumption and performance levels: An effective water balance can only be maintained through correct and accurate measurement of the processes!"

Until 2010, AQP had not had recourse to solutions which combined local and remote energy monitoring. The company's Energy Managers lacked the right tools to measure energy consumption on individual machines; the time frames were also very tight and energy consumption measurements had to be simultaneously related not only to the electricity provider's tariff bands, but also to the water level and flow rate measurements, in order to control costs, performance and trends over time.

"In the past, we used to use data loggers. We did not have a single dedicated system that could network interface directly with the Supervisory Control and Data Acquisition (SCADA) system for energy analysis integrated with an analysis of the water profiles provided by the process equipment in the work area," added Mr Fiori. "It was precisely this requirement that we immediately described to Intesis and Rockwell Automation with regard to the Sinni water purification plant. Together, they fully grasped the issues which were critical for us. They showed real team work in supporting us in developing a highly integrated project, based on the PlantPAx™ platform. The success of this project would be defined by achieving optimal integration of automation, water monitoring and energy analysis."
The PlantPAx platform proposed by Rockwell Automation was developed with the support of Intesis for the Sinni water purification plant. The platform provided for an automation and control solution based on two higher range programmable automation controllers (PACs) in redundant configuration with hot backup, operating as master controllers, and 13 midrange PACs distributed on the two East and West lines of the plant. In effect, each of these 13 midrange PACs is responsible for controlling the sequences for each phase of the process. These include: the initial supply of untreated water and the subsequent clariflocculation phase (the sludge is separated from the water by sedimentation, in eight semi-conical cylindrical tanks equipped with doctor blades, four in the East Line and four on the West Line).

Next is the filtration phase (using 40 quartz sand filters, regulated by more than 280 valves, with 20 filters on the East Line and 20 filters on the West Line). Finally, there is the chlorination phase; the purified water is stored before it is pumped to the Parco del Marchese plant. The midrange PACs are also responsible for overall management of all the washing sequences of the 40 filters, including initial and final drainage, bubbling, backwashing with water and/or air scouring and recovery of the backwash water. Finally, another midrange PAC is responsible for managing the digested sludge thickener in the sludge treatment process: In fact, Sinni has a parallel line for the purification, dehydration and subsequent storage of residual sludge generated in the clariflocculation phase.

Each midrange PAC has a corresponding 10\" HMI panel. This is used for the display and local monitoring of parameters, set-points and signals received in the work area. Examples include regulation of in- and out-flow rates, hydraulic pressure, pump operation (on/off) and valve operation (open/closed). It also measures the vat and tank levels and metering in parts per million (ppm) of the additives required for the process (e.g. chlorine dioxide for the pre-chlorination and final chlorination, aluminium polychloride and active silica for the clariflocculation phase). Finally, it also shows the water properties (oxygen, redox, temperature, conductivity, turbidity, pH and chlorine).

AQP’s PlantPAx platform also provided for the installation – in a client/server architecture – of two servers with a FactoryTalk® View platform in redundant configuration with hot backup. It also included one server with FactoryTalk VantagePoint, dedicated to central monitoring and control of plant running parameters, as well as one Server with FactoryTalk Historian with 5000 tags, dedicated to storing historical data.

To monitor the energy consumption levels of the Sinni water purification plant, nineteen power meters (providing quantitative energy analysis) were also distributed across the various sections of the plant. Another power meter was installed for qualitative analysis, including analysis of harmonics, oscillography and transient current. The power meters are directly connected to a higher range PAC and are managed and configured using Energy Management FactoryTalk® EnergyMetrix™ software, which gathers and analyses all the electrical data transmitted from the meters.

The hardware and software solutions of Rockwell Automation’s PlantPAx platform communicate via a single EtherNet/IP network deploying a fibre optic ring, including 15 managed industrial Ethernet switches. All the platform’s logic control, supervision and monitoring solutions are programmed using two development environments: FactoryTalk® View Studio SE and RSLogix™ 5000.

Vincenzo Lanave, General Manager of Intesis, explains: “We collaborated with Rockwell Automation on software development and integration. We created integrated and customised electrical and hydraulic parameters for the PlantPAx platform; our aim was to provide AQP with a monitoring and automation solution for the Sinni plant.
which was directly connected to the Energy Management software, including a direct interface with the corporate remote control information system Sismap.

In addition to offering the standard functionality of a SCADA (such as diagnostics, information display, real-time analysis of trends and historical data), the PlantPAx platform has enabled energy monitoring to be fully integrated, based on the measurements taken in the work area by the power meters. Mr Lanave adds, “Working on such an open software as FactoryTalk EnergyMetrix, we were able to create 100 aggregated video summary pages which were very detailed. These show the performance of each individual machine and phase of the process, with trends within a specific time frame or in a given tariff band. They can be used to manage the power factor correction system, always distinguishing between the two different cost centres for lifting and water purification.

This enables AQP to determine performance levels and key performance indicators to control consumption levels and costs; it is also possible to support operation simulations to create budgets for energy expenditure and balance sheet forecasts.”

Working with Rockwell Automation and Intesis has helped AQP to maximise its efficiency – in a plant like Sinni where performance was already high but where energy consumption was also high – achieving an annual energy consumption saving of between 1% and 2%.

“For us, it is more important to analyse trends rather than absolute values. This enables us to make more realistic forecasts to support the strategic decision-making phases,” states Mr Fiori. “Thanks to Intesis’ customisation, our partners find the data is more usable as it is in the perfect format and the extremely user-friendly screens in the FactoryTalk software make the data easy to read. If your measurements are not correct, you cannot have an effective water balance: With Rockwell Automation’s PlantPAx platform, we have real-time energy data which we can use to make real savings!”

Additional Information
www.rockwellautomation.com

The results mentioned above are specific to Acquedotto Pugliese SpA’s use of Rockwell Automation products and services in conjunction with other products. Specific results may vary for other customers.

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