Single, multi-discipline supplier delivers multiple benefits to leading European water company

A recent programme of upgrades and plant expansions has seen a major Spanish water company experience many benefits from its adoption of contemporary technologies and services from Rockwell Automation.

**Solutions**

A Rockwell Automation solution was installed, which included:

- FactoryTalk AssetCenter
- Integrated Architecture

**Results**

- With the installation of the latest prediction system for protection and on-line monitoring ATLL has managed to integrate all the information on the condition of the water supply pumps into the plant control system.
- Access control
- Back up
- Security
- Asset auditing

**Background**

Certified to ISO9001-2000, EMAS, ISO 14001-2004, UNE 1600:2010 and OHSAS 18001, Aigües Ter Llobregat (ATLL) is appointed by Generalitat de Catalunya SA to supply drinking water to more than a hundred municipalities in its regional network, from the Ter and Llobregat rivers and from desalinated seawater.

Rockwell Automation’s involvement is best visualised when split into three distinctive areas: Asset Management of a large and geographically dispersed automation and control infrastructure, Integrated Architecture installed to control the world’s largest reversible electro-dialysis plant and an on-line condition monitoring system to assist in the implementation of a complete predictive maintenance strategy.

**FactoryTalk AssetCentre**

ATLL must provide drinking water regardless of the quality of the local river supply, which changes constantly each day. Every day, during the different shifts, the ATLL control engineers are confronted with multiple changes in the adjustment points of the PLCs, in response to the different quality of water in-flow.
ATLL employs some 230 PLCs – comprising Allen-Bradley® PLC5®, SLC500™ and ControlLogix® – in conjunction with 210 Allen-Bradley PanelView™ operator panels. Engineering and maintenance of the PLCs is undertaken by four employees, including a systems integrator. Even though the PLCs are distributed over more than 2,000km², that can all be monitored from a central position thanks to satellite communication.

ATLL has invested time, money and effort to obtain the ISO9001-2000, ISO14001-2004, EMAS, UNE 1600:2010 and OHSAS 18001 certifications, in order to prove to its clients that it can provide water continuously, at a consistent level of quality while respecting environmental demands at all times. With these factors in mind, asset monitoring is vital, especially with regards to any changes made in the PLCs. Therefore, it is important for ATLL to control access to the control equipment and at the same time manage its maintenance.

ATLL worked in direct collaboration with Rockwell Automation in order to install the management solution of the FactoryTalk® AssetCentre into its IT infrastructure. The solution currently administers approximately 100 PLCs, along with two desktop PCs used by ATLL staff and the systems integrator. Functions implemented include: access control, an auditing system, a backup and disaster-recovery plan and a reports solution. The benefits include the ability to monitor changes to specific parameters, which affect water quality and the accuracy of the flow meters, more efficient exchange of information and knowledge between control engineers working on different shifts, the prevention of PLC problems when several contractors are working simultaneously on the installations and the security with which timely backups are made.

ATLL plans to improve its maintenance operations through the implementation of a complete disaster-recovery plan, so that the PLCs, jointly with the HMI, can continually supply quality water, even in the event of an emergency. ATLL will use the FactoryTalk AssetCentre solution as part of the requirements of ISO9001-2000, as it will be able to prove that it complies specifically with the regulations pertaining to control of industrial assets.

Integrated Architecture
Through expansion of the installation, the drinking water treatment station (ETAP) at Llobregat has increased its production from 200,000 to 345,000m³/day.

The project, co-financed by the cohesion fund of the European Union, is designed to improve the treatment line, as water from the lower branch of the River Llobregat presents salinity and contamination (Trihalomethanes) problems, which make the purification process difficult. For this reason, ATLL needed to put a desalination plant into operation, based on a reversible electrodialysis system (EDR), which allow improvements to be made to the chemical and organoleptic properties (taste and smell) of the water.

Another challenge was reaching a greater level of plant automation. All the control and site components must be
monitored from a central position. The purpose of this is to increase the 100,000 existing signals with 30,000 new signals (distributed over an area of 2,000km²), monitored in real time from the control room which regulates the operation of the regional distribution network. Finally, the high availability of the installation is also a legal issue – it is unacceptable to stop production of drinking water, even for a few hours. This factor implies that the plant process is structured in parallel and that a reliable, flexible, and scalable control solution is found.

Working jointly with ATLL, Rockwell Automation and EBE Associates developed an advanced automation solution for the new plant based on the Rockwell Automation Integrated Architecture. The control solution integrates 11 ControlLogix PLCs; nine of which are located in the EDR, subdivided into nine totally independent production lines. This allows engineers to only need to stop one-ninth of the plant for any reason. Each of these PLCs is connected to a PanelView Plus 1250 operator panel, allowing the local monitoring and manipulation of each of the nine lines. The I/O is divided into four remote ControlLogix frames and the decentralised I/O on site is configured using three frames of Flex™ I/O cards.

All the controllers, operator panels and decentralised inputs and outputs are connected using a redundant ControlNet™ network, which helps ensure high availability of data in any situation. In order to act on the site valves, there are DeviceNet™ networks for each of the nine production lines. In summary, the desalination plant includes a total of nine redundant ControlNet networks, 18 DeviceNet networks and a total of 10,200 signals, 1,000 of which are analogue for processing.

The other two redundant ControlLogix controllers are responsible for managing the pump station, the lime beds, the control of the addition of chemicals and auxiliary components of the installation. The inputs and outputs are distributed on site using Flex I/O cards and joined through a redundant ControlNet network. All the controllers are joined together at the central control room using an EtherNet/IP™ network on fibre optic ring topology, which configures the ideal means for displaying any parameter from any device in real time.

The great versatility of the Integrated Architecture, which combines: Logix multidiscipline controllers platform, NetLinx open networks architecture, View display platform and FactoryTalk data and information services, provides the highest level of reliability, flexibility and scalability necessary for meeting the objectives stated from the start of the project.

On-line condition monitoring
ATLL has experience in the use of predictive maintenance systems based on vibration readings in its machines, through the use of portable data collectors. The advantage in this case, is that with a reduced investment in the acquisition of instrumentation and software, a large number of machines in one plant can be measured. The problem, on the other hand, is the assumed cost of a full team trained in these techniques, and the lack of information in real time of the mechanical condition of equipment considered critical for the process.

One of the most critical installations in the plant is the water intake. This intake, initially made up of four vertical pumps, has now been increased to eight. After an extensive analysis of the different alternatives on the market relating to online monitoring of vibration, temperature and critical parameters, ATLL opted for Rockwell Automation’s solution based on the Allen-Bradley XM® family. The reasons which brought them to this decision are listed below.

Variable-speed machines
In installations where drives are used to regulate motor speed, savings in energy consumption have been achieved of up to 50% when centrifugal loads, such as water, are regulated with pumps working between 100 and 80% of their capacity. This means that the machines used must have a very accurate speed control for regulating the flow, and from a mechanical point of view, certain precautions when operating and maintaining them. Thanks to the tachometer input, which the series Allen-Bradley XM-120 vibration control devices have, it is possible to correlate the vibration level and operating
speed directly. This allows the vibration value to be controlled permanently as a multiple of the speed of rotation (1x, 2x, 3x, etc.). This data, as well as the phase reading, is key when starting and stopping the pumps, and under normal operating conditions, as they allow the critical and resonance frequencies of the system assembly to be ascertained.

Distributed system
The price of copper, the cost of maintaining the cabling and developments in communications have favoured the use of fieldbuses, resulting in a new concept of distributed architecture. At ATLL, four vibration channels, one tachometer and six temperature-reading channels have been connected to the corresponding XM units installed in a small cabinet at the foot of each of the pumps. Each of these cabinets communicates using DeviceNet real time. In turn, these are connected to other distributed devices such as: a ControlLogix controller, a converter unit XM-500, and a pair of PanelView 1250 operator panels which carry out monitoring and control. The controller also creates a bridge between the field DeviceNet and the plant’s Ethernet.

Restrictions of 4-20mA transmitters
The first restriction that was found was that these transmitters are designed to work at predetermined amplitude and frequency ranges. This restricts the use of a specific transmitter unit with regard to an approximate amplitude for each type of machine. Also, the mid-frequency ranges, (always fixed) may not filter vibration levels from other machines, and are not even capable of detecting mechanical problems, such as bearing failures, due to the incompatibility of ranges or measurement units. The use of these probes made it necessary to wire up each channel point to point, and to have cards available at the reception (controller), which were compatible with analogue signals, with the resulting additional cost.

ATLL chose the XM solution, which allows the installation of standard vibration probes (accelerometers) with no restrictions regarding frequency or amplitude ranges, and without any kind of distinction between them, given that the point and machine configurations are carried out during programming of the XM units, not during selection of the probe.

Capacity for analysis
ATLL appreciates that the devices in field have sufficient information necessary for making an advanced diagnosis. Each XM 120 vibration unit is capable of measuring, in real time, more than 30 vibration parameters: spectrum FFT, waveform, four configurable bands regarding frequency and speed of rotation, independent amplitude levels with regard to the type of failure (imbalances, misalignments, bearings, etc.), sensor states, record of files and inhibition of alarms with respect to the speed of the machine. This information is processed locally for each unit and sent to the ControlLogix controller and to the different systems and departments of the plant, so that the general states and parameters of the pumps can be known in real time. The maintenance staff also should have more complete information such as the wave analysis of spectra, and should in turn be recorded in the database of the Emonitor program.

Conclusion
ATLL, with the installation of the latest prediction system for protection and on-line monitoring, has managed to integrate all the information on the condition of the water supply pumps into the plant control system. This information will be extremely useful for general operations, and to more efficiently adapt the maintenance plans to the real conditions of the machines, and may be easily expanded to the remaining critical equipment of the plant.

Additional Information
www.rockwellautomation.com

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