The Future of Control Systems
in the modern UK water industry

On the eve of AMP4, major players in the UK water industry supply chain are battling for prized framework status with one or more of the water and sewage companies (WASCs). Just one of the many frameworks under scrutiny for this AMP period will be the provision of Motor Control (MCC), human machine interface (HMI), and respective process control and information systems (PLC & SCADA).

Nanstallon Sludge Processing Centre is controlled by an integrated control system using Rockwell Automation components. Photo: courtesy Rockwell Automation

Like many industrial organisations, the UK WASCs face a diverse number of business challenges. For example:

* downward pressure on prices;
* environmental, health and safety issues;
* regulatory issues;
* changing technology;
* impact of the internet.

Impact of MCCs

The design, manufacture, installation, test and operation of Motor Control Centres (MCCs) influences all of these challenges and with AMP4 suggesting significantly more mechanical and electrical refurbishment, the significance of the MCC specification is more important now compared to any previous AMP period.

For years, conventional or passive motor control devices have effectively carried out simple functions such as short circuit protection, isolation, switching and mode protection.

Rockwell Automation has brought together leading edge motor control and protection devices, with advanced networking and visualisation technologies, to provide a new generation of Motor Control.

Rather than saving pennies by squeezing prices down to a conventional control equipment within the MCC, a value engineered solution using smaller, more intelligent components saves pounds.

The major difference with an Intelligent Motor Control solution is communications. Many of our IMCs solutions support network communications via the DeviceNet network. DeviceNet enables

devices such as motor starter, circuit breakers and relays to send and receive information: bringing big benefits. Some of these are:

* rapid troubleshooting with information-rich, active diagnostics;
* increased motor life, through enhanced protection;
* reduced downtime, resulting from built-in condition monitoring and warning before shutdown;
* statistical information for process optimisation;
* low start-up costs, with easy integration, using 'open Logix control architecture;
* reduced overall space requirement;
* reduced time for project delivery;

There are already many examples of how the use of Intelligent Motor Control components are saving water companies time and money. Whatever the application, intelligent components in tailor made solutions are offering today's water industry flexible MCC manufacturing options, such as:

* centralised;
* decentralised, or distributed local control;
* conventional, hard-wired;
* intelligent, networked solutions, for both panel and/or field devices;
* in-situ refurbished options.

It is now time for all the water and sewage companies to review their methods of standard MCC procurement, design and manufacture and subsequently collect the instant rewards.

The following case studies illustrate the use being made of human machine interfaces:

South West Water's Nanstallon Sludge Processing Centre
The sludge process centre at Nanstallon accepts imported sludge from sites throughout Cornwall. Sludge of varying composition and concentration is delivered by road tanker for dewater prior to disposal to landfill. The sludge is first discharged into a reception tank before being transferred into holding tanks and stored at 2-3% solids ready for processing. A centrifuge controlled by a 45Kw *Allen-Bradley PowerFlex 700* inverter drive receives a maximum of 40 cu m/h of raw sludge from the holding tanks by way of progressive cavity pumps, controlled by *PowerFlex 70* inverter drives. Dosed sludge at 2-3% solids enters the centrifuge and is subjected to centrifugal forces to cause separation of solids from the water.

The water is collected at a waste storage sump and pumped onto a wastewater treatment plant for further processing. The solids are discharged from the centrifuge at approximately 28% solids and carried on a belt conveyor to a waste skip for disposal at approved landfill sites.

The plant is controlled by an integrated control system using *Rockwell Automation* components. At the heart of the system is a ControlLogix PLC and a PanelView Plus 700 human machine interface running RSView to visualise the complete system. This gives the operator the ability to interrogate each device over the DeviceNet network and display parameters such as status, motor current and temperature,

The diagnostic information available includes device trip and warning status, time to trip/time to reset, and previous tripping history.

The Intelligent Motor Control Centre used to control the plant, features products from the *Allen-Bradley* Modular Control System range, including contactors, MCCBs, MCBs 193-E3 Overload Relays and the 141A Busbar Mounting System..

A key feature of the panel system was the introduction of the 193-E3 electronic overload relay with its own built in DeviceNet and diagnostic capability.

The unique characteristics of the overload enables *Tecker*, an established company with expertise in process, mechanical, electrical instrumentation and control engineering disciplines, to discard traditional protection devices, simplifying the panel wiring and reducing commissioning time. With the enhanced control and diagnostic features within the remit providing predictive information, this was particularly useful for process critical motors on the plant, and will provide operational benefits and downtime avoidance.

With DeviceNet connecting the 193-E3 overload relays, PanelView HMI and the Powerflex variable speed drives, early fault indication and diagnostic information is immediately available from all areas of the process.

The 141A busbar mounting system enabled all the control elements for the conveyor, pumps and fans to be incorporated into one area of the control panel with the ability to retrofit control components under power should the need arise.

The use of *Rockwell Automation's* KwikLink flat cable system meant cabling costs were greatly reduced and the facility to add future devices without breaking into the network will minimise downtime.

The Intelligent MCC was housed in a cubicle system 20% smaller than a conventional panel system enabling *Tecker* to comply with space restrictions at the site. *Tecker's* position as a *Rockwell Automation* Intelligent Motor Control partner, has enabled the company to extend the technical solutions it can provide to client's.

The combination of its engineering expertise alongside the innovative products from Rockwell Automation ensured its clients are investing in the future!

Tecker, working in partnership with the framework centrifuge supplier, and acting as principle contractor, was responsible for all aspects of the construction to the proposed sludge processing centre.

Scope of works at Nanstallon sludge processing centre included:
* site survey;
* structural steel work & foundation design;
* process & electrical design;
* civil construction;
* steelwork fabrication/erection & equipment supply;
* mechanical installation;
* control panel manufacture;
* electrical installation;
* process commissioning & training.

Dee Valley Water – Pendinas WTW
For over 100 years, there has been a water treatment works at Pendinas, high above the village of Llandegla near Wrexham, North Wales. As the water company evolved from the Brymbo Water Company through Wrexham Water to its present name of Dee Valley Group, water collected in Pendinas and Llyn Cyfynwy reservoirs continued to be treated in the plant and sent out to supply.

As part of its continuing Capital Works Programme which endeavours

to preserve water resources and minimise waste Dee Valley decided to build a new works at Pendinas. This works would replace the existing building and in addition enable treatment of water from another source Nant-y-Ffrith reservoir.

Biwater Treatment Limited was contracted by Dee Valley Water to manage the construction of the new works. The contract included the requirements for an Availablity, Reliability and Maintainability study, which had to demonstrate that downtime would not exceed more than six continuous hours in any ten year period of operation. In addition, space on site was extremely limited.

These two factors pointed towards a Form 2 Intelligent MCC solution. Form 2 construction uses far less space than the Form 4 construction traditionally used in the water industry whilst maintaining the required level of protection and maintenance access.

As long time integrators of *Rockwell Automation's Allen-Bradley* motor control gear for the water industry, *Biwater*, in close consultation with Dee Valley Water and its advisers *Black & Veatch Consulting,* selected a design based upon the *Rockwell* automation range of products.

The intelligent features of the *Allen-Bradley* starters and drives provide early warnings of pending plant failure along with detailed fault and diagnostic information, permitting rapid troubleshooting and repair of the works.

A demountable busbar system forms the basis of the Form 2 sections of the MCC. Here a single carrier plate holds all the drive components for a fixed speed drive. This provides a single assembly to change in case of drive failure. Each fixed speed drive consists of an intelligent overload, and appropriately sized motor contactor and MCCB.

All of the intelligent motor overloads and variable speed drives connect via DeviceNet back to the PLC. The provision of three separate DeviceNet networks prevents a single network failure affecting more than one process stream. The use of networked devices within the MCC reduces the volume of inter-compartment wiring, contributing to a shorter MCC construction period and a more reliable product.

The choice of an *Allen-Bradley ControlLogix PLC system* provides seamless operation across a variety of networks, comprehensive diagnostics and error reporting from distributed intelligent I/O modules, and symbolic addressing for ease of programming and maintenance. A single ControlLogix processor is able to control I/O in its local rack, remote I/O via a dual ControlNet network and the drives via DeviceNet.

The remote I/O racks are in field located 'Local Distribution Panels' (LDP), which also house power distribution boards and power supplies. All field based instruments and valves connect to the nearest LDP, minimising cabling runs and associated containment systems in the limited space available.

A single 18 inch colour LCD touch screen provides process visualisation and operator control. This is driven from a high specification industrial PC running the RSViewSE SCADA application and Microsoft Windows 2000. This connects via Ethernet into the ControlLogix processor and the other networks.

The SCADA provides visualisation for the intelligent aspects of the MCC as well the traditional plant mimics and alarming functions. Each drive has an individual faceplate showing a standard water industry Form 4 compartment form and a parameter screen that gives maintenance technicians the ability to consider each of the major parameters of a drive without the use of other software or a programming laptop. From the mimic screen, the operator can drill down to a series of diagnostics available from the intelligent drives over DeviceNet. These include, amongst others, time to trip and individual phase currents and help to reduce maintenance time and increase plant availability.

In addition to the original scope of works, the provision of a wash water recovery plant has already realised some of the benefits of the flexible distributed design. This plant has been added to the design by means of an additional LDP, which incorporates not only power distribution, power supplies and remote I/O, but also has the additional DeviceNet connected drives in Form 2 compartments. The modular nature of the architecture has enabled work on this area to be carried out in parallel to the main works without severe disruption to the programme.

The utilisation of modern MCC design, networking technologies and distributed intelligent modules, along with the active participation of all members of the design team, has enabled quantifiable benefits in terms of space utilisation and cost to be realised within a normal project programme. This will form the basis of future designs that realise shorter design cycles and thus increased cost benefits. ■

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