

Solutions

- **Allen-Bradley SLC5/05s**
 - PID loops enable accurate control of temperature and humidity
 - Complex control routines enable sophisticated control of roof louvres
 - Robust hardware provides reliability and low maintenance
- **RSView32 ADS**
 - Visibility of control system status and reporting functions
- **RSLogix500 editor**
 - Complete control over programming and system design

Results

- **Close control over internal environment**
 - Works of art always kept in ideal conditions to prevent deterioration
 - Maximum amount of daylight allowed into galleries
- **High level of reliability**
 - Robust industrial hardware offers increased reliability over typical HVAC systems
 - Standard, off-the-shelf components guarantees parts availability

National Portrait Gallery protects priceless works of art with SLC500s

The National Portrait Gallery in London uses a wide range of Rockwell Automation hardware and software to provide the reliable, accurate control required to protect the valuable works of art on display



Background

Founded in 1856, the National Portrait Gallery (NPG) in London houses over 10,000 works of art in its primary collection.

Precise management of the environment in which these works of art are shown is essential to avoid long term damage.

The NPG has been substantially extended and refurbished since 1992 with the help of National Lottery grants and substantial donations from its patrons.

Part of this £38 million investment programme has involved an upgrade of the building control systems to maintain the ideal internal environment for displaying and preserving fragile works of art.

Challenges

Displaying paintings and sculptures in a public building involves a delicate balancing act between providing the right lighting while preventing ultra violet and other harmful rays causing damage.

Accurate control of the heating, ventilating and air conditioning (HVAC) plant to maintain internal conditions close to the ideal of 20°C and 50% relative humidity is also vital to prevent deterioration of pictures.

Thousands of people pass through the building every day, and the HVAC system has to respond quickly to maintain constant humidity levels, especially when it is raining and large numbers of visitors arrive wearing wet clothes.

Solutions

The demands of the NPG are such that, rather than a conventional building management system (BMS), it uses a range of Rockwell Automation industrial control hardware and software to manage its building services.

This includes Allen-Bradley SLC500 controllers and motor control gear as well as a Rockwell Software RSView32 Active Display Server (ADS) SCADA system.



David Coulthard came from ICI to become the NPG's in-house manager of mechanical and electrical engineering in 1994. The Gallery had already been using Allen-Bradley SLC5/03s for its environmental systems for two years, and Mr Coulthard quickly saw the benefits of staying with these powerful yet flexible industrial controllers for the planned expansion projects.

"The National Portrait Gallery isn't like a factory or office building, and with paintings dating back to the 15th century the consequences of losing control of the building could be catastrophic," he says. "So we need a reliable system that offers precision control and functional flexibility – and Rockwell Automation gave us all that."

Kevin Dunn, managing director of systems integrator Davenport Control & Instrumentation Ltd of Benfleet in Essex, worked closely with Mr Coulthard to develop the latest systems, which make extensive use of proportional integral derivative (PID) loops to improve accuracy of control.

"The Gallery originally chose Allen-Bradley products for their reliability," he says. "We were also able to demonstrate that the SLC5s were more powerful and flexible – and could control conditions far more accurately – than any building management system."

The new system uses 16 SLC5/05 processors linked to an RSView32 ADS server and three client workstations via a 10MB EtherNet/IP fibre and copper network. The outputs of the SLC500s are hard wired via I/O racks to the HVAC plant and 1-10V actuators, and take 4-20mA or 0-10V analogue inputs from a range of sensors.

Results

Control of light levels is just as important and in many ways more difficult than managing temperature or humidity, as daylight can fluctuate from a dull, cloudy sky to the 60,000 lux of bright sunlight in seconds.

Original oil and water colour paintings in particular are at great risk of fading if exposed to too much light, and to prevent damage it is essential that direct sunlight is never allowed to fall on the paintings.

Central to the brief for the latest refurbishment of the top floor Regency Galleries opened in May 2003 was the integrated control of motorised solar roof blinds and gallery lighting. To control the daylight entering upper floor rooms 17 to 20 through the roof lights, Davenport developed a sophisticated system of control of motorised louvre blinds to replace the existing fixed louvres.

The SLC500s use inputs from light sensors and positional feedback from potentiometers fitted to the blind actuators to adjust the angle of each set of louvres every four minutes. The position of the louvres is determined by a complex control routine that provides progressive, unobtrusive operation while protecting the paintings from excessive daylight.

A special routine written into the SLC500 program uses astronomical data and spherical trigonometry to constantly calculate the position of the sun relative to each set of blinds. The louvres are then individually positioned to block direct sunlight even in a cloudless sky. The blinds are fully opened early in the morning and late in the evening to maximise daylight and fully closed at night or in high winds.

A second routine progressively relaxes the calculated limits when sky radiance measured by a roof-mounted light sensor falls below 10 klux. A sudden increase in sky radiance triggers the blinds to revert back to their calculated positions.

A third, over-riding routine monitors light reaching the pictures hung in the four rooms protected by the blinds using special Brooks Sensors. These sensors accurately measure the light falling on the painting. If this exceeds the maximum permitted 200 lux for oil paintings or 50 lux for water colours the blinds are immediately adjusted to bring light levels down to safe limits.

"Using the RSLogix500 editor, the SLC500 gave us complete control over programming and system design, allowing us to start with a blank sheet of paper when it came to writing the control software," says Mr Dunn.

The amount of light the paintings are exposed to over a period of time is also logged by RSView32, enabling the Gallery to ensure that the safe annual limit of 650 klux is not exceeded. Light levels, temperature and humidity are recorded in the RSView32 database, enabling graphical reports to be quickly generated and analysed.

"It is important that people who might loan us their valuable paintings have confidence that we will look after them properly, and good records of the conditions we maintain in the galleries gives them that confidence," says Mr Coulthard.

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