Automation IT

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Automation IT automates Jet Inertisation Unit for Queensland Mines Rescue Service

QMRS is a non-profit organisation dedicated to providing a leading edge emergency response capability to the coal industry. Volunteers within the industry receive quality training in Mines Rescue procedures and utilise the most technologically advanced equipment available.

The GAG Inertisation Unit is designed to generate inert gases and transfer them to a section of a mine that is on fire with the use of a jet engine in order to extinguish the flames.

THE PROCESS

The GAG Inertisation Unit works by sucking air in through a cloth filter, where it is injected with kerosene fuel and this fuel and air mixture is ignited by spark plugs reducing the oxygen content to approximately 17%. The energy of the fumes' flow, powers the compressor part of the turbine, fuel pumps and electricity generating systems.

Additional fuel is then injected under a high pressure into the afterburner. The afterburner operates at such a high temperature (around 527^{o}C) that the injected fuel evaporates and burns instantly, further reducing the oxygen level to approximately 2-4%.

The exhaust gases are then cooled with water in a diffusive way to a temperature of 85^{o}C at the GAG's outlet. The result is a wet inert mixture of fumes, water vapour and water droplets.

This "gas" is then transferred via an air duct to the hazardous section of a mine and forced onto the flames at intense pressure smothering the fire and depriving it of any oxygen, thus extinguishing the blaze.

THE PROBLEM

The issue with automating such a system is that the device has to perform in intense conditions whilst remaining extremely accurate, reliable and above all, safe.

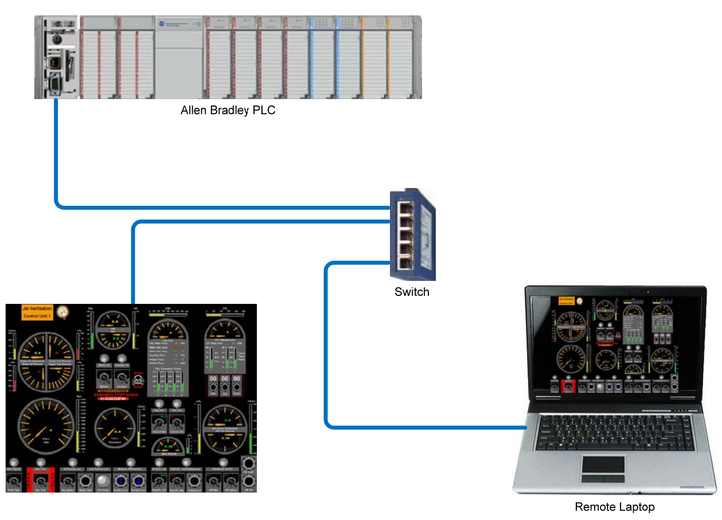
When a fire on a mine occurs the Inertisation Unit is called out to eliminate the fire as soon as possible and so it is imperative that the unit functions exactly as desired by the operator or the safety of the whole team could be jeopardised.

THE CHALLENGE

It is for this reason that every precaution had to be thought of when designing an automation solution for the Inertisation Unit so that the operator would be able to remain in full control of the GAG turbine at all times and suitable safety measures be set in place in the event of an emergency.

THE SOLUTION

The solution consisted of an Allen Bradley PLC that is mounted in a separate enclosure at the front of the trailer. A separate enclosure houses a touch panel human to machine interface (HMI). The engine and additional equipment can be controlled from this HMI, or monitored via a remote laptop that communicates via Ethernet.



PLC OVERVIEW

The Allen Bradley CompactLogix 1769-L32E PLC was chosen for this project because of its high performance in a small footprint. That is, the CompactLogix uses rackless I/O for flexible installation, but still possesses high functionality such as analog, digital and specialty modules that cover a wide range of applications as well as advanced system connectivity to EtherNet/IP, ControlNet and/or DeviceNet Networks.

As a result, CompactLogix was the ideal choice for the Jet Inertisation Unit due to it being specifically designed to deliver unprecedented performance to control machine-level applications, using system-connected control over Ethernet, in a compact and economical platform.

OPERATOR PANEL

The HMI Screen used is a Red Lion 15-inch G315C LCD Operator Interface which combines powerful features with the reliability of a dedicated operating system. It is built around a high performance core with integrated features, allowing it to provide SCADA-like functionality at a fraction of the cost.

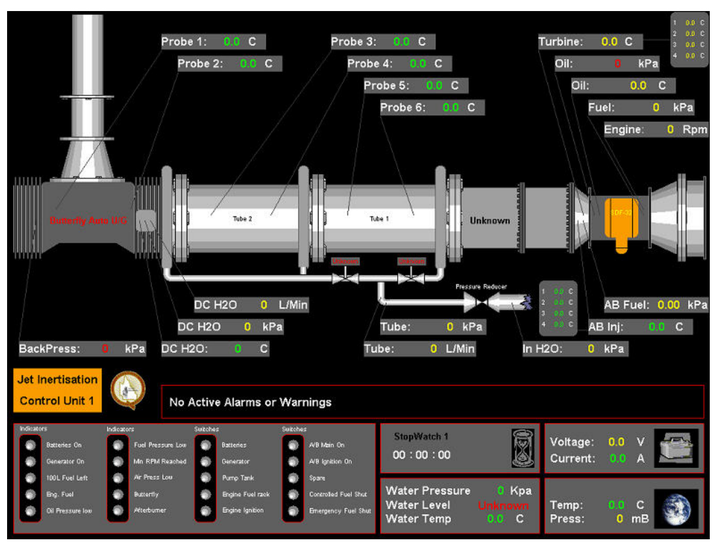
Similarly, with its built-in web server it allows processes to be monitored remotely, which is a major requirement for this project.

The main operator panel that is displayed on the HMI (shown below) is based on the layout of the original physical panel and the indicators and controls on the screen are all fully animated. A similar view can be obtained for monitoring only via the web server.

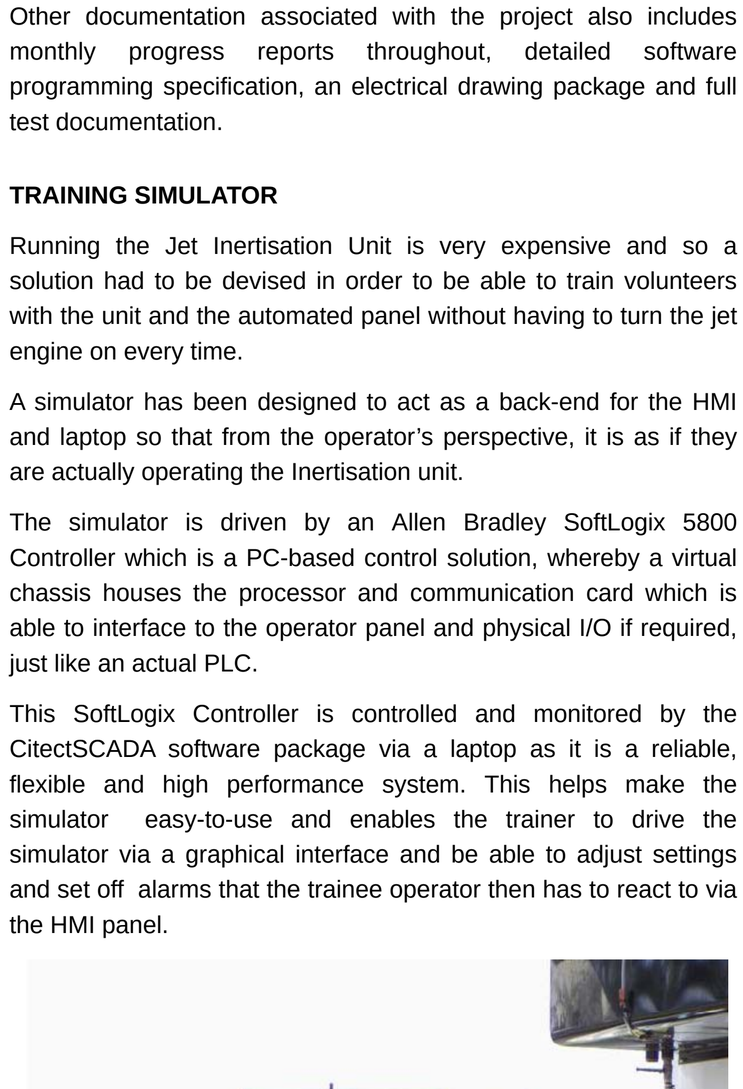
Operator Panel

The Operator panel also contains an overview page which shows all of the controls and values as per the Control Panel but displayed in real proximity of the equipment. The screen is fully animated, whereby the operator is shown what stage of the process the control unit is currently in and if there are any active alarms or warnings occurring that the operator should be aware of.

The Operator is also able to check alarms, adjust setpoints or view trends of the data collected from the Inertisation unit on the HMI screen.



Graphic Overview



Alarm/Warnings Settings Panel—where alarms can be adjusted and acknowledged

DOCUMENTATION

As with all Automation IT projects a fully documented project solution provids detailed operations and maintenance manuals for the operations team to keep and refer to once the project has been fully completed and questions arise about the PLC or software.

Other documentation associated with the project also includes monthly progress reports throughout, detailed software programming specification, an electrical drawing package and full test documentation.

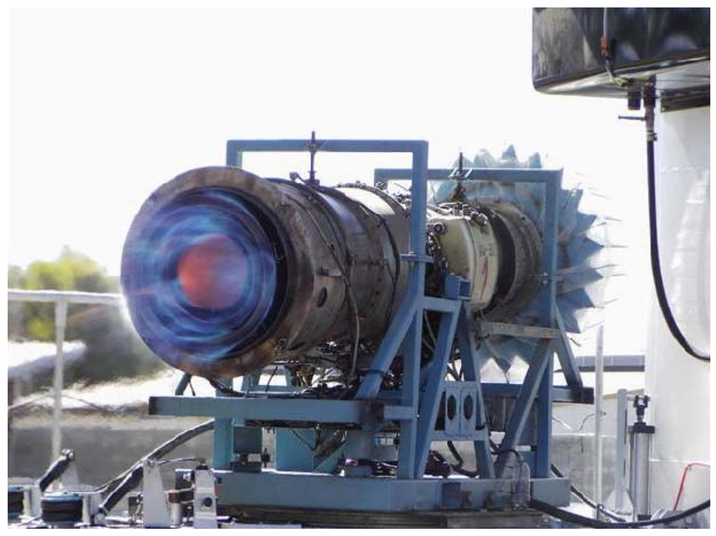
TRAINING SIMULATOR

Running the Jet Inertisation Unit is very expensive and so a solution had to be devised in order to be able to train volunteers with the unit and the automated panel without having to turn the jet engine on every time.

A simulator has been designed to act as a back-end for the HMI and laptop so that from the operator's perspective, it is as if they are actually operating the Inertisation unit.

The simulator is driven by an Allen Bradley SoftLogix 5800 Controller which is a PC-based control solution, whereby a virtual chassis houses the processor and communication card which is able to interface to the operator panel and physical I/O if required, just like an actual PLC.

This SoftLogix Controller is controlled and monitored by the CitectSCADA software package via a laptop as it is a reliable, flexible and high performance system. This helps make the simulator easy-to-use and enables the trainer to drive the simulator via a graphical interface and be able to adjust settings and set off alarms that the trainee operator then has to react to via the HMI panel.



The afterburner of the jet engine

CONCLUSION

By successfully automating this system, Automation IT was able to increase the accuracy and reliability of the Jet Inertisation Control Unit as well as ensure the safety of the volunteers operating the machine.

Furthermore, with the new AIT developed control system the operating and maintenance costs of the unit were dramatically reduced due to the increased control and analysis tools. Each step of the inertisation process can be monitored more closely and hence reduce waste and increase efficiency.

Automation IT helping to increase safety and efficiency in the coal mining industry