

## Network Rail - On Track to a Remote Conditioned Future

The city of Liverpool is served by its own underground system that is operated by Serco Ned under the name of Merseyrail. Network Rail owns and maintains the operational infrastructure comprising track, signalling, power distribution and plant assets. The particular environment that is at the centre of the system (underground and inaccessible) was an ideal proving ground to install a Remote Condition Monitoring system. Early warning of failure and the switching of various pieces of plant by remote control has allowed significant improvements to safety and operational performance of the rail network. Network Rail selected products from Wonderware for their new system in conjunction with Cougar Automation to undertake system design and development.

*The key role of Wonderware Application Server is now fully appreciated as further projects will be built around this central system.*

The network serving the Liverpool area spreads over 75 route miles and has 67 stations, with five stations being underground at the centre of the system in the city centre. There is also a rail tunnel that goes under the River Mersey to service Chester and Ellesmere Port, the tunnel being constructed in 1886. The system is vital to this busy commuting centre where 30 million passenger journeys are completed per annum.

Network Rail is organised into routes and the Liverpool area falls within the London North

warning of imminent plant failure and switch on alternative systems, these were in the main isolated systems and had resemblance to early building automation.

### Safety...

Safety of operation is paramount and many systems have to instigate an automatic shutdown when a fault is detected. This action has significant financial penalties and immediately and directly bears upon customer satisfaction.

When Network Rail considered solutions for its latest improvement plans it was clear that a system was needed that was robust and was built from standard, supportable products. More, higher integrity, information would produce better service availability and punctual running. The initial phases of the project would be a "proof of concept" for deployment on a wider scale.

The immediate critical issue for the underground system was the pumps that operate in bore holes that control the water table in the local area of the tunnels and the underground stations. It was here that the engineers decided to undertake the initial deployment. Five boreholes are pumped by dual 34Kw pumps with inverter drives that ensure that the water table is held at the correct level. This is no simple matter, as over-extraction is not allowed by the local authority as this can have effects on buildings and also it would allow salt water to be drawn in from the river, with corrosive effects and also potentially contaminating drinking water bore holes.

### Getting the work done...

With this decision made, Network Rail



Merseyrail train at station

Western route, the infrastructure that they are responsible for extending from Crewe through to Weaver junction south of Warrington.

Parts of the underground system in Liverpool are over 100 years old, and "modern" monitoring techniques have been deployed over the last 20 years that would give some

contracted out the specification, design, installation and commissioning of the system. Cougar Automation was selected on the basis of their expertise and capability to undertake this critical work. Cougar Automation is a certified system integrator with Wonderware United Kingdom, Wonderware's sole authorised distributor and support provider in the UK and Ireland. Cougar Automation proposed a solution that utilised the InTouch HMI system to visualise events in real-time, and Wonderware Historian as the real time database. Most data being accessed through plant level programmable controllers. However, realising that the system would have a high level of plant replication which would be an issue over the many phases of work, Cougar Automation recommended that Wonderware Application Server (Wonderware System Platform) was also used as the key part of the architecture.

This was a decision that was not undertaken lightly, but after a fuller appreciation of the benefits that Wonderware Application Server would bring in the immediate project and in the progression of project extensions in the future, the decision was made to go ahead.

#### Objects to make it efficient...

Wonderware System Platform provides an application server that runs in real-time, with re-usable objects, a single name-space (that is all data points in the system are stored in one place and can therefore be easily referenced from any part of the system), and near limitless expansibility (across multiple servers). The "re-usable objects" feature in this project allowed the software for a single pumping station to be thoroughly designed and tested, and then deployed multiple times for as many

pumping stations that exist. Slight differences are accommodated in the structuring of each deployment.

In a similar manner the application now includes point heaters; these are above ground and heat the track points during freezing conditions – keeping the trains running. Here a similar approach was taken; a single "point heater" object was created, designed and tested and then will be redeployed on all the point heater controls – as they are upgraded.

The significance of this is demonstrated by the track network having 700 "point ends" that have heating; each point end being monitored remotely as well as heated. This method greatly reduces application development time and improves software quality.

The same approach was again used to solve a requirement for rail curve lubrication. This is another area where the control requirements initially appear simple but end up being complex. The problem is that there are some tight radius track curves in the tunnels that lead to metal particles being ground off the wheel flanges and rails, this produces excessive wear and affects the insulation between the tracks, and this in turn can cause signalling problems, and system shutdown.

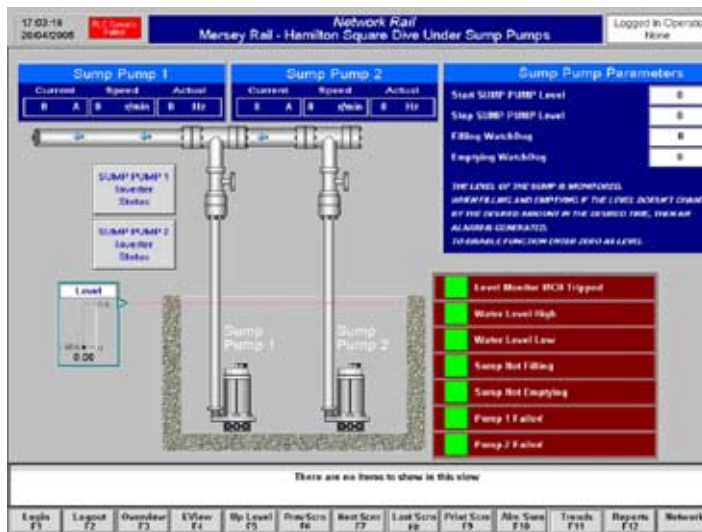
The solution is simple – lubricate the rails at the curves and avoid the wear, but, if this is done excessively then traction is lost and some of the steep inclines would prove to be impossible for the trains. Optimal greasing control has been affected that solves this problem through the design of a standard tested single object (in software) that is redeployed as and when it is needed – with high confidence and fast implementation.

The system uses fibre-optic networking to connect most of the plant together, other units being accessed by dial-up connection. The Wonderware Historian handles all such information through its store and forward routines – ensuring that the historised data is valid and correct.

In use the InTouch HMI provides a realistic visualisation of the borehole water level and the pumping system. Each measured value is constantly updated and provides the maintenance team with a true picture of current and archive status of all associated plant. This is routine for such systems, but the hidden benefit in this application is that the equipment is inaccessible and highly hazardous to work on in normal operation, to undertake any work the trains cannot be running. The provision of accurate trend information allows faults to be anticipated and avoided (faults being typically owing to objects falling into the borehole wells and other blockages).

#### Emergency lighting installation





**Dewatering display**

**Man the pumps...**

A particular feature of the system is the tunnel under the River Mersey. This has to be pumped at all times. Two wells exist, one at each end of a drainage tunnel that is situated below the running tunnel, and with a profile that is opposite to that of the running tunnel – that is, its high spot is at mid river, the water flowing to the ends. The Pumping stations at each end use dual 400Kw pumps capable of pumping 5500 gallons per minute. These are fully controlled and monitored to keep the running tunnel dry. This extracted cold water is not put to waste; it is fed through a heat exchanger to cool the machinery in a city centre printing press. The story does not end there as the hot water from this process is then used to supply another city building with heating water.

**Tunnel View**



The system has been a great success and is proving that the technologies provided by Cougar Automation are the right ones for this project. The maintenance supervisors can see from the system where work is required and that work has been completed. The historical data can show what happened around key events, so that new procedures can be developed – based upon actual and detailed information. The ease of use of the Wonderware’s ActiveFactory software reporting tool making access to data available for all users, rather than at the behest and workload priority of an IT department.

The key role of Wonderware System Platform is now fully appreciated as further projects will be built around this central system. During the design and commissioning of the project support from Cougar Automation was in turn supported by Wonderware United Kingdom’s Industrial Consultants. Both project management and teamwork have been exemplary throughout the programme.

**European City of Culture reliably on time...**

The effect of the system can be witnessed any day at Liverpool, the punctuality of running and the rail network’s reliability mean that MerseyRail is the best rail service provider in the country. All which will was needed for Liverpool’s year as European City of Culture, with thousands of visitors descending to an underground that has the very latest in control and remote condition monitoring.

**Appendix:**

Since the initial success story the project has developed with an increasing use of the standard objects for tunnel lighting, point heating and dewatering pump control. In some cases this also involved changes to the objects, based upon experience in their use. The benefit of the convenient deployment of these updated objects provided engineering efficiencies and reduced system disruption.

*Wonderware UK wishes to thank the following companies for their valued contribution to this success story...*

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