IS Ethernet in Coal Mining

Industry : Underground Coal Mining

Products
9466-ET, 9465-ET, 9461-ET, Wonderware

In Brief

Reliable control and portability are critical requirements for underground coal mining operations. A mine environment is an 'enclosed space' where explosive dust and methane gas can be present, with areas often many kilometres from the nearest exit. In such an environment, an intrinsically safe solution - not only for the 'at-face' mining equipment but also the associated communications system - can provide significant economic advantage compared with conventional systems using other explosion protection techniques.

Daw Mill Colliery is the flagship deep mine of UK Coal. Set against a background of the earlier wholesale closure of mines and privatisation, UK Coal found that they needed to take a complete review of their control and monitoring and find newer and more supportable technology. Daw Mill decided to use Intrinsically Safe PLCs and Intrinsically Safe Ethernet systems on all underground production and conveying.

MTL IS Ethernet products:
9465-ET (top), **9461-ET** (left), **9466-ET** (right)

Daw Mill is situated above the Warwickshire coal field and is uniquely assisted by its favourable geology, by the width and depth of the seam, and by coal quality. The mine was opened in 1961, following the discovery of the rich seam during the sinking of a ventilation shaft for another nearby mine. Production is almost 3 million tonnes per annum and 96% of the extracted material is saleable. Almost all the coal is used for power generation at a rate of 1200 tonnes per hour. This environment has to be carefully managed and full control made available to ensure that production is constantly economically viable in the face of imported coal.

Above all other considerations safety is paramount, in machine operation, transport, environment, ventilation and gas monitoring. Automation has been fully implemented at the mine with machinery being controlled by Intrinsically Safe Programmable Logic Controllers (IS PLCs). This underground intelligence allowed the use of commercially available real-time SCADA software to supervise, monitor and attend to alarms. In addition, data is extracted from the mine's equipment that is used to provide real time information for many management functions.

The current renewal and update programme can be traced back to 1998 when the industry had shrunk and questions were being raised about the ongoing viability of the legacy, highly bespoke, data-gathering solution. In addition to this, the existing systems architecture was inherently slow and prohibited effective control. Deciding upon a solution for the programme involved visits to process industry sites and discussions with several suppliers. The decision was made to use Intrinsically Safe PLCs with an Intrinsically Safe Ethernet System to add networking communication with the surface.

The PLCs are monitored and controlled at the surface control room by use of Wonderware's Intouch SCADA system and use this to manage the underground logic controllers. High value coal cutting machines and conveyors, as well as the underground environment, were thus brought under proper control. Safety, as already stated, is the primary concern and particular emphasis was made upon monitoring airflow, methane and carbon monoxide. Alarms are set that shut equipment down at pre-determined levels and also initiate evacuation.

CA-9460-100610

COOPER Crouse-Hinds

www.mtl-inst.com

The PLCs control Machinery including the coal-face coal shearing machines, ventilation, and conveyors. The coal face at Daw Mill is currently 10km from the control room; therefore communication has to be fast and effective - fibre optic Intrinsically Safe Ethernet is being used throughout the mine.

One of the unique differences found in mining, as opposed to manufacturing, is that the plant is under continuous movement and redeployment. When a coal seam reaches a boundary all of the mining equipment may be moved to a position several kilometres away and have totally different operating conditions. It was therefore important to the UK Coal engineers that the PLCs be capable of easy re-configuration and ongoing development.

Daw Mill has two shafts, one for the miners and one for equipment; but it is in fact a drift mine in that the coal is transferred to the surface by inclined conveyors. The conveyors have powerful motors to cope with the weight and loading changes in operation. These conveyor system motors are also monitored by PLCs.

Within the project period it was noticed that a motor was drawing higher than normal current, but examination of the fine resolution data showed that this was caused by external effects rather than imminent motor failure. The fault proved to be a belt scraper that was pressing on the belt and causing it to slip – thereby explaining the high current.

The benefit to UK Coal of accurate diagnosis that prevented a shutdown was about £500K (calculated from the cost of replacement parts and lost production). The diagnosis allowed the problem to be fixed in 5 minutes by clearing a blocked air pipe. This diagnosis was possible due to the availability of high resolution archive data which is continually updated from all controllers to the historian server. These examples show immediate cost savings that were made possible by the system. The benefits of real-time systems applied at the colliery are felt in day to day running by improved insight to events and

ease of access to meaningful and useful information.

The system has become the backbone of the way that the colliery operations communicate; information that is required underground is readily available where and when it is required. This allows manpower to be allocated in an optimum way – with added certainty that the right team is being deployed for the right reasons. When distances underground are measured in kilometres, it is clearly very time consuming to be "on the wrong mission".

The IS Ethernet infrastructure allows the options of adding wireless access points to connect to IS mobile computers, cameras for operations, safety and security, RFID for asset and people tracking and VoIP telecommunications in the future.
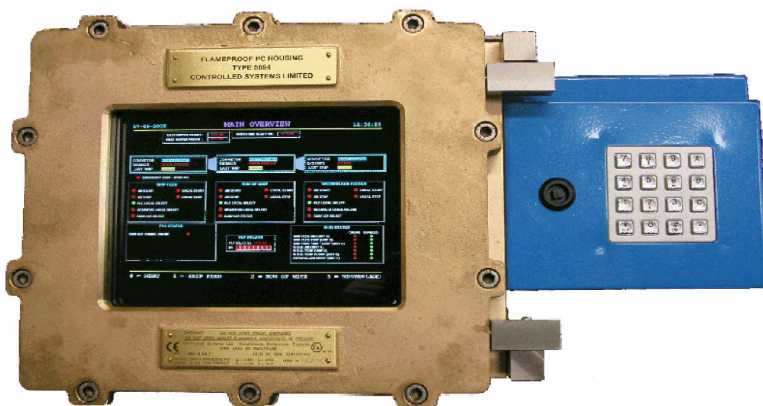
The use of IS PLCs and Intrinsically Safe Ethernet system has benefited UK Coal by providing advanced features that are easy to assimilate and take advantage of. The system is subject to constant change and development according to changing operating conditions and the realisation of solutions that will directly affect productivity and cost, cutting edge technology delivering benefits in depth!

UK Coal have taken the IS PLCs and Intrinsically Safe Ethernet system and are now using them extensively at six other collieries

Products: Initially the Daw Mill used the 9260 range of IS Ethernet infrastructure components but more recent extensions have employed the 9466-ET 5-port IS Ethernet Managed Switch together with the option of Power-over-Ethernet (PoEx™) to distribute the d.c. power.

IS Ethernet cards in PLCs throughout the mine are connected to a 'local' 9466-ET switch together with 9461-ET IS Ethernet Serial Gateways that are used to communicate with a range of IS serial devices. The 9466-ET switches are all interlinked with lengths of fibre-optic cable via 9465-ET IS Ethernet Copper-To-Fibre Media Converters, ultimately reaching the surface to link into the control system servers. The use of multimode fibre-optic Ethernet connections is invaluable for the long distances involved in coal mining, supporting 2km distances at 100Mbps or 5km at 10Mbps, while IS Ethernet over copper supports the standard 100Tx Ethernet distance of 100m.
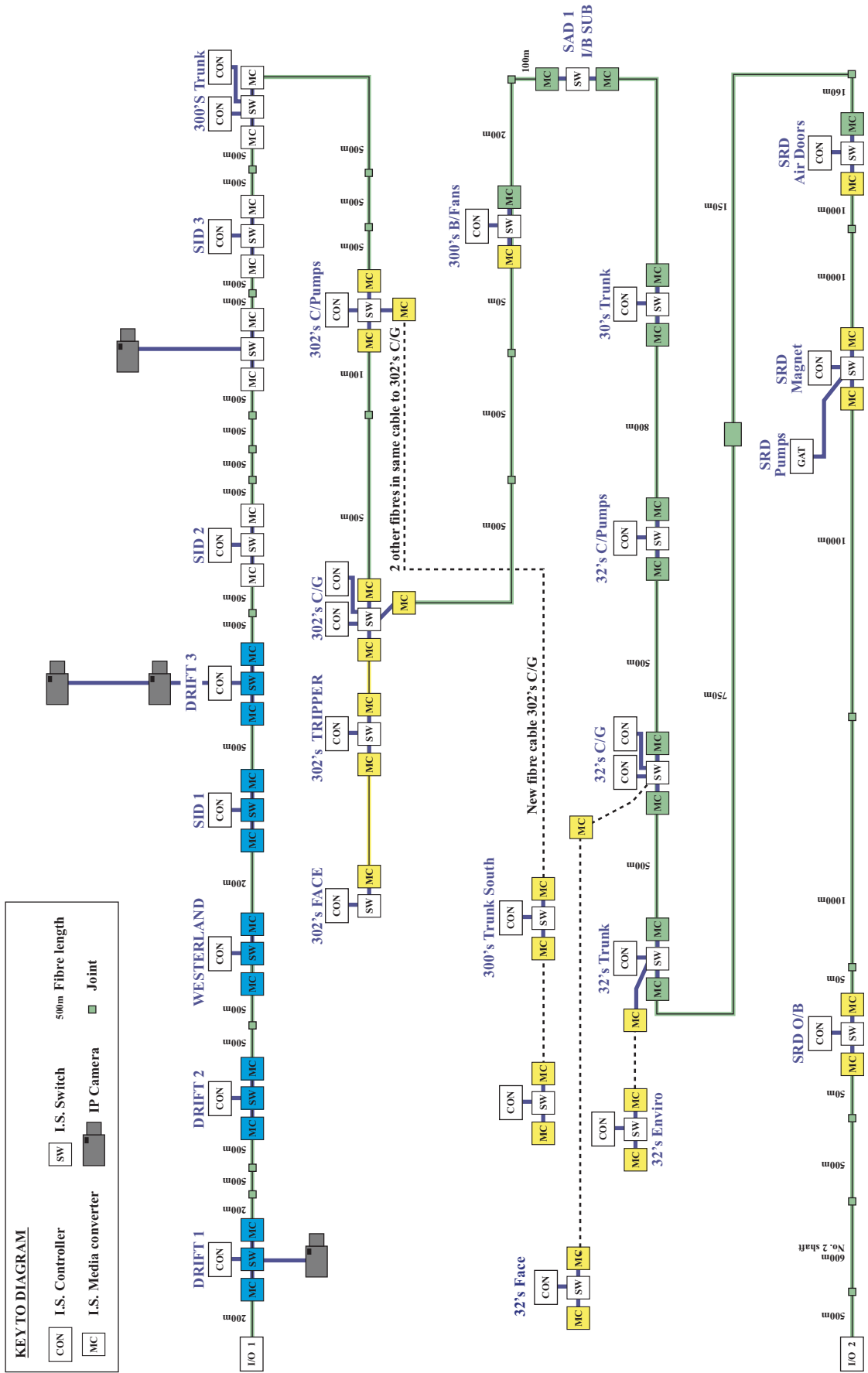
Intrinsically Safe Ethernet ring installation at a UK coal mine

KEY TO DIAGRAM

CON	I.S. Controller
MC	I.S. Media converter
SW	I.S. Switch
	IP Camera
500m	Fibre length
	Joint

Labels (top section):
300'S Trunk · CON · CON · SID 3 · CON · 500m · 500m · 500m · 500m · 500m · 500m · 500m · 500m · 500m · SID 2 · CON · 500m · 500m · DRIFT 3 · CON · SID 1 · CON · 200m · WESTERLAND · CON · 500m · 500m · DRIFT 2 · CON · 500m · 500m · DRIFT 1 · CON · 200m · I/O 1

Middle section:
302's C/Pumps · CON · MC · 100m · 302's C/G · CON · 302's TRIPPER · CON · 302's FACE · CON · 2 other fibres in same cable to 302's C/G · New fibre cable 302's C/G

Right section:
SAD 1 I/B SUB · 100m · 200m · 300's B/Fans · CON · 50m · 30's Trunk · CON · 800m · 500m · 32's C/Pumps · CON · 500m · 32's C/G · CON · CON · 500m · 750m · 32's Trunk · CON · 32's Enviro · CON · 32's Face · CON · 300's Trunk South · CON

Far right (SRD section):
SRD Air Doors · CON · 160m · 1000m · 1000m · SRD Magnet · CON · SRD Pumps · GAT · 150m · 1000m · SRD O/B · CON · 50m · 50m · 500m · 600m No.2 shaft · 500m · I/O 2