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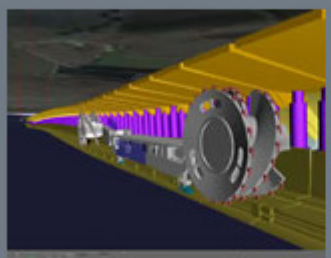
ACARP MATTERS

LONGWALL AUTOMATION



Powered supports and AFC pan line are aligned with SPMS pitch and roll

Longwall automation was identified as a major project by ACARP's Underground Technical Committee because Australian coal producers believed that longwall mining systems were not achieving their full potential. They were hazardous, and production rates were lower than the potential of the equipment being used. Consequently, operating costs were not optimised. The aim of the Longwall Automation Project was to develop a longwall face that would operate automatically within pre-defined parameters to enhance health and safety and production consistency, to lower operating costs and improve return on capital.

In a fully automated longwall, a robotically-controlled shearer capable of detecting the coal seam interfaces between the roof and the floor automatically advances across the face. As it passes, each hydraulic jack is advanced to support the newly exposed roof behind the shearer. By eliminating the manually-controlled shearer, longwall automation reduces the exposure of workers to health and safety risks such as respirable dust, gas emissions and other hazards.

Longwall automation has the potential to achieve:

- Improvements in workplace safety by removing people from hazardous areas into associated support roles;
- Improved and more consistent productivity through more effective control of longwall equipment;
- Higher machine availability through improved condition monitoring and equipment reliability.

LONGWALL AUTOMATION PROJECT

The project was undertaken in two stages. CSIRO and the Centre for Mining Technology and Equipment (CMTE) were invited to present proposals to the Longwall Automation Steering Committee (LASC) on their concepts for longwall automation. The groups were asked to jointly conduct a seed project to establish a detailed work program and, in June 2001, they were jointly awarded a $4 million research contract. CSIRO and CMTE contributed a further $2 million to the project.

The aim of the first three-year project was to develop a longwall system comprising a shearer, armoured face conveyor and powered roof support combination that would:

- Carry out routine functions such as cutting and loading coal, maintaining face alignment and moving and setting roof supports within pre-defined operating boundaries and without human intervention;
- Monitor itself and the surrounding operating environment to provide for self-diagnosis of system health and indications of approaches to and departures from the pre-defined operation boundaries;
- Initiate requests for human intervention based on approaches to and departures from the pre-defined operation conditions.

This technology was first successfully trialled at South Bulga, resulting in the position of the shearer being tracked to within 100mm of its position in 3D space.

In 2005, the project was extended for a further two years. The scope of the $2.419 million extension project was determined by LASC, which evaluated the outcomes of the initial project and produced a set of technical outcome areas. One of the major goals of the second stage was to produce commercial prototype automation systems from the proof-of-concept outcomes of the original project. Commercialisation activities have been undertaken by CSIRO in parallel to the project.

LONGWALL MINING

Most large, underground coal mines in Australia use longwall mining equipment to mine large blocks of coal in a single pass. This technique uses two tunnels (or headings) which are about 1500 metres long and up to 400 metres apart, and are joined together at the end by a third tunnel. A third cross tunnel is when the longwall is located and commences mining. A longwall comprises three main pieces of machinery – roof supports (large hydraulic jacks), a coal cutter/shearer and an armoured face conveyor. The shearer cuts a metre or more of coal on each pass using carbide-tipped cutting drums at each end, and simultaneously loads the coal onto the conveyor for transport out of the mine. The shearer keeps mining coal slice by slice until the longwall has travelled the length of the tunnel. Once the coal has been mined, the rock above it is allowed to collapse safely. After the longwall equipment has mined the 1500 metre block, the longwall is relocated to the next block and mining recommences. Longwall mining is a very efficient technique.

WHY BELTANA?

South Bulga (the underground mine that was part of the Bulga Complex before Beltana was commissioned) was the site of the original longwall automation project. Beltana was, therefore, an appropriate site for further trials. In addition, Xstrata Coal has two industry representatives on the Longwall Automation Steering Committee – Jim Sandford and Peter Henderson, who have both worked at Beltana and South Bulga. Pete Henderson was a recipient of an ACARP Award in 2005 for his contribution as co-researcher and for providing the industry technical input during this stage of the Longwall Automation project.

The primary commercialisation model has concentrated on the first three technology outputs:

- Shearer position measurement system;
- Automated face alignment (which ensure the shearer's cutting drums follow the seam accurately);
- INS-based horizon control.

Longwall automation requires reliable communication between the components, so a high-capacity underground communications system was developed at the same time as an industry standard for data communication was created.

The next step was to address automation of the machinery and this resulted in:

- A patented positioning and guidance system which ensured the shearer maintains its alignment to the face;
- Horizon control to make sure the cutting drums are at the right level vertically to cut across the heart of the face.

Pre-commercial prototypes are now being used at Xstrata's Beltana and BMA's Broadmeadow longwall mines.

THE OUTCOMES TO DATE

Demonstration of commercial prototypes for face alignment is now complete and is being utilised at 3 sites. Commercial products are now (or soon to be) available from two OEMs, and a third is expected to enter the market in due course. Final demonstration of the creep measurement commercial prototype is planned for Q1 2009 at one or more demonstration sites.

Cessation of "string tests" for twice-daily long wall alignment testing has resulted in a reduction in human exposure to the high hazard long wall face. The half hour of set-up time previously allocated for face alignment testing each test is now available as additional cutting time.

Anecdotal reports of reduced personal dust exposures for longwall employees at one site where coal production has increased by 75% over several years appear to corroborate the reports of reduced employee exposures to high hazard environments. One test site using automatic shearer control reports increased cutting rates of approximately 5% as a result of less operator intervention, faster approaches to cut-finish and higher quality of the finish cut. This could result in an additional 300,000 saleable tonnes per year. It is possible that cutting rate increases of 10-15% may be achievable with fully automated shearer control and horizon control, depending on the underground conditions.

The Longwall Automation Project has successfully demonstrated that the industry can collaborate with researchers and OEMs in a significant and long term project to successfully bring about step change to improve productivity and provide safer working conditions for workers.

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