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# Reducing injury risks associated with underground coal mining equipment

ACARP Project C14016

Robin Burgess-Limerick PhD CPE

Burgess-Limerick & Associates • Draft Final Report • February 2007

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**Burgess-Limerick & Associates**

Ergonomics and Research Consultants

**ACARP**

Australian Coal Association Research Program



## EXECUTIVE SUMMARY

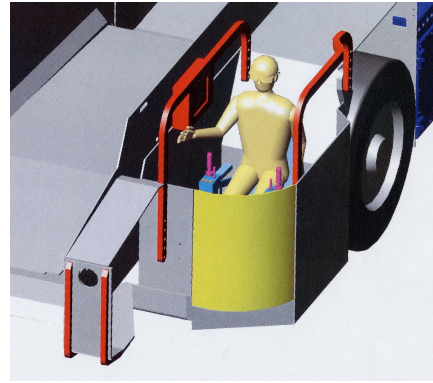
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This report summarises the activities and outcomes of ACARP project CL4016 “Reducing Injury Risks Associated with Underground Coal Mining Equipment” undertaken by Burgess-Limerick & Associates from March 2005 to February, 2007. The project work encompassed analyses of NSW and US injury narratives for equipment related injuries, visits by project staff to fourteen Australian underground coal mines, a US underground coal mine, an Australian lead mine, as well as seven manufacturing sites in Australia and the USA. Reports on related topics previously compiled for US, European, and South African agencies were reviewed, and a draft generic equipment injury risk assessment tool prepared and circulated for comment. Injury hazards associated with underground coal mining equipment have been described and control measures identified. An outstanding issue relating to the appropriate design of bolting controls was identified for further research. Some of the project work was undertaken during a 6 month period the team leader spent at the NIOSH Pittsburgh Research Laboratory as a National Academy of Sciences, Senior Research Associate.

The project results have been progressively disseminated through presentations at industry conferences, and papers in industry magazines and academic journals. A list of presentations and papers arising from the project is provided. A one day seminar which formed part of the project was held on October 17, 2006 in Pokolbin, and was attended by 100 people from mining companies, contractors and manufacturers. Slides and papers from this seminar are available at [burgess-limerick.com](http://burgess-limerick.com).

The final outcome of the project is a “Handbook for the Control of Injury Risks Associated with Underground Coal Mining Equipment” which documents the injury risks, controls, and outstanding issues. The handbook (Appendix A) also incorporates a generic equipment injury risk assessment tool, and a training DVD.

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## OBJECTIVES

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The objectives of the project were: (i) to identify injury risks associated with the ergonomics of underground mining equipment through analysis of the full-text description of incidents involving underground equipment and audits of participating sites; (ii) to identify and evaluate existing control solutions through audits of participating sites; (iii) to identify and evaluate potential controls for outstanding issues through collaboration with all stakeholders; (iv) to develop a generic ergonomics risk assessment tool for application to new equipment; (v) to communicate the consolidated views of diverse mine sites to manufacturers; and (vi) to disseminate the results of the project to mine sites, engineering students, and manufacturers.

## WORK SCHEDULE

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The project was divided into three phases. Phase 1 was completed prior to ACARP funding and involved an assessment of the risks of injury associated with three high risk items of equipment through examination of detailed incident data and observation.

The outcome of the second phase was a systematic identification of hazards associated with underground mining equipment and collation of controls currently in place at different Australian mine sites through undertaking visits to underground mines in NSW and Qld. This process was supported by an analysis of injury data held by Coal Services and communication with, and visits to other sites, manufacturers, government agencies and international research organizations to identify potential controls for outstanding injury risks. As part of this phase, an invitation was accepted from the National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory (ex-USBM laboratory) to spend 6 months at the laboratory as a National Academy of Sciences Research Associate from November 2005 to May 2006.

Phase 3 of the project was focussed on providing practical outcomes of phase 2 and dissemination. In addition to presentations at industry conferences and publications in trade and academic journals, the results of the project were disseminated through a one day seminar. Papers and slides from the seminar were published on the web, and are included in this report (Appendix A). A central part of this part of the project was the development of a generic tool, and associated training materials, to assist in systematically assessing and controlling the injury risks associated with underground equipment. The tables below provides a summary of the work program, associated milestones and timetable.

**Table 1: Work program and associated milestones**

Phase 1	Milestones and Progress
Analysis XstraSafe data for development equipment (Continuous miner, Shuttle car, LHD), review of relevant prior research.	Completed, reported to Xstrata Coal NSW, June 2004, presented at Pokolbin seminar, November 2004.
Visits to Beltana and West Wallsend, interviews/discussion of analysis with experienced operators. Examination of current methods of risk assessment for equipment, and existing risk assessments.	Completed, reported to Xstrata Coal NSW June 2004.

Phase 2	Milestone and Progress
Detailed analysis of historical full-text injury data for XCN sites	<p>Completed, reported in 6 month progress report - September 2005</p> <p>Report presented at NSW (Leura), QLD (Townsville), Safety in Mines Research Institute conference, (all 2005), and published in <i>Ergonomics Australia</i>. (Burgess-Limerick, 2005).</p>

Phase 2	Milestone and Progress
<p>Detailed analysis of NSW injury data</p> <p>Complementary analysis USA data</p>	<p>Analysis of 3 years NSW injury narratives (02/03 - 04/05) completed and reported in 12 month progress report - March 2006.</p> <p>Papers presented at an HFESA Queensland Branch meeting and XCN seminar, 2005, NSW Mining Safety conference 2006, International Ergonomics Association Congress (Maastricht, 2006), and accepted for the 2006 HFESA National Conference. A journal paper has been accepted for publication in <i>Mining Technology</i>. A short version of this paper appeared in <i>Australian Longwall Magazine</i>, and <i>International Longwall News</i>. A paper describing US injury data has been submitted.</p>
<p>Benchmarking audits across 12-16 NSW and Qld underground coal mining sites to identify existing control solutions to known risks.</p>	<p>Completed, reported in 12 month progress report - March 2006</p> <p>14 QLD &amp; NSW sites visited. Supplementary visits undertaken in US underground coal mine and Australian lead mine.</p>
<p>Facilitation of communication between sites, mining companies, through consultation with, and visits to, manufacturers, government agencies, and research agencies (eg, NIOSH PRL, SIMRAC) to share results of audit and identify solutions to outstanding issues. Ongoing review of relevant research</p>	<p>Extended visit to NIOSH PRL Nov 05-May 06. Discussions with staff from NIOSH, MSHA, and CSIR (RSA), review of prior reports to US, European, and South African agencies, visits and/or discussions with manufacturers including Joy, VA, Hydramatic, Waratah, Macquarie Manufacturing, DBT, Fletcher, and SMV.</p> <p>Outstanding issues regarding the appropriate design of bolting controls have been identified and a resulting research proposal accepted for future ACARP funding.</p>

Phase 3	Milestone
<p>Organisation of a seminar on the ergonomics of underground coal mining equipment and publication of proceedings.</p>	<p>Seminar held October 17, 2006 at Pokolbin.  Papers and slides published on <a href="http://burgess-limerick.com">burgess-limerick.com</a> and in this report</p>
<p>Development of an ergonomics risk assessment tool and training materials for underground mining equipment compatible with site risk ranking systems, trial across a range of sites and equipment types and modify as necessary.</p>	<p>Draft tool month 20 - November 2006  Draft tool completed and distributed for trial and comment. Revised version distributed at Pokobin seminar in October.  Final tool included in handbook</p>
<p>Develop handbook for the control of injury risk associated with underground coal mining equipment including documentation of risks, known controls, and outstanding issues; and incorporating the risk assessment tool and training materials.</p>	<p>Final Report and handbook, month 24 - February 2007</p>

## ACTIVITIES AND OUTCOMES

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An analysis was undertaken of full text descriptions for 1000 equipment related injuries occurring at XCN sites. The results of this analysis were presented at the 2005 NSW Mining Safety Conference (Leura) and at the 2005 Queensland Mining Safety Conference (Townsville). The paper was also presented at the Safety in Mining Research Institutes conference (Brisbane) and has been published in the journal of the Human Factors and Ergonomics Society of Australia, *Ergonomics Australia* (Burgess-Limerick, 2005).

A similar analysis of injuries involving development equipment for all NSW underground coal mines for the 3 years to June 2005 (02/03-04/05) has been completed and was reported at an HFESA (Qld branch) meeting in Brisbane (2005), at an Xstrata NSW safety seminar at Pokolbin (2005), and a NIOSH PRL seminar (Pittsburgh, 2006). Conference papers were presented at the 2006 NSW Mining Safety Conference (Leura), the International Ergonomics Association congress (Maastricht, 2006) and at the 2006 HFESA National conference (Sydney). A paper describing these data has been accepted for publication by *Mining Technology*. This information was also communicated through an article in the June 2006 issue of *Australian Longwall Magazine*. This article also appeared in *International Longwall News* (July 18, 2006). A complementary analysis of US injury data has also been undertaken and a manuscript describing this analysis has been submitted to *Mining Engineering*.

Project staff (Robin Burgess-Limerick, Suzanne Johnson, Gary Dennis, & Jenny Legge) collectively visited 14 Australian underground coal mines (Ulan, Beltana, United, Baal Bone, West Wallsend, Oaky North, Kestrel, Dartbrook, Denbrobium, Metropolitan, Angus Place, Douglas Park, Newlands and Appin mines), a US underground coal mine, an Australian Lead mine (Cannington). Visits have been made to 7 manufacturing sites (the Australian and USA offices of Hydramatic and VA Eimco, Joy Haulage [USA], Waratah Engineering, and Specialized Mining Vehicles). Discussions have also taken place with DBT, SMV, Waratah and other exhibitors at the Queensland Mining and Engineering Equipment Exhibition (Mackay, 2006) and by telephone and email with Macquarie Engineering, and with representatives of Fletcher (USA). The project leader also participated in meeting of the committee revising MDC35 and a focussed recall session in which high potential risks associated with continuous miner operation was examined on behalf of Xstrata NSW.



As seminar was held at Pokolbin, NSW as part of the project on October 17, 2006. The seminar attracted 85 attendees (and 15 presenters) from eight manufacturers, 15 NSW and QLD mines (representing five companies; Anglo, BHPB/BMA, Centennial, Rio Tinto & XCN) as well as the NSW Minerals Council, Coal Services Health, and both NSW and Qld Departments of Primary Industries. Feedback from the attendees was very positive. The presenters' slides and written papers from selected presenters are published at [www.burgess-limerick.com](http://www.burgess-limerick.com). Interest has been expressed by the Queensland Department of Mines and Energy in holding a similar seminar in Queensland in 2007.



The final outcome of the project is a “Handbook for the Control of Injury Risks Associated with Underground Coal Mining Equipment” which incorporates the information gathered during the project regarding risks and controls and contains a generic risk assessment tool and training DVD.

## PRESENTATIONS

Xstrata Coal NSW Safety Seminar, Pokolbin, November, 2004

NSW Mining Safety Conference, Leura, May, 2005

QLD Mining Safety Conference, Townsville, August, 2005

Safety in Mines Research Institute Conference, Brisbane, October, 2005

Human Factors and Ergonomics Society of Australia QLD branch scientific meeting, Brisbane, November, 2005

Xstrata Coal NSW Safety Seminar, Pokolbin, November, 2005

National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory colloquium series, Pittsburgh, March 2006.

NSW Mining Safety Conference, Leura, May, 2006

International Ergonomics Association Congress, Maastricht NL, July, 2006

Ergonomics of underground coal mining equipment seminar, Pokolbin, October, 2006.

Human Factors and Ergonomics Society of Australia annual conference, Sydney, November 2006.

## PUBLICATIONS

Burgess-Limerick, R. (2005). Reducing injury risks associated with underground coal mining equipment. *Ergonomics Australia*, 19(2), 14-20.

Burgess-Limerick, R. (2005). Reducing injury risks associated with underground coal mining equipment. In Bell, S., Oberholzer, J. & Cliff, D. (Eds). Proceedings of the 31st Biennial International Conference of Safety in Mines Research Institutes. ISBN: 0-9758179-0-6 (pp. 102-105).

Burgess-Limerick, R. & Steiner, L. (2006) Injuries Associated with Continuous Miners, Shuttle Cars, Load-Haul-Dump, and Personnel Transport in New South Wales Underground Coal Mines. *Mining Technology (TIMMA)* 115, 160-168.

Burgess-Limerick, R., & Steiner, L. (2006) Reducing Injuries. *Australian Longwall Magazine*, June, 2006 (and on-line in *International Longwall News*).

Burgess-Limerick, R. & Steiner, L. (submitted) Opportunities for preventing equipment related injuries in underground coal mines in the USA.