

DRAFT

OHS RESEARCH STRATEGY

SUMMARY

A review of injury data from Queensland and NSW coal mines was undertaken to develop an OHS research strategy and priorities to assist funding agencies effectively address OHS.

Key issues highlighted by the data included:

- eleven percent of injuries with a duration of 30 days or more resulted in 60% of costs; and
- while overall the numbers of lost time injuries have been substantially reduced, more serious injuries (over 30 days) have not similarly declined.

On the basis of cost and from a human perspective, the proposed research vision which forms the basis for the following strategy is **the elimination of serious or permanent disabling injuries and fatalities.**

Recognising the limitations in current industry injury data, a key component of the strategy is the development of an appropriate data base to support preventive efforts and the identification of research issues into the future.

Research topics have been developed in the following areas:

General research

- improved data system
- musculo skeletal injury
- noise induced hearing loss
- health issues
- interaction of lifestyle issues and OHS
- vibration and jarring

Open Cut

- dozers - tracked
- loaders
- light vehicles
- draglines - bucket
- scrapers

Core Risks

- strata control
- fire and explosion

Underground

- loaders
- continuous miners
- man transporters
- conveyors
- roofbolters
- supervisors

All Research Projects identified in the strategy are summarised in **Appendix 1.**

BACKGROUND

The main agencies funding occupational health and safety research in the coal industry are:

- ACARP
- BHP Special Research project
- JCB Health and Safety Trust

Their common objective is to contribute to the prevention of occupational injury and disease within the coal industry.

Each agency has pursued OHS research funding over a number of years. ACARP has replaced the NERDDP Scheme (and continued funding for a number of OHS projects undertaken by NERDDP). **Appendix 2** lists the key OHS research projects recently and currently funded by these agencies.

In 1993 these agencies agreed that a more coordinated approach was necessary and that priorities should be developed based on the best available data. Accordingly, the Victorian Institute for Occupational Safety and Health (VIOSH), was funded to evaluate current and past research in Australia and overseas and undertake a study of available injury data to help determine priorities.

The findings of the VIOSH study are contained in a two main reports and relate to both the style of research which should be undertaken as well as highlighting the major problem areas based on an assessment of cost (as a measure of severity).

Subsequently, through further data analysis and consultation, these broad problem areas have been considered to determine how they might be addressed in particular, whether there is scope to contribute to their solution through industry level research.

This document offers a blueprint for OHS research for the next five years. The document is a **research strategy**, not a comprehensive OHS strategy. Therefore, it is vital that the problems highlighted also receive a focus by individual companies.

This draft strategy will be forwarded to all coal companies for comment prior to being finalised. It is also planned to monitor the implementation of the strategy, and review and update it annually. As the data on which the strategy is based improves, so will the relevance and effectiveness of the strategy

VISION (10 years):

- eliminate all deaths and cases of permanent disability in the Coal Industry

RESEARCH OBJECTIVES:

- develop a scientific information base to assist industry target areas of highest exposure to the risk of death and permanent disability
- support and produce innovations which coal companies can use in combination with management, training, awareness raising and other initiatives to eliminate deaths and permanent disabilities.

PHILOSOPHY:

- pursue a co-operative approach to research funding in OHS between the major coal funding agencies for coal specific OHS research
- pursue and promote joint funding with other funding agencies on non-coal industry specific OHS research (ie participate where there is high leverage)

[A number of National, State and industry bodies contribute funding for OHS in the coal, mining and quarrying industry and may be prepared to contribute to research projects that have implications beyond coal.]

- pursue research in the context of broader industry and company level responsibilities and activities for occupational health and safety (eg education and training, solution sharing, standard setting etc)
- focus on research with practical outcomes which will contribute directly to prevention
- build on/encourage company efforts to innovate in addressing priority issues

DATA ANALYSIS

The following sections contain the key data underlying this strategy. For more detailed data refer to **Appendix 3** and the VIOSH Reports. The data used in the VIOSH study was compiled for the period 1/1/91 to 30/6/93. Additional data analysed for equipment specific injuries covers the period 1/1/91 to 30/6/94.

Fatality Data Key Features

Over 50% of fatalities in the coal industry are related to industry specific risks (eg roof falls, explosions etc) associated with the working environment. The remainder are due to energies commonly found also in other industries. Special attention needs to be paid to those risks which have the potential to cause multiple fatalities.

Major agencies identified are:

- working environment underground
- equipment (non-mobile and mobile)
- coal mine gases

Injury Data Key Features:

- Underground mining has the highest incidence and severity of injury (more than six times that of open cut mining).
- Serious injuries (ie greater than 30 days duration) which represent around 11 percent of the injuries result in more than 60% of the costs.
- While the overall number of injuries is decreasing, the potential for severe injury (greater than 30 days duration) does not appear to be significantly decreasing.

Underground and open cut equipment associated with the most severe injuries were identified as follows:

Underground Equipment	Open Cut Equipment
loaders	dozers - tracked
continuous miners	loaders
man transporters	light vehicles
conveyors	draglines - buckets
roofbolters	scrapers

Occupation Data

Using information on the numbers of employees in various employment categories the following conclusions were drawn from the underground sector:

- face workers suffer the highest incidence/severity of injury
- supervisors suffer a disproportionate incidence and severity of injury

Health Data Key Features

Health data is not as extensive as injury data. The VIOSH study highlighted the need to improve disease/illness categorisation and harmonise Qld (which had more extensive categorisation) with NSW. Data from the VIOSH study included:

- in NSW deafness accounted for 64% of disease claims at a cost almost equivalent to the total cost of open cut injury claims;
- from the Qld data:
 - deafness accounted for 65% of total “no lost time injury” compensation experience
 - carpal tunnel syndrome represented 12% of no lost time claims experience in Qld
 - 7 heart attack claims averaged \$31 391/claim in comparison with deafness at \$1942/claim

Other features of the industry with potential health impacts include:

- an ageing workforce
- diesel emissions
- stress
- altered shift patterns

In NSW the JCB has recently published the results of a study into cancer and mortality rates in NSW coal miners. The study did not identify any areas of major concern although melanoma was the cancer closest to reaching statistical significance. It is anticipated that the study will continue and will be revisited in 5 -10 years.

RESEARCH PRIORITIES

Research - Core Risks

From the fatality data it is clear that traditional “core” risks accounting for a significant proportion of fatalities include:

- strata control
- fires and explosions (including outbursting)

These areas are being addressed by current research projects as follows:

Strata Control: Appendix 1 highlights the range of projects already being undertaken in this area. The Joint Coal Board/University of NSW project on strata control is a key project. The UNSW team is also receiving ACARP funding for investigating improvements in rib control and to extend the JCB project into soft strata environments. Other areas receiving funding support include roof support techniques, operating safety of bolting equipment and industry's ability to effectively monitor strata conditions.

The current work is yielding good results. There may be a need to stocktake what has been achieved and an assessment of future research needs when funding for current projects is nearing a conclusion.

Fire and Explosion: Basic industry strategy, reflected currently by ACARP is to attempt to control gasses involved with either explosions or outburst. Gas drainage has a high priority and research focuses on the effective, accurate drilling of gas drainage holes. Research will also continue in addressing electrical sparking, frictional ignition and spontaneous combustion.

At present a Mining Wardens' inquiry is being held to determine the cause of the 1994 disaster at Moura No. 2 Mine. On completion of the Inquiry the Warden will hand down his recommendations with the aim of preventing a recurrence. When these recommendations are released they will be reviewed to identify any possible research implications. Should new research initiatives be identified, appropriate changes will be made to this strategy.

From preliminary discussions with the Department of Minerals and Energy the following topic may warrant further consideration in parallel with the Wardens' recommendations:

ACTION:

Ventilation Gas analysis

- *identify the most appropriate points for positioning gas monitoring sensors to detect early signs of spontaneous combustion, prior to and after sealing of sections/goafs*

An outburst task force has been established to assist in monitoring the outcomes of research, and ongoing identification of research needs. Topics warranting consideration include:

ACTION:

To assist in prediction of outbursting develop instrumentation for:

- *real time monitoring of CO₂*
- *measurement of gas pressures in the coal seam*

Research - General (open cut and underground mines):

Data Systems

Data systems need to be oriented to reflect the priority of eliminating death and permanent disability, and to provide quality information to assist in targeting and driving performance improvement in these areas of concern.

The VIOSH study used cost as an indicator of severity, and duration (ie 30 days lost time) has also been used to identify more serious injuries. There are, however, a range of limitations to this approach and an improved system should include:

- a categorisation of injuries/disease which is mutually exclusive and related to the injury outcome - ie., death, permanent disability, temporary disability
- a risk formula highlighting the potential consequence and likelihood of re-occurrence
- appropriate exposure information (ie population exposed to particular risks at industry level)
- a means of capturing significant, potentially high consequence incidents
- other data including serious bodily injuries and dangerous occurrences
- information on accident causation
- a means of accurately capturing contractor OHS performance

ACTION:

Establish a scientific information base (data collection, analysis and use) to identify and address, at the industry and enterprise level, the risk of death and permanent disability

- *review industry data collection (including health data) and analysis systems and their relationship with corporate data collection and analysis systems*
- *review opportunities for standardisation of data collection across Australian mining industry*
- *review and assess corporate models of data collection and analysis*
- *identify and monitor emerging issues: eg., carpal tunnel/stress*
- *develop recommendations for industry and corporate data collection and analysis models*

Musculo-skeletal Injuries (joint funding with other non-coal industry funders)

Musculo-skeletal injuries were very prevalent in severe injury data for the coal industry. The most effective prevention is achieved through ergonomic intervention where risks are designed out of the work process. However, factors such as the ageing workforce and post injury management may also be addressed in a comprehensive strategy.

ACTION:

Review Study - evaluate "state of the art" methods for addressing musculo-skeletal injuries in the coal industry to guide on-site preventive strategies including the following areas:

- *ergonomic design equipment*
- *job/task redesign methodologies*
- *education, training, awareness*
- *person-task fit eg "fitness for job", selection/assessment*
- *effectiveness of personal protective/support devices*
- *management/rehabilitation of musculo-skeletal injuries*

Noise-induced Hearing Loss

Noise induced hearing loss is the most prevalent permanent disability highlighted by industry health data. Preventive strategies for noise induced hearing loss are well known and contained in documented Codes of Practice. Few companies in coal or in any industry have implemented comprehensive approaches aimed at eliminating this problem. Equipment used in coal mining currently generate significant amounts of noise.

Strategic approaches address this issue through "buy quiet" policies, identifying and reducing the noise of equipment contributing to the exposure for employees and automation (to remove the worker from the source of the noise).

ACTION:

- *Identify barriers and opportunities for effective management of noise (incorporating purchasing, retrofit noise reduction, administrative controls, rehabilitation strategies, hearing protection management) following National Standard and Code of Practice, in coal companies.*
- *Identify a priority list of major noise sources within the industry contributing to employee exposure (currently and likely to have ongoing use in the industry for some time) to form the focus of research aimed at reducing the noise of these sources.*

- *Pursue automation as a long term strategy in areas which are not readily amenable to noise reduction, so that equipment can be operated remote from the noise.*

Health Issues

Diesel emissions is the main emerging health issue related to underground mining activities. While the health affects of exposure to diesel particulate remain uncertain, the industry should be working to minimise exposure to emissions. A number of projects are already underway in this area. Further projects may be required to develop undertake more detailed work on the control of emissions:

ACTION:

- *Evaluate conditioning /scrubber system configurations to determine those design characteristics which contribute to the optimal control of diesel emission and diesel engine system performance*
- *Investigate the ventilation required to support the use of diesels and the relationship between ventilation and diesel emission dispersion*

General Lifestyle Issues

While health data is inadequate to assess the impact of lifestyle issues on the coal industry, heart attack and stress are two health issues relevant to the industry which were identified in the data. The ageing nature of the coal industry workforce (particularly for older minesites), shiftwork, drugs and alcohol are also key issues currently being addressed in the industry.

ACTION:

Review study: Review and assess the interaction between lifestyle factors and coal industry employment; in particular, the implications for health and safety of:

- *shiftwork*
- *drug and alcohol*
- *fitness for work*
- *healthy lifestyle etc*

Vibration and Jarring

A major category of serious injury involves severe jarring of the operators of mobile equipment. Research should be directed towards improvements in vehicle and seat suspensions aimed at minimising vibration and jarring, and in particular the problem of the “bottoming out” of suspension systems. The role of restraining devices for operators should also be considered in addressing this issue.

ACTION:

- *Assess and review solutions to the problems of damaging energy exchange during the interaction between the drivers, their machines and the roadway in open cut and underground mines*

Underground Mine Specific Research Topics

Underground equipment in coal mines most commonly associated with serious injury are:

- loaders
- continuous miners
- man transporters
- conveyors
- roofbolters

In addition, the data also pointed to a significant incidence of injury amongst supervisors in underground mines.

Loaders

While there are not high numbers of injuries associated with loaders, the injuries that do occur tend to be more serious. Appropriate research topics include:

ACTION:

- *Assess damaging energy exchanges during interaction of drivers, the loader and the roadway and the general working environment during operation and identify ways to reduce the potential for serious injury.*
- *Review and develop solutions for reducing the potential for slip/trip injuries associated with access/egress to loaders.*

Continuous Miners

Continuous miners are associated with the second highest (to roofbolters) number of injuries of the equipment types analysed. Because of the increasing use of remote controls as a standard feature, research should be directed towards the operation of remote controlled continuous miners only.

ACTION:

- *Assess damaging energy exchanges during remote operation of continuous miners and identify means to reduce the potential for serious injury.*
- *Assess the risk of serious injuries from manual handling of continuous miner cables and ancillary equipment; undertake a stocktake of methods to reduce this risk and develop solutions to unresolved areas of risk.*

Man Transporters

Injuries arising from man transporters, while few in total numbers there are a high percentage of serious injury.

ACTION:

- *Assess damaging energy exchanges during interaction of drivers, passengers, the machine and the roadway during operation (include access/egress and load/unload) of the various types of man transporters in use in underground mines. Provide a risk ranking for such transporters and identify solutions which will reduce the potential for serious injury. Develop solutions to strategically selected, but specific items of equipment..*

Conveyors

There are a relatively high number of injuries associated with conveyor belts, with 20% extending to 30 days or more lost time.

ACTION:

- *Develop more reliable (requiring less maintenance) and more flexible (with less heavy work and or automation for extension/retraction) systems to carry coal from underground mines.*
- *Assess the potentially damaging energy exchanges during extension/retraction of conveyor belts. Undertake a stocktake of methods/equipment being used to reduce risks and develop solutions to unresolved areas of risk*

Roofbolters (hand held and machine mounted)

Injuries associated with hand held roof bolters are the most common of all the underground equipment categories, although the likelihood of serious injury is significantly less than most other equipment analysed.

The increasing introduction of machine mounted and automatic roofbolters will continue to reduce the numbers of injuries common with hand held bolters. The potential for serious injury with machine mounted bolters combined with a much reduced frequency of injury points to the need for proactive risk assessment prior to implementation.

ACTION:

- *Develop auto-bolters to reduce the manual handling of bolts and drill steels for machine mounted bolters.*

Supervisors

The data shows that the incidence of injury to underground supervisors is high (1 in 6), but that the proportion of serious injuries is relatively low (19%). Most common injuries are slip/trip and manual handling in support of operational activities.

The significance of this high incidence rate in the supervisory category should not be underestimated. The leadership role of supervisors in injury prevention and their contribution to a safety culture is a key issue for the industry.

ACTION:

- *Assess the risk factors and attitudinal issues contributing to injuries to supervisors and develop enterprise strategies and tools to address the problems identified.*

Back Injuries

Back injuries are the most prevalent injury in underground mining and are also associated with long term injury. A multi-factorial back study is similar to that currently being undertaken at a NSW open cut mine to identify causes and progressively implement changes to eliminate those causes would contribute to the development of appropriate prevention strategies.

ACTION:

- *Undertake a multi-factorial back study in an underground coal mine.*

Open Cut Mine-Specific Research Topics

Open cut equipment most commonly associated with serious injury include:

- dozer - tracked
- loaders
- light vehicles
- dragline - bucket
- scrapers

Other areas of concern include noise/whole body vibration and manual tasks.

Dozer - Tracked

There is a high incidence of injury associated with the operation of dozers. Injuries associated with access/egress and jarring are commonly associated with serious injury.

ACTION:

- *Automate the operation of dozers*

- *Assess the damaging energy exchanges between operator, vehicle and roadway and identify means of reducing the potential for serious injury.*
- *Develop, for large earthmoving equipment, means to sense and display the location of nearby vehicles to eliminate the risk of collision.*

Loaders

This category of open cut equipment had the highest percentage of severe injury outcomes. Access/egress and operational related activities particularly those related to severe jarring of the operator must be the focus for further research.

ACTION:

- *As a long term goal automate the operation of loaders.*
- *Improve access/egress systems for operation and maintenance activities*
- *Improve vehicle and seat suspensions aimed at minimising vibration and jarring, and in particular the problem of the "bottoming out" of suspension systems. Appropriate restraining devices for operators may also be worthy of further investigation.*

Light Vehicles

Injuries associated with light vehicles were the most common for equipment analysed for this study, while the likelihood of serious injury was reasonably low.

ACTION:

- *Review available manual handling aids capable of being mounted on light vehicles. Design addition aids as necessary.*
- *Evaluate vehicular traffic flow systems and road design to minimise the risk of collision/overturn*

Dragline Bucket

All of the data reviewed concerned maintenance activities. There was a high likelihood of the injuries being serious (ie over 30 days duration). By far the majority of serious injuries were sustained through manual handling tasks while carrying out maintenance on dragline buckets.

ACTION:

- *Undertake a stocktake of mechanical aids used in conjunction with dragline bucket maintenance and develop additional mechanical aids to replace the high risk manual operations, eg., custom designed lifting devices, hydraulic/pneumatic presses to remove pins.*

The use of mechanical aids will also reduce the risk of injury which result from metal splintering when objects such as link pins are struck by hammers.

Scraper

The majority of scraper related injuries were sustained through operation of the scraper

ACTION:

- *Automate the operation of scrapers*
- *Review access systems for scrapers; where necessary design systems for retrofit to existing equipment.*