Department of Mineral Resources
New South Wales

Mechanical Engineering
Safety Seminar

Friday 22nd March, 1996
Penrith Panthers Leagues Club
Mulgoa Road, Penrith

Coal Mining Inspectorate and Engineering Branch

THEME

"DEVELOPING QUALITY ENGINEERING MANAGEMENT SKILLS"

- **KNOWLEDGE**
- **COMPETENCE**
- **LEADERSHIP**

Index

SIXTH MECHANICAL ENGINEERING SAFETY SEMINAR

PROGRAMME

REGISTRATION

8.30 AM - 9.00 AM		Castlereagh Cinema Penrith Panthers Leagues Club

OFFICIAL OPENING

9.00 AM -9.15 AM		Paul Hartcher Operations Manager Wambo Mining Corporation Pty Ltd

SESSION 1

Chairman		Roger Hoerndlein Inspector of Mechanical Engineering Department of Mineral Resources
9.15 AM - 9.40 AM		**"REGULATING FOR RISKS ASSOCIATED WITH THE USE OF ELECTRICITY IN NSW COAL MINES"**
	Speaker:	John Waudby Inspector of Electrical Engineering Department of Mineral Resources
9.40 AM - 10.05 AM		**"INDUCTION TRAINING FOR CONTRACTORS"**
	Speaker:	Grant Douglas Manager Southern Mines Rescue Station
10.05 AM - 10.30 AM		**"MANAGEMENT OF TRAINING & COMPETENCY REQUIREMENTS FOR CONTRACT EMPLOYEES"**
	Speaker:	Norm Greedy Mine Mechanical Engineer Mt. Owen Mine & Cumnock South Mine
	Speaker:	David Whan Mine Mechanical Engineer Liddell Open Cut Mine
10.30 AM - 10.40 AM		**QUESTION TIME**
10.40 AM - 11.00 AM		**MORNING TEA**

SESSION 2

Chairman			Roger Hoerndlein Inspector of Mechanical Engineering Department of Mineral Resources
11.00 AM	-	11.20 AM	**"ROLE OF MECHANICAL CP & AAA'S"**
	Speaker:		Greg Venticinque Manager Engineering Safety Services Pty Ltd
11.20 AM	-	11.40 AM	**"HUMAN ERROR - RISK INFORMATION PROCESSING MODEL PRIOR TO ACCIDENT"**
	Speaker:		Corrie Pitzer Managing Director Institute of Organisational Systems(Aust)Ltd
11.40 AM	-	12.Noon	**"ENDEAVOUR MINE EXPLOSION - ASSESSMENT OF MECHANICAL EQUIPMENT"**
	Speaker:		Wally Koppe Inspector of Mechanical Engineering Department of Mineral Resources
12Noon		12.20PM	**"REVIEW OF FSV ACCIDENTS AT UNDERGROUND COAL MINES – 1988 TO 1995.**
	Speaker:		Leo Roberts Senior Inspector of Mechanical Engineering Department of Mineral Resources
12.20 PM	-	12.30 PM	**QUESTION TIME**
12.30 PM	-	1.30 PM	**LUNCH**

SESSION 3 — **KEYNOTE PRESENTATION**

Introduction:-

Leo Roberts
Senior Inspector of Mechanical Engineering
Department of Mineral Resources

1.30 PM to 3.00 PM — Topic:- **"YOU THE LEADER CAN MAKE THE DIFFERENCE"**

Speaker:-

Margot Cairnes
Leadership Strategist
The Change Dynamic Pty Ltd

leader
professional
ourselves as
where

In our keynote address leadership Strategist Margot Cairnes will have us laughing, thinking, and perhaps even crying about the realities of being a in today's hurly burly, complex world. Working with a troupe of actors she will provide us with practical advice on how to empower leaders at the same time as we increase our personal well-being and peace of mind. Margot's wisdom in these matters comes from years of hands on experience with companies such as Alcoa, BP, CSR, and Pacific Power she has worked with leaders from the coal face to the Boardroom.

SESSION 4 — **OPEN FORUM**

Chairman

Gordon Jervis
Inspector of Mechanical Engineering
Department of Mineral Resources

3.00 PM to 4.00 PM

A. **"BATTERY POWERED FREE STEERED VEHICLES - MECHANICAL MAINTENANCE REQUIREMENTS FOR HAZARDOUS ZONE OPERATION"**

Speaker:

David Spears
Engineering Manager
Gateway Engineering

B. **"EVALUATION OF 70'S DESIGN DIESEL ENGINE FLAMEPROOF SYSTEM TO THE 1991 VERSION OF THE AUSTRALIAN STANDARD"**

Speaker:

David Ng
Unit Co-ordinator Mechanical Section
Londonderry Occupational Safety Centre

C. **"PUNCH MINING - CONTROL OF RISKS ASSOCIATED WITH MAINTENANCE ACTIVITIES"**

Gordon Shannon
Commercial Manager
Peabody Resources- Mining Services Division

	D.	**"EARTHMOVING EQUIPMENT FIRES RESULTING FROM INADEQUATE MANUFACTURING/MAINTENANCE PRACTICES"**
Speaker:		Ray Smith Inspector of Mechanical Engineering Department of Mineral Resources
	E	**"ASSESSMENT OF MDG15 RE CONTRACT MACHINERY MAINTENANCE/REBUILDS"**
Speaker:		David Flynn Mining Sales Manager Marubeni Construction & Mining Pty Ltd
4.00 PM	- 4.10 PM	**QUESTION TIME**
4.10 PM	- 4.20 PM	**CLOSING REMARKS** **PRESENTATION OF INAUGURAL ANNUAL AWARDS FOR LEADERSHIP DEMONSTRATED BY AN UNDERGROUND AND OPEN CUT MINE MECHANICAL ENGINEER DURING 1995.**
4.20 PM		**POST SEMINAR DRINKS**

PAPER 1

ENGINEERING AND MANAGEMENT IN THE COAL INDUSTRY.

INTRODUCTION.

Our industry and various organisations have had, and often still have, a "holy grail" approach to management. Our corporate leaders search for the magic elixir of change that will produce the results they desire and hence the constant chasing of one fad after another without final commitment to any. We have had the catchwords describing the latest panacea that is always absolutely essential for achievement of our specific objectives; e.g. total quality, independent work teams, empowerment, horizontal structures, re-engineering. I am not being critical of these management strategies or systems, but I am being critical of the over reliance on such theories or practices as the means to successfully manage an operation or department.

The reality is that technological change in our industry has been transforming the workplace and we have been struggling to keep up, hence we restructure, reorganise, reinvent, downsize, out source or whatever action makes us feel as though we know what is needed. All the time we are really only looking for effective **management**.

ENGINEERS IN THE COAL INDUSTRY.

Good Engineering requires good management and the further an individual progresses up the corporate tree, the greater the emphasis on management rather than specific discipline skills. It must be recognised by the individual and the industry that the pressures on engineers are varied and are not solely related to any one issue such as the safety and welfare of men and equipment or the maintenance costs for last month.

Businesses all have to survive in the same gladiatorial marketplace and as a result budget constraints, targets and deadlines are always present in any engineer's thought processes. In our industry, an engineer's performance is invariably assessed on adherence to cost forecasts, achieved equipment availabilities and successful project completions, it is an often quoted truism that you are only as good as your last failure.

An engineer's resources are often the subject of limitations imposed on overtime, manning levels, overtime rosters, demarcation barriers, contractor bans or limitations or other work practices that have these days generally became the subject for negotiation within enterprise agreements. Thus an engineer can find that the very people who demand attention be given to equipment and who claim that management can't manage are the same people who collectively make it, at times, almost impossible to satisfy their requirements.

This often leads to the delightful situation where corporate executives are not interested in an engineering manager's explanations for failure to achieve budget adherence and state that it is clearly due to a failure on the engineer's part to manage, conveniently forgetting that it was their decision to cut the submitted budget in the first place. Union delegates are not interested in the engineer's explanations regarding budget limitations and the difficulties in keeping equipment in reliable condition and state that it is clearly due to a failure on the engineer's part to manage, conveniently forgetting that it was their work practices that restricted maintenance effectiveness in the first place.

People require attention and any good manager must be capable of obtaining respect without losing assertiveness, we have all worked with or for a manager who wanted to be liked by everyone. An engineer must be aware of the personal capabilities and limitations of the people to be managed, their problems and how they react within the group. The three "D's", Decide, Direct and Delegate obviously require skill, but intuition and communication abilities are necessary to a point where employees have confidence in the guidance and instructions received and are willing to constructively contribute to engineering management at the mine. A failure on the part of the engineer to manage human resource issues could result in high absenteeism, high overtime costs, machine downtime, low work outputs and standards, constant arguments and in the worst situations, industrial action.

What about the reportables. It's often described as a failure in the management system and the engineer should have ensured that there was an auditable trail based on checks and balances that obviously would have reduced or even eliminated the possibility of the incident occurring, this is despite the fact that the operator tied the shutdown back.

ENGINEERING MANAGEMENT RESPONSIBILITIES	**SKILLS REQUIRED**	**SUBJECTS TAUGHT**
Costing Forecasts	Accounting	Physics
Budget Adherence	Contract Management	Chemistry
Equipment Availabilities	Legal	Auto Control
Project Justification	Industrial	Circuits and Devices
Project Management	Psychology	Fluid Mechanics
Industrial Negotiations	Communication - Written and Oral	Calculus
Statutory Compliance	Negotiation	Algebra
Communication	Interviewing	Machine Dynamics
Maintenance Planning	Analytical	Properties of Materials
Team Management	Engineering	Mechanics of Solids
Engineering	Statutory Knowledge	Design Engineering
Contract Formulation and Compliance		Metallurgy
Human Resources		
Systems Design		
Employee Selection		

And there is some legislation that needs to be considered; e.g. the Coal Mines Regulation Act, the Occupational Health and Safety Act and their associated "shall ensures", there's the Clean Waters Act, the Dangerous Goods Act, the Local Government Act, the Environmental Planning and Assessment Act, the Clean Air Act, the Noise Control Act and all other legislation or regulations applicable to the conduct and operation of the mine. Failure to comply is a failure to manage since you knew of their existence and relevance.

How well prepared then is an engineer for the management responsibilities encountered in the workplace. Consider a graduate mechanical engineer, the above table has been created to compare generalised management responsibilities, requisite skills and education received. Such a table could be generated for an engineer in any position from any background and the same result would usually eventuate, that the person placed in the position of responsibility is ill prepared for the role.

Our industry often places people in management positions based upon their performance and skills as an engineer or tradesman creating a pool of "middle management", that is, they rise to their next level of incompetence.

MANAGEMENT IN THE COAL INDUSTRY.

Management needs and skills exist in all levels of the workforce and workplace and must be promoted and developed to achieve maximum efficiencies and benefits. It is beholding on any manager, at any level, to accept the responsibilities relevant to the position and it is beholding on any business that titles someone a manager to skill that individual for the role required of them.

We work in a regulated industry that has prescriptive accountabilities built around "shall ensure" terminology, couple this with the range of actual management skills in the workplace and middle management "black holes" are often created. These black holes are where all the good ideas, best efforts and well designed management systems disappear, sometimes without trace and sometimes they re-appear again to a chorus of, "we've tried that and it didn't work".

The message is this, whatever position you hold in our industry you've put your hand up and you must accept the responsibilities that accompany your role. Whether your an Engineer In-Charge, Shift Engineer, Longwall Engineer, Maintenance Planning Engineer or Chief Engineer; whether you work at a mine, or are a supplier or are employed by a regulatory Authority, in this environment it is not enough to hand to an engineer another set of rules, standards, policies, procedures or guidelines and say this is what must be achieved to satisfy the tenats of good management.

Successful management is not achieved or measured on the basis of the experience or the education of the management team. If an engineer attempts to manage according to one singular set of conditions or likewise, if a corporation promotes strongly one facet of management at the expense of other areas of responsibility then failure is inevitable.

Management is an holistic experience and requires involvement and interaction in all areas by all members of the "team". How many times have personnel been sent to a course to be upskilled in management techniques and return enthusiastic and ready for change only to find that senior executives won't change or adhere to the principals learnt at the course they required employees to attend. How often do frontline managers receive confusing and apparent conflicting messages from decision makers dependent upon the pressures of the day without explanation of the reasons.

Management is a process that when successful, exists in an environment of trust, not fear; that makes use of the resourcefulness, optimism, drive, adaptability and tolerance of the workforce; that anticipates rather than reacts and is built on quality, innovation, communication, service, and...**you**.

This is the sixth annual Mechanical Engineering Safety Seminar and to my knowledge, it is the only forum where a collective of Coal Industry Mechanical Engineers get together under the banner of the department. I commend the department for their pursuit of constant improvement through communication, I commend you all for your attendance and on behalf of the department I formally welcome you here today and open today's proceedings.

PAPER 2

Regulating for Risks Associated with the Use of Electricity in NSW Coal Mines.

J. F. Waudby
Department of Mineral Resources, NSW, Australia.

ABSTRACT. This paper describes the methodology used and the outcomes of the electrical regulations review, for both underground and open cut mines. Firstly a brief outline of the industry and current legislation is given. The contemporary issues influencing safety legislation are discussed and the main features of the review environment are outlined. The concepts of core risk and risk management are discussed, leading to a philosophy for reviewing the electrical regulations. The process and general outcomes of the review are described. The paper concludes by summarising the review, asserting the outcome is appropriate for the NSW coal industry at this time, and that it is a stepping stone to the future.

1. INTRODUCTION

The NSW coal industry is predominantly an export industry and is critical to the economic well being of the state. The free on board value of export coal is approximately \$3,000 x 10^6, with a capital expenditure this year of \$436 x 10^6, and net after tax profit of \$198 x 10^6 (MINFO).

There are 46 underground mines, 22 open cut mines, and a number of stand alone coal preparation plants. The mines produce 102 x 10^6 tonnes of raw coal per annum, and employ 14,000 people (NSWCIP, 1995). The major stakeholders in the NSW coal industry are the coal mine owners, the employees and associated trade unions, the manager's association, suppliers of services and the government (representing the people of NSW).

The lost time injury accident frequency rate for 1994 was 92 for underground mines and 38 for open cut mines (Joint Coal Board statistics). Since July 1984 there have been over 800 serious bodily injuries, approximately 20% occurring at open cut mines, 40 fatalities, approximately 17.5% occurring at open cut mines, and 35 ignitions of seam gas (SRADO, 1984-94). From these figures it can be concluded that the overall safety performance is not satisfactory. Since July 1984 there have been 26 reports of electrical staff in underground mines and 10 reports of electrical staff in open cut mines, receiving an electric shock and/or electrical burns. There have been no fatal electric shocks received by electrical staff (SRADO, 1984-94). This electrical safety record is one of the best in the world.

There is a requirement to review legislation on a regular basis for the purpose of determining relevance in today's society (SL,1989). In 1994 the Joint Safety Review Committee [JSRC] was given the task of urgently reviewing all regulations made pursuant to the Coal Mines Regulation Act 1982, No.67 [CMRA]. Within the scope of the review were the electrical regulations for both underground and open cut mines.

2. THE CURRENT LEGISLATION.

The hierarchy of the main coal mine safety legislation is:
- NSW Occupational Health and Safety Act 1983, No. 20 as amended [OH&SA].
- Coal Mines Regulation Act 1982, No. 67 as amended.
- Regulations made pursuant to the CMRA.

With the implementation of the OH&SAct, which is Robens style legislation (Quinlan, 1991), it was envisaged that earlier legislation would be gradually replaced by revised and updated provisions to improve the standard of protection it affords (Gunningham, 1984). This has not happened in the coal industry, leading to a messy system of safety legislation.

The CMRA and regulations are associated legislation and can be termed detailed specification legislation or prescriptive legislation (Klingner, 1994). This means that mine owners do not have a free choice in adopting reasonable care, they must adopt the detailed specifications in the coal mines regulation act. "It is only in relation to risks to health and safety not addressed by the detailed specifications and limited performance standards that they [mine owners] have a choice as to the measures they will adopt to eliminate those risks" (Brooks, 1992). The current regulations have evolved in response to major disasters, fatal accidents, serious injuries and some near misses and can be considered a database of hazard controls (Rose, 1991).

3 CONTEMPORARY ISSUES.

Many companies are responding to the expected increased demand for coal by striving for competitive advantage in all aspects of their business. Any legislation restricts the scope for implementing competitive strategies, hence there is a the call for self regulation or even de-regulation of business activities, including occupational health and safety. This in turn causes reactions from other interested parties such as the unions and government. The complex interactions between interested parties leads to arguments for and against the current style of legislation, which in turn, influences the review of electrical regulations.

A good example of striving for competitive advantage is the Queensland Government's push to introduce duty of care legislation. Basically duty of care means that an employer has a duty to take reasonable care for the health and safety of its employees, it confers discretion as to the ways and means by which a duty is performed (Enright, 1989), and is consistent with the Robens recommendations. A consequence of this action by the Queensland Government will be greater freedom for mine owners to implement occupational health and safety strategies that may give them a competitive advantage over their NSW counterparts. The NSW government is aware of this possible competitive advantage to Queensland and is actively promoting less regulation. This is evidenced by Lowder's statement of, "... moving from a strictly prescriptive and regulatory approach to the industry to one based on cooperation with greater emphasis on advisory and educative programs..."(DMRCP, 1995).

Another example of trying to achieve competitive advantage is the attempt by a number of companies to implement management structures that conflict with statutory requirements and duties.

Business's push for less prescriptive legislation is evidenced by Klingner's statement:

> "The fact is that the current system [of prescriptive legislation] actually impedes management from making changes. It does so by removing incentives on behalf of management and the workforce to improve safety in the work place. It encourages compliance rather than self reliance. It is another example of the pernicious effect of quarantining coal mining from the full force of the changes that have affected the rest of industry."

All of the above examples infer a strong link to the Robens Report, so at this point it is prudent to mention some of the outcomes of the Robens report. Quinlan et. al. states:

> The Robens report argued ... that paternalistic and punitive legislation had not only failed to minimise injuries but had also exerted a narcotic effect on employer activism... The report ... call[ed for] ... a shift in philosophy away from direct government specification of standards and towards greater self-regulation, whereby employers and workers would collaborate to develop standards or codes of practice to cover their industries and workplaces. The promotion of self regulation was based on four fundamental presumptions within the report.
>
> [1] the punitive approach had failed and could not work...
> [2] the single most important cause of industrial accidents was apathy...
> [3] the primary responsibility for prevention should reside with those directly affected, namely employers and workers...
> [4] it was assumed that there was a far greater interest amongst employers and workers in the area of OH&S than was the case elsewhere, especially... industrial relations...

It becomes evident that the Robens Report has had a significant influence on both government and business with regard to the management of occupational health and safety.

If the Robens recommendations are to be implemented successfully, there needs to be a shift in the culture of workers, including management, from one of apathy, to one accepting responsibility (Rose, 1991). However Waring states:

> Any fundamental shift in an organisation's safety culture decided by senior management is likely to take years to complete. In the UK offshore oil and gas industry, a 5-10 year timeframe is reckoned by many as realistic for the 'safety culture' shift envisaged by Lord Cullen.

It should be realised that the coal industry "culture" is hundreds of years old, whereas the offshore gas and oil industry relatively new. It could be argued that the timeframe for a culture shift in the coal industry will be significantly longer than 5-10 years. If this timeframe is correct, it could be argued that appropriate legislation, similar to the current form, is necessary, to provide for the health and safety of workers, until the culture shift is achieved.

It should be realised that Robens is not without his critics, Quinlan et. al. points out:

- That it may be wrong to portray that the punitive approach has failed when no serious effort has been made to implement it. This is supported by Hopkins et. al who concludes that there has been no serious effort by government to enforce coal mine safety regulations.
- The premise that apathy is the most important cause of accidents at work is "...a false premise upon which to build a set of legislative solutions."
- There is much controversy as to the extent self regulation can substitute for state intervention.
- A mutuality of interest between workers and business, in any area, flies in the face of over 150 years of history in Australia.

This is supported by the fact that some of the stakeholders have been unable to objectively support their position. This is evidenced by Klingner's inability to give any examples that the current legislation was inhibiting implementation of effective occupational health and safety management, when questioned at the 16th Annual Colliery Safety Symposium. In an attempt to support the position of de-regulation, the catch cry has been 'duty of care.' Duty of care has been a fact of legal life for over 50 years. It can be argued that duty of care legislation has already failed as employers have had over 50 years to exercise duty of care, and have failed to do so, as evidenced by the health and safety performance of the coal industry.

There are arguments for having strong regulation. Perry concludes,

> ...that strong safety laws reduce coal mine fatalities and that, if laws are strong, coal mine fatalities decrease with increases in [government] spending on mine health and safety.

This is supported by Gunningham who states,

> Law enforcement based on mandatory standards, although far from being the whole answer, can be regarded as the foundation of an effective health and safety program.

Hopkins also states:

> ...the most serious mining hazards such as roof falls, gas outbursts and explosions, all of which generate relatively few lost time injury claims but which can result in loss of life, sometimes more than one life, when they occur. It is these occurrences which make mining a hazardous occupation and it is here that effective government regulation is critical.

This infers that there should be effective regulation and it should focus on the high consequence hazards of coal mining.

When the contemporary issues are considered collectively, it can be inferred that some balance between duty of care and prescriptive legislation is attainable.

4. THE REVIEW ENVIRONMENT

By summarising the preceding discussions and including other factors, the main features of the environment in which the review was conducted can be identified as:

- The safety legislation in NSW can be termed as messy. However the current regulations contain useful information on controlling known hazards (Rose, 1991).
- There are a number of interested parties, often with opposing views and objectives, participating in the regulation review.
- The arguments for self regulation are based on the Robens report.
- There are claims that the Robens report is flawed.
- There are strong arguments for government regulation with some element of prescription.
- At best, it can be assumed that there is an appropriate balance of prescriptive legislation and self regulation. This infers that an appropriate approach to any regulation review is to look for a balance between prescriptive legislation and 'duty of care' (Rose, 1991).
- The regulation review is not part of a structured and holistic approach, and the contentious nature of the issue may limit the success of the review.
- There is a desire by mine owners to move away from statutory management structures.
- Risk management is becoming more widely accepted as a method of managing occupational health and safety issues.
- Throughout the eighties and nineties, the major stakeholders, represented by electrical engineers, have participated in the formulation of many standards, codes and guidelines, dealing with electrical equipment for use in coal mines, and industry in general.
- The electrical safety record of the industry is very good.

5. NSW COAL INDUSTRY HAZARDS

Contemporary occupational health and safety management use risk management as a tool to minimise the risk of disease or injury. Steps in risk management include identifying the hazards and quantifying the risks associated with those hazards. The hazards may vary from industry to industry and the risks associated with those hazards will have a broad spectrum from industry to industry (Tweedale, 1995). The hazards encountered in the coal industry are not unique in themselves, however the combinations of hazards are unique. Walton et. al. identified the need to recognise the interaction of different hazards and to categorise them into key risk areas, so as to effectively manage the risks. An example of the interaction of key risk areas is given in Figure 1 (Morton, 1995).

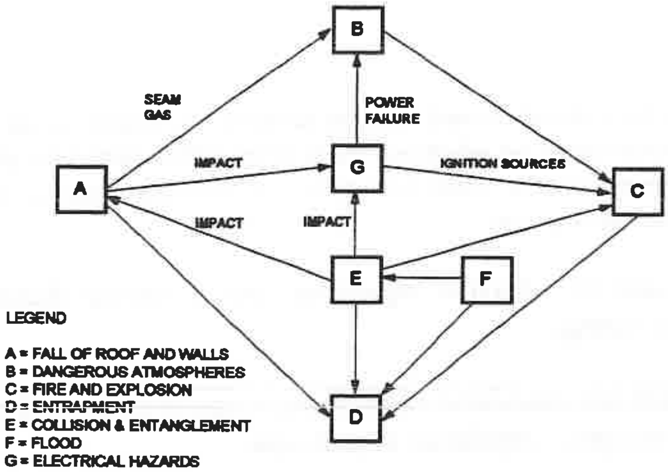

Figure 1. Interrelationship of key risk areas

The relationship demonstrates how one particular key risk area can impact on other key risk areas. For example; if there is a fall of roof that releases methane gas and damages electrical equipment; then there may be an explosive atmosphere and an ignition source. Hence the risk of an explosion increases significantly.

If one considers the concept of 'core risks' as; the unique combination of hazards encountered in coal mining with high consequence outcomes, then it can be argued that core risks and non core risks can be used as a suitable basis for safety legislation. Core risks requiring prescribed controls and non core risks being controlled by the employers 'duty of care.'

To effectively implement hazard controls there is a need for suitable equipment, effective procedures and competent personnel (Vincoli, 1993). However procedures are only effective when supported by good management. Reczek states:

> In NSW in the 1990's health and safety issues have become management rather than technical issues. Health and safety issues arise directly as a result of failures to adequately manage existing controls and barriers for known hazards.

Therefore when regulating for high consequence hazards there is a need for:

- Fit for purpose equipment,
- Competent people,
- Effective management of the whole process.

6. ELECTRICAL REGULATION REVIEW PHILOSOPHY.

After considering all the elements of the preceding discussions a philosophy of reviewing the electrical regulations was formulated. The cornerstone of the review philosophy was the premise of a balance between prescriptive legislation and 'duty of care.'
In conducting the review:

- The current regulations were used as a basis for the review.
- Any new regulations had to cater for the unique combination of hazards and the high consequences of many hazards inherent in coal mining [the core risks].
- Many of the hazard controls identified as clauses in the current regulations were now covered by Australian Standards and used in industry in general, and could be classified as "duty of care." For example the use of explosion protected equipment in surface applications such as at open cut mines were covered by Australian Standards.
- Any new regulations had to provide for fit for purpose equipment, competent people and management.
- It was realised that the prescribed management structure has contributed significantly to the excellent safety record with regards use of electrical equipment in NSW coal mines, and could not be discarded.
- It was realised that management was a contentious issue and provision for an alternative to the prescribed management structure was needed politically.
- Any new management structure would have to be linked to the National Training Board Policy and Guidelines on workplace competency.
- Word the regulations in a manner appropriate for 1995.

7. ELECTRICAL REGULATION REVIEW PROCESS

A review team was assembled, consisting of an industry representative (statutory mine electrical engineer) and a government representative (Inspector of Electrical Engineering). Coordination of the review was by a member of the JSRC.
The review team determined the objectives as:

> **To review the existing electrical regulation for coal mines to minimise prescription for non core mining hazards which are already catered for in general industry provisions for standard practice. To ensure that core hazards for coal mines continue to be addressed and to ensure complete occupational health and safety management systems remain in place for:**
>
> **1. Competency of persons to supervise or carry out electrical work.**
> **2. To ensure equipment provided to guard against core hazards is fit for purpose.**
> **3. To require management systems to be implemented to ensure continuity of 1 and 2.**

The steps in the review process are shown in Figure 2.

From the process it became apparent that each of the regulation categories of, apparatus, people and management, could be further categorised, in that the clauses specified particular hazard controls. These hazard control methods are:

APPARATUS HAZARD CONTROL METHODS.

- Means of turning on and off the electrical power and the operation of electrical equipment.
- Minimise the risk of malfunction.
- Adequate design and rating.
- Earthing / neutral connection.
- Specific applications / equipment.
- Maintenance.

PEOPLE HAZARD CONTROL METHODS.

- Use of equipment.
- Examination of equipment.
- Carrying out electrical work.
- Removal / restoration of electrical power.

MANAGEMENT HAZARD CONTROL METHODS.

- Provision of equipment resources.
- Provision of people resources.
- Procedures / rules.
- Responsibilities.

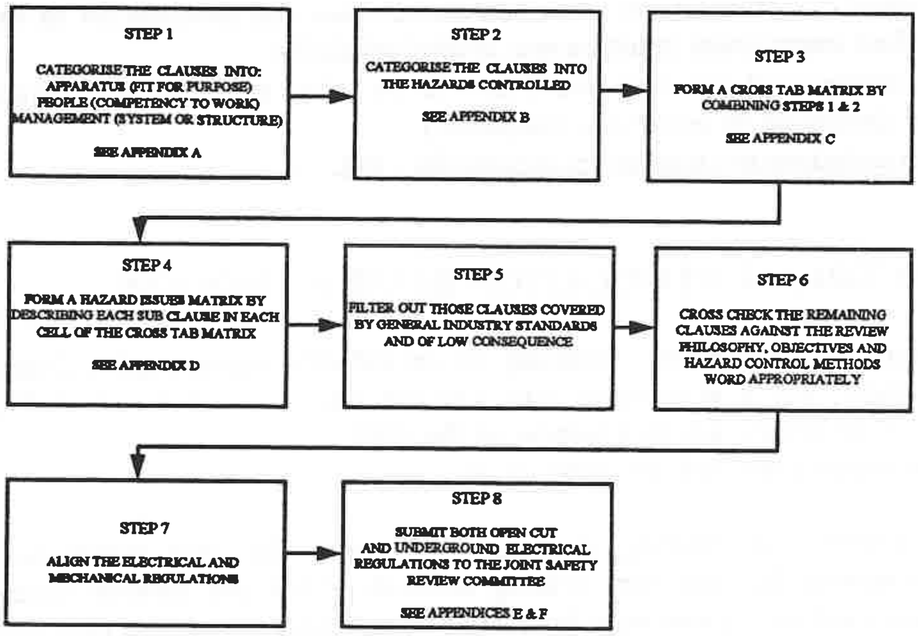

Figure 2. Review process

When the regulations were submitted to the JSRC. The JSRC reviewed the regulations and made alterations. The author does not know what criteria were applied by the JSRC when any alterations were made. The JSRC then submitted the regulations to the parliamentary draftsperson, who then worded the regulations to satisfy parliamentary requirements.

8. SUMMARY

The review of the open cut and underground electrical regulations was forced on the industry as part of an overall review of the coal mines regulations. The review process for the electrical regulations was greatly influenced by:

- The environment in which the overall review took place.
- Contemporary occupational health and safety management techniques.
- The need to recognise the National Training Board Policy and Guidelines on workplace competency.
- The need to integrate competency and management systems.

The outcomes of the electrical review process, up to the point of the JSRC receiving the final submission from the electrical review team identified hazards that needed to be regulated, and provided for:

- Fit for purpose equipment.
- Competency of electrical staff consistent with the National Training Board Guidelines.
- Traditional management structure.
- Alternate management structure.
- The achieving of the documented objectives of the review team.

The author is not privy to any alterations the JSRC may have made, or to the submission to the parliamentary draftsperson, and can not make any comment as to whether the final regulations will achieve the stated objectives.

The success of the regulation review may be limited due to it not being done in the context of a complete review of coal mine safety legislation and linking it in a consistent manner to the Occupational Health and Safety Act.

However the author believes that the outcome of the electrical regulation review, as submitted to the JSRC is appropriate for the NSW coal industry. The outcome should be considered as a stepping stone to either, further self-regulation, or a return to prescriptive legislation, depending on the industry's safety performance over the next few years. However if the next step is less regulation, all stakeholders in the industry will have to participate in formulating more codes, standards and guidelines for the safe use of electricity in open cut and underground coal mines. These codes, standards and guidelines can be the solid base on which industry can become more self regulating.

The views expressed are my own and not necessarily those of the NSW Department of Mineral Resources.

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APPENDIX A

REGULATION CATEGORY	NO. OF CLAUSES/SUB-CLAUSES
Apparatus (Fitness for purpose)	96
People (Competency to work)	32
Management (System or structure)	42
Miscellaneous	7
TOTAL	177

Figure A1. Number of sub-clauses/clauses in each category.

APPARATUS (FIT FOR PURPOSE)	PEOPLE (COMPETENCY TO WORK)	MANAGEMENT (SYSTEMS OR STRUCTURE)	MISCELLANEOUS
14 (2), 23(1), 24, 25, 26, 27a, 27b, 27c, 27d, 27e, 27f, 28, 29, 30(1), 30(2), 30(3), 30(4), 31, 32, 34, 35, 37(2), 37(3), 38(1), 38(2), 38(3), 38(5), 38(6a), 38(6b), 38(6c), 39, 40, 41(2), 41(4), 41(5), 41(6), 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 55(3)	6(2), 9(1), 9(2), 10(1), 10(3), 12, 14(1), 15(1), 15(2), 16(1), 17(1), 18, 19, 20(1), 23(2), 23(3), 41(1), 41(3), 54	6 (1) (structure) 11 (structure) 16(2) (structure / procedure) 17(2) (procedure / report damage) 20(2) (provision of resources) 20(3) (procedure) 20(4) (procedure) 20(5) (procedure) 20(6) (procedure) 20(7) (procedure) 21(1) (procedure) 22(2) (procedure) 33 (procedure testing E/L) 36 (procedure clearances) 37(1), 38(4), 38(6d) 52 (procedure notices) 55(1), 55(2)	7, 8, 10(2), 13, 22, 56

Figure A2. Regulation categorisation.

APPENDIX B

REGULATION HAZARD CATEGORY	NO. OF CLAUSES/SUB-CLAUSES
Electrical	163
Gas	62
Dust	40
Mechanical	12
Thermal	23
Liquid	4
Radiation	2
Corrosion	0
Acoustic	0
TOTAL	306

There are 306 sub-clauses/clauses in total, as some sub-clauses/clauses control multiple hazard categories.

Figure B1 Number of sub-clauses/clauses controlling each generic hazard.

HAZARD	REGULATION CLAUSE NO.
Dust	14(2), 17(1,2), 23(2,3), 25, 26(1)b,c,d, 26(2), 27, 28, 35(1), 37(1) 38(2), 43(1a), 47, 50, 51, 54, 55(3),
Gas	14(2), 17(1,2), 18, 20, 23(2,3), 24(3), 25, 26(1)b,c, 26(2), 27, 29, 35(1), 37(1), 38(2,3b,4,6c), 41(4), 43(1a), 45, 46, 47, 50, 51, 52(7) , 54, 55(3)
Liquid	26(2), 34(2), 37(1)
Corrosion	
Radiation	26(2), 39
Electricity General	6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17(?), 19, 20(5,6,7), 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37(2,3), 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55
Mechanical	23, 25, 26(1)a, 26(2), 27(c), 35(2), 41(1), 52(2)
Acoustic	
Thermal	40, 25, 26(1) a, 26(2), 34(2), 35(1), 37(1,3), 38(3a,6), 41(2), 44(1), 52(1b), 53

Figure B2 Regulation hazard categorisation.

APPENDIX C

	REGULATION CATEGORY No. OF CLAUSES/SUB-CLAUSES		
HAZARD CATEGORY	**APPARATUS**	**PEOPLE**	**MANAGEMENT**
Electrical, battery	8	0	8
Electrical, diesel	17	0	0
Electrical, mains	52	7	9
Electrical, general (all of the above)	46	21	20
Seam gas	38	9	5
Other gas	5	2	5
Dust	32	2	1
Mechanical	10	3	1
Thermal	26	0	3
Liquid	3	0	1
Radiation	2	0	0
TOTAL (336)	239	44	53

There are a total number of sub-clauses/clauses of 336. The reason being that some sub-clauses/clauses control multiple electrical hazard categories.

Figure C1. Number of sub-clauses/clauses in the cross tab matrix.

HAZARD	APPARATUS (FIT FOR PURPOSE)	PEOPLE (COMPETENCY TO WORK)	MANAGEMENT (SYSTEM OR STRUCTURE)
Battery	38(1,2,3,5,6a,6c), 45		38(4,6d), 55(1)
Diesel	40, 43, 49, 50		
Mains power	23, 24, 25a, 29, 34, 40, 41(2,4,5,6), 43, 44, 46, 47, 49, 50, 51, 53	17, 23(2,3), 41(1,3), 20(1)	20(5,6,7), 21, 36 17(2)
All above	14(2), 16(2), 25(b), 26, 27, 30, 31, 32, 35, 37(2,3), 42, 44, 48, 50	6(2), 9, 10(1,3), 12, 14(1) 15, 16(1), 19, 54	6(1), 11, 16(2) 33, 52
Seam Gas	24(3), 25, 26(1)b,c, 26(2), 27, 29, 35, 38(2) 41(4), 43(1a), 45, 46, 47, 50, 51	18, 20(1,2), 54	20(3,4,5,6,7)
Other gas	26(2), 38(2), 38(3b), 38(6c), 45	54	37, 38(4), 52(7)
Dust	25, 26(1)b,c,d, 26(2), 27, 28, 35, 38(2), 43(1a), 47, 50, 51	54	37(1)
Mechanical	23, 25, 26(1)a, 26(2), 27(c), 35(2)	23(2,3), 41(1)	52(2)
Thermal	26(2), 38(3a, 6,a,b,c), 40, 41(2), 44, 53, 25, 26a, 34(2), 35(1), 37(3)		52(1b), 37(1), 38(6d)
Liquid	26(2), 34(2)		37(1)
Radiation	26(2), 39		

Figure C2. Cross tab matrix

APPENDIX D

HAZARD ISSUES IN CLAUSES	APPARATUS (FIT FOR PURPOSE)	PEOPLE (COMPETENCY TO WORK)	MANAGEMENT (SYSTEM OR STRUCTURE)
Seam gas	Power restoration, provision of isolation for production machines, provision for isolation to all motors, Electrical protection, Explosion protection, I.S. only when CH4 dangerous, equipment to specified standard, earthing/bonding, rating of circuit opening devices, battery design, cable design, earth fault limitation, battery earth leakage, earth continuity to mobile/portable equipment in hazardous zone, restoration of power onto faulty equipment, limitation of voltage to certain equipment, separation of lightning earthing from mine earths, earthing of metal into the mine	Removal of power when gas detected, reporting of detection of gas, no power restored until it is safe, inspections to be carried out before power restored, qualifications of person doing inspection, repair of explosion protected equipment	Report of inspection before restoring power, requirements to be included in the report, rules for removal and restoration of power (prescribed matter), display of rules.

Figure D1 Hazard issues for the hazard of seam gas.

APPENDIX E

COAL MINES REGULATION (ELECTRICAL UNDERGROUND MINES) REGULATION 1984
under the
COAL MINES REGULATION ACT 1982

AS SUBMITTED TO THE JOINT SAFETY REVIEW COMMITTEE.

Definitions

5. (1) In this Regulation, except so far as the context or subject-matter otherwise indicates or requires:
"active conductor" - any one of those conductors of a supply system which is maintained at a difference of potential from the neutral or earthed conductor.

"active conductor" - any one of those conductors of a supply system which is maintained at a difference of potential from the neutral or earthed conductor.
``approved'' in relation to any equipment, apparatus, material or thing, means approved:
(a) by the Chief Inspector; or
(b) by an accredited assessing authority,
~~under the Coal Mines Regulation (Approval of Items) Regulation 1984;~~
``circuit'' means an electrical network providing one or more closed paths;
"competency" means to have the technical knowledge, practical experience and physical capability to carry out work on or with electrical apparatus without personal risk or risk to others that may arise of the carrying out of such work.
``competent person'', in relation to a mine, means a person appointed in writing by the manager of the mine to undertake the duties referred to in the provision in which the term is used, being a person having the necessary knowledge and experience to avoid any danger associated with the performance of those duties;
``electrical apparatus'' means any electrical appliance, machine or fitting in which conductors are used, but does not include a cable;
"electrical equipment means electrical apparatus, appliance, machine, fitting, or cable in which conductors are used to transmit and utilise electricity.
``electrical protection'' means a relay or apparatus whose function is to detect defects or conditions of an abnormal or dangerous nature in any electrical circuit, apparatus or power system and to initiate appropriate control circuit action;
``electrical staff'' means persons appointed under Part 2;
``energised'', in relation to an electrical conductor, means connected to a source of potential difference or charged so as to have a potential significantly different from that of earth;
``explosion-protected'', in relation to any circuit or electrical apparatus, means safeguarded, by approved means, so as to prevent the ignition of flammable vapours or gases in air external to the circuit or apparatus;
``fixed cable'' means a cable consisting of a single conductor or a combination of conductors insulated from one another and which is not designed to afford relative motion between its terminal points while it is energised;
``flexible cable'' means a cable consisting of a stranded conductor or a combination of conductors insulated from one another and which is designed to afford relative motion between its terminal points while it is energised;
``hazardous zone'', in relation to a mine, means:
(a)a part of the mine on the return side of such points in the intake airways of each ventilation district as are 100 metres outbye to the most inbye completed line of cutthroughs or 100 metres from, and on the intake side of, a longwall or shortwall face; or
(b)a part of the mine specified as an area in which there may be a dangerous concentration of methane or other flammable gases or vapours;

``intrinsically safe'', in relation to any circuit or electrical apparatus, means explosion-protected by such means that any spark or thermal effect produced in the circuit or apparatus is incapable of causing ignition of an explosive mixture of methane or other flammable gases or vapours and air;

`main intake airway'' means that part of a mine which, by virtue of its location in the ventilating air circuit, is independently connected to air from the surface of the mine and is on the intake air side of any hazardous zone;

``mains'' means conductors or cables connecting mains switch-gear with an electrical power distribution or load centre;

``mains switch-gear'' means power circuit switching or interrupting devices in combination with associated control, instrumentation, metering, protective and regulating devices, or assemblies of any such devices, and associated inter-connections, accessories and supporting structures, used primarily in the transmission, distribution and conversion of electric power;

"management plan means a document which specifies the outcome of work and how the work is to be carried out to ensure the installation use and maintenance of electrical equipment is without risk to health and safety.

"management system means a documented self monitoring process set in place to achieve an outcome or series of outcomes and defined in a management plan and which is capable of being independently audited to existing Standards to determine that expected outcomes of work are being achieved.

``methane concentration'', in relation to a mine or any part of a mine, means the proportion (by volume) of methane in the general body of air in the mine or that part of the mine, as the case may be;

``mine earthing system'' means all of the earth electrodes and conductors installed in accordance with this Regulation;

``mobile apparatus'' means machinery not being portable apparatus but capable of being readily moved about while it is carrying out its function;

``overload'', in relation to any electrical apparatus, means the current, voltage, power or torque of the apparatus in excess of the rating;

``portable apparatus'' means apparatus capable of being borne or carried manually while it is carrying out its function;

``rating'', in relation to any electrical apparatus, means the designated limit or limits for the characteristics of voltage, current, temperature, power or torque within which the apparatus is designed to operate;

``specified'' means specified by the Chief Inspector and published in the Gazette;

``the Act'' means the Coal Mines Regulation Act 1982;

(2) For the purposes of this Regulation, the methane concentration in a mine or a part of a mine shall be deemed to be dangerous if it is at or above 1.25 per cent.

(3) In this Regulation, a reference to an Australian Standard is a reference to a standard published by the Standards Association of Australia, as revised and republished from time to time.

PART 2 APPOINTMENT AND DUTIES OF ELECTRICAL STAFF

Appointment of electrical staff

6. (1) The manager of a mine shall appoint in writing:

(a) a person to be the mine electrical engineer; and

(b) as many persons to be supervising electricians and electricians as may be necessary to supervise and effect the proper installation, examination, testing and maintenance of all electrical equipment at the mine.

(2) At any time when a mine electrical engineer is not on duty and electricity is supplied to the underground workings, the manager of the mine shall ensure that a supervising electrician or an electrician with at least 2 years' underground experience is in charge of the persons required to effect the proper installation, examination, testing or maintenance of electrical equipment at the mine.

(3) As an alternative to the foregoing structure of engineering management:

The owner must have established a management system to ensure that electrical equipment is acquired, installed, used and maintained to minimise the risks to health and safety in accordance with a specified Standard of risk management.

(4) A management system established under this provision:

(i) must contain an approved management plan for the acquisition, installation, use and maintenance of all electrical equipment used at the mine, and

(ii) must be staffed by persons who are competent within the range of competencies defined in national competency standards frame works, to fulfil their roles in the system.

Qualifications of mine electrical engineer

7. (1) In the case of any mine at which the total equivalent electrical power at the mine exceeds 1000 kilowatts, or where the Chief Inspector by notice to the manager of the mine so requires, a person shall not be appointed as the mine electrical engineer unless the person is the holder of a certificate of competency as mine electrical engineer.

(2) In the case of a mine at which the total equivalent electrical power does not exceed 1000 kilowatts, the mine electrical engineer shall be qualified under clause 9 (1) or 9(2) to be appointed as an electrician and shall have had not less than 2 years' experience as an electrician at an underground mine. Being experience in effecting the installation, examination, testing and maintenance of electrical equipment.

(3) Nothing in this clause shall prohibit the continued employment of any person who, on the commencement of this Regulation, was employed as a mine electrical engineer.

General supervision by mine electrical engineer

8. The mine electrical engineer shall control the duties of all persons at the mine who have a duty to supervise or effect:

(a) the installation of electrical equipment;

(b) the examination and testing of electrical equipment before it is put into use, after installation, re-installation or repair;

(c) the maintenance of electrical equipment, in safe working condition when in use and in accordance with all requirements imposed by or under the Act; and

(d) the systematic examination and testing of all electrical equipment in accordance with the scheme in force at the mine under section 103 of the act.

Qualifications of electricians

9. (1) Any person appointed by the manager of a mine as an electrician shall be the holder of one of the following qualifications:

(i) an electrician's license valid in the Commonwealth of Australia

(ii) an electrical trades certificate valid in the Commonwealth of Australia.

(2) A person shall not be appointed to be a supervising electrician unless the person is qualified under subclause (1) to be an electrician and has had not less than 2 years' experience as an electrician at an underground mine.

(3) Nothing in this clause shall prohibit the continued employment of any person who, on the commencement of this Regulation, was employed as a supervising electrician or electrician.

Electrical staff to carry out electrical work

10 Persons working on or with electrical equipment must be competent to do so.

Defective equipment

11 The mine manager must implement a defect management system to identify any defects on electrical equipment used at the mine, that may affect its safety. The management system must provide for:

(a) the prevention of the use of the defective equipment until any defect has been repaired;

(b) the recording of the details of any defect; and

(c) the recording of any actions taken to remedy the defect.

Records made pursuant to sub-clauses (a) and (b) must be maintained for the life of the equipment.

Use of portable apparatus

12 The manager of a mine must make rules with respect to the use of portable apparatus. The rules must ensure the exclusion of non-explosion protected portable apparatus from any hazardous zone as defined in this regulation or Australian Standard.

Unsafe work

13. (1) No person shall in a hazardous zone within a mine do any work on any electrical equipment while it is energised if the doing of that work will cause the equipment not to be explosion-protected.

(2) For the purposes of this clause, an electrical equipment shall be deemed not to be explosion-protected if it does not comply with any standards or conditions under which it was approved as being explosion- protected.

Work on uninsulated live conductors

14. (1) No person at a mine shall do any work upon or in the proximity of an uninsulated electrical conductor which is part of a circuit in which the operating voltage exceeds extra low voltage unless the mine electrical engineer, a supervising electrician or an electrician has ensured that the conductor is not energised and has taken any necessary steps to ensure that it will remain in that condition while the work is being carried out.

Procedure where gas detected

15. (1) Where in any place at a mine any person finds or reasonably suspects a dangerous methane concentration, that person shall forthwith:

(a) cause the supply of electricity to be cut off from all mains-fed electrical apparatus in that place other than such apparatus as has been approved as intrinsically safe; and

(b) cause any battery-powered electrical apparatus, in that place and all places on the return side of that place, which has not been approved as intrinsically safe (other than an approved safety lamp or other approved item of personal apparel) to be removed to a main intake airway.

(2) Where the normal duties of a person to whom subclause (1) applies do not include the taking of measures required to be taken under that subclause, the person shall be deemed sufficiently to comply with that subclause if the person forthwith reports the matter to an official of the mine or a person whose normal duties include the taking of those measures.

(3) Where action has been taken to cut off the supply of electricity to any place or to remove any battery-powered apparatus therefrom in pursuance of subclause (1):

(a) the supply of electricity shall not be restored

(b) no battery powered equipment shall be brought into the place.

until the official in charge of that part of the mine, being satisfied that the methane concentration in that place is not dangerous, so directs.

Restoring power to a mine

16. (1) no power is to be introduced into the mine or into any section of the mine after a lapse of 4 hours unless it has been inspected for the presence of methane in the 4 hours immediately preceding the introduction of the power and the methane concentration has been found not to be dangerous.

(2) The manager of a mine shall make rules with respect to the removal and restoration of power from and to the mine or parts thereof.

(3) For the purposes of section 104 of the Act, the subject-matter referred to in subclause (5) in respect of which a manager of a mine is required to make rules is a prescribed subject-matter.

ADD PART 3 STANDARDS OF ELECTRICAL EQUIPMENT

Electrical Reticulation and explosion protection

Provision for cutting off power

17. (1) The manager of a mine *must* provide, at the surface of a mine at which there is installed below ground electrical apparatus which is supplied from the mains, suitable switch-gear for cutting off the supply of electricity therefrom.

(2) in relation to every flexible cable at the mine effective means of switching off the supply of electricity from the cable at the apparatus by which it is connected to a fixed cable.

Separate power supply in sections of mine

18. (1) For the purposes of this clause, the manager of a mine shall, subject to subclause (2), divide the power supply system in the underground parts of the mine into sections.

(2) * * *

(3) The manager of a mine shall equip each section of the mine with some means of preventing the power supply system within that section from being automatically energised when the power is turned on from the surface of the mine.

Explosion protection

19. (1) The mine electrical engineer shall ensure that:

(a) only electrical apparatus which is of a type which has been approved as explosion-protected shall be energised with electricity in any part of the mine which is a hazardous zone;

(b) only electrical apparatus which is of a type which has been approved as intrinsically safe shall be energised with electricity in any part of the mine in which the methane concentration is dangerous; and

(c) The mine electrical engineer must ensure that any electrical equipment located in areas where there is coal dust is adequately safeguarded against the ingression and ignition of coal dust.

(d) The mine electrical engineer must ensure that electricity at a voltage exceeding 4000 volts is not be applied at the mine to electrical apparatus which by this Regulation is required to be approved as explosion-protected;

(e) The mine electrical engineer must ensure that a cable on the secondary side of a transformer that is used at the mine to supply apparatus that is required by this Regulation to be approved as explosion-protected is constructed so as to prevent incendive sparking in the earth conductors as a result of electrical induction.

(2) Subclause (4) does not apply to a cable that:

(a) has a maximum current rating below 20 amperes; or

(b) is used on an alternating current system at a voltage not exceeding 250 volts.

Apparatus approval

20. Electrical apparatus which is:

(a) located in a hazardous zone;

(b) explosion-protected;

(c) mobile;

(d) to be used for the purpose of providing electrical protection:

(i) for earth leakage;

(ii) for earth continuity; or

(iii) for earth fault lockout; or

(e) specified as being required to be approved,

shall not be used unless it is approved.

Division 2 Earthing and electrical protection

Earth conductors to be of low resistance

21 Equipment that forms part of an electrical earthing system is to be constructed, used and maintained in accordance with the relevant parts of AS3007.

Earth continuity.

22 The mine electrical engineer must ensure that any mobile apparatus at the mine or portable apparatus at the mine which has been approved as explosion-protected and is supplied with electricity through flexible cables shall be protected to ensure that the apparatus is effectively earthed and that the connection thereto remains unbroken.

Restriction of earth fault current

23 (1) The mine electrical engineer must ensure that an electrical system at the mine that is not approved as being intrinsically safe and:

(a) has a voltage exceeding 32 volts a.c. and is used underground at the mine; or

(b) is used to supply mobile apparatus on the surface of the mine at a voltage exceeding 110 volts a.c.,

is such that the current from a single fault to earth cannot exceed:

(c) 5 amperes, where the nominal voltage does not exceed 4 000 volts; or

(d) 50 amperes, where the nominal voltage exceeds 4 000 volts.

(2) On any system in which the earth fault current is restricted in accordance with subclause (1), the mine electrical engineer shall ensure that all apparatus is connected between phases and the tripping ratio is at least 10.

Electrical protection

24 (1) The mine electrical engineer must ensure that electrical equipment used at the mine shall be protected and safeguarded to avoid danger from excessive temperatures, sparking, touch potential, exposure of live conductors or malfunction.

(2) Without affecting the generality of subclause (1), the mine electrical engineer must ensure that electrical protection is provided to interrupt the supply of electricity:

- (a) in the event of a short circuit between any active conductors;
- (b) in the event of a single fault to earth on:
  - (i) electrical equipment supplied at a voltage exceeding 110 volts; or
  - (ii) mobile or portable apparatus supplied at a voltage exceeding 32 volts; and
- (c) to any hand-held tool in the event of an earth fault that causes a current exceeding 30 milliamperes to flow.

Protection against earth fault

25. The mine electrical engineer must ensure that electrical protection shall be provided to prevent the establishment of electric supply to mobile or portable apparatus at the mine which has been approved as explosion-protected in the event of there being an earth fault on the apparatus or any flexible cable associated therewith.

Division 3 Specific requirements for certain equipment

Transformers

26 There shall be provided by the manager of a mine means of containing any fluid that may escape from any fluid filled transformer underground at the mine unless:

- (a) the fluid is of an approved non-flammable type; or
- (b) an approved automatic system of fire protection is provided at the transformer,

and any such means of containment shall be adequate for the fluid capacity of the transformer.

Overhead power lines

27. (1) A zone shall be established by the manager of a mine beneath every overhead power line that traverses the surface of the mine, within which no crane or similar mechanical means for lifting shall be worked while the line is energised.

(2) Such a zone shall have a width of at least one and one-half times the height of the lowest line conductors, or 20 metres, whichever is the less.

(3) Where vehicles are required to pass beneath an overhead power line, adequate precautions shall be taken by the mine electrical engineer to prevent any contact by those vehicles with the power line.

Storage batteries

28. (1) This clause does not apply to a battery approved as being intrinsically safe and applies only in respect of equipment used below ground.

(2) The mine electrical engineer shall ensure that any battery used on a vehicle at the mine is designed and maintained to minimise the risk of arcing and electrical leakage to the battery earth.

(3) Without affecting the generality of subclause (2), the mine electrical engineer must ensure that any battery or battery container complies with the requirements of AS2595.

(4) No person shall change or charge a battery of a battery-operated vehicle at a mine otherwise than at a place appointed for that purpose by the manager of the mine

(5) The manager of a mine must ensure that every battery-charging station at the mine is designed, used and maintained to minimise risk to the mine from fire and the generation of dangerous gases.

Lasers

29 The mine manager must ensure that any laser in use at the mine is used in accordance with Australian Standards.

PART 4 GENERAL

Safeguards against lightning

30 In order to safeguard against danger arising from the effects of atmospheric electricity, the electrical installations must be protected in accordance with AS1768. in addition, to minimise the risk of transferring the effects of atmospheric electricity to the underground workings, earth electrodes provided for the purposes of this clause must be separated from the mine earth electrodes and such separation in air shall be at least 3 metres , and in the ground must be at least 15 metres.

Notices to be posted

31 (1) The manager of a mine at which electrical equipment is installed below ground must ensure that there is kept at the mine an accurate and up to date plan of the mine showing the location of all electrical equipment supplied through mains switch-gear (other than any mobile or portable apparatus, the switch-gear supplying any such apparatus or any signalling apparatus).

(2) the following notices which must be exhibited by the mine electrical engineer in every place containing mains switchgear:

(a) a notice illustrating directions as to the resuscitation of persons suffering from electric shock;

(b) a notice containing directions as to the procedure in case of fire; and

(c) a notice giving directions as to the method of communicating with the surface in the case of emergency.

(3) Where a vehicle may pass beneath an overhead power line that crosses the surface of a mine, notices must be provided by the manager of the mine in a prominent position to warn of the presence and voltage of the overhead line.

(4) The mine electrical engineer must ensure that every switch and circuit breaker, except light switches, belt control switches and signalling control switches, used to isolate equipment is clearly labelled to indicate the equipment controlled or protected from that switch or circuit-breaker, as the case may be.

(5) All notices and labels provided pursuant to this clause shall be in accordance with AS1939.

Facilities for maintenance

32. (1) The manager of a mine shall ensure that no person shall repair any flexible cable used at the mine to supply mobile apparatus other than at a workshop that has been approved and registered for the purpose.

(2) The manager of a mine shall ensure that no person shall perform work on any explosion-protected apparatus at the mine that may affect its explosion-protected properties other than through facilities that are approved for the purpose.

(3) For the purposes of section 103 (2) of the Act, the implementation of a management plan for the maintenance of all electrical equipment at the mine is a prescribed matter with respect to a scheme prepared under section 103 (1) of the Act in relation to electrical equipment

Means of communication

33. (1) The manager of a mine shall ensure that the mine is provided with a telephone system (or other approved means of transmitting speech both ways) between the surface and any of the following locations:

(a) every entrance below ground to every shaft or outlet used for affording the means of ingress and egress by persons employed at the mine;

(b) every locomotive charging or diesel filling station below ground;

(c) every deputy's station below ground;

(d) a place in proximity to underground switch-gear that is used for the purpose of isolating sections of the main electricity distribution system below ground;

(e) every approved workshop below ground;

(f) a place in proximity to every conveyor belt drive head and transfer or loading point below ground.

Compliance with Australian Standards

34 Without affecting the specific requirements of the foregoing clauses, electrical equipment must comply with the requirements of Australian Standards

Exemptions from complying with provisions of Regulation

35. A manager of a mine may apply to the Chief Inspector in writing for an order under section 174 (5) of the Act that any specified provision of this Regulation:

(a) shall not apply to or in respect of any specified person or class of person or any specified act, matter or thing or class of act, matter or thing; or

(b) shall not so apply in specified circumstances.

APPENDIX F

COAL MINES REGULATION (ELECTRICAL - OPEN CUT MINES) REGULATION 1984
under the
COAL MINES REGULATION ACT 1982

AS SUBMITTED TO THE JOINT SAFETY REVIEW COMMITTEE.

Definitions

5. (1) In this Regulation, except so far as the context or subject-matter otherwise indicates or requires:
"active conductor" - any one of those conductors of a supply system which is maintained at a difference of potential from the neutral or earthed conductor.

"active conductor" - any one of those conductors of a supply system which is maintained at a difference of potential from the neutral or earthed conductor.
``approved" in relation to any equipment, apparatus, material or thing, means approved:
(a) by the Chief Inspector; or
(b) by an accredited assessing authority,
under the Coal Mines Regulation (Approval of Items) Regulation 1984;
``circuit'' means an electrical network providing one or more closed paths;
"competency" means to have the technical knowledge, practical experience and physical capability to carry out work on or with electrical apparatus without personal risk or risk to others which may arise of the carrying out of such work.
``competent person'', in relation to a mine, means a person appointed in writing by the manager of the mine to undertake the duties referred to in the provision in which the term is used, being a person having the necessary knowledge and experience to avoid any danger associated with the performance of those duties;
``electrical apparatus'' means any electrical appliance, machine or fitting in which conductors are used, but does not include a cable;
"electrical equipment means electrical apparatus, appliance, machine, fitting, or cable in which conductors are used to transmit and utilise electricity.
``electrical protection'' means a relay or apparatus whose function is to detect defects or conditions of an abnormal or dangerous nature in any electrical circuit, apparatus or power system and to initiate appropriate control circuit action;
``electrical staff'' means persons appointed under Part 2;
``energised'', in relation to an electrical conductor, means connected to a source of potential difference or charged so as to have a potential significantly different from that of earth;
``flexible cable'' means a cable consisting of a stranded conductor or a combination of conductors insulated from one another and which is designed to afford relative motion between its terminal points while it is energised;
``mains'' means conductors or cables connecting mains switch-gear with an electrical power distribution or load centre;
``mains switch-gear'' means power circuit switching or interrupting devices in combination with associated control, instrumentation, metering, protective and regulating devices, or assemblies of any such devices, and associated inter-connections, accessories and supporting structures, used primarily in the transmission, distribution and conversion of electric power;
"management plan means a document which specifies the outcome of work and how the work is to be carried out to ensure the installation use and maintenance of electrical equipment is without risk to health and safety.
"management system means a documented self monitoring process set in place to achieve an outcome or series of outcomes and defined in a management plan and which is capable of being independently audited to existing Standards to determine that expected outcomes of work are being achieved.
"MDG15" means Coal Mines Inspectorate and Engineering Branch, "Guidelines for Surface Mobile and Transportable Equipment for use in Coal Mines."

"mine earthing system" means all of the earth electrodes and conductors installed in accordance with this Regulation;

"mobile apparatus" means machinery not being portable apparatus but capable of being readily moved about while it is carrying out its function, excluding equipment that is capable of being registered under the Road Traffic Act.

"overload", in relation to any electrical apparatus, means the current, voltage, power or torque of the apparatus in excess of the rating;

"portable apparatus" means apparatus capable of being borne or carried manually while it is carrying out its function;

"rating", in relation to any electrical apparatus, means the designated limit or limits for the characteristics of voltage, current, temperature, power or torque within which the apparatus is designed to operate;

"specified" means specified by the Chief Inspector and published in the Gazette;

"the Act" means the Coal Mines Regulation Act 1982;

(2) For the purposes of this Regulation, the methane concentration in a mine or a part of a mine shall be deemed to be dangerous if it is at or above 1.25 per cent.

(3) In this Regulation, a reference to an Australian Standard is a reference to a standard published by the Standards Association of Australia, as revised and republished from time to time.

PART 2 APPOINTMENT AND DUTIES OF ELECTRICAL STAFF

Appointment of electrical staff

6. (1) The manager of a mine shall appoint in writing:

(a) a person to be the mine electrical engineer; and

(b) as many persons to be supervising electricians and electricians as may be necessary to supervise and effect the proper installation, examination, testing and maintenance of all electrical equipment at the mine.

(2) At any time when a mine electrical engineer is not on duty and electricity is supplied to the open cut workings, the manager of the mine shall ensure that a supervising electrician or an electrician with at least 2 years' mining experience is in charge of the persons required to effect the proper installation, examination, testing or maintenance of electrical equipment at the mine.

(3) As an alternative to the foregoing structure of engineering management:

The owner must have established a management system to ensure that electrical equipment is acquired, installed, used and maintained to minimise the risks to health and safety in accordance with a specified Standard of risk management.

(4) A management system established under this provision:

(i) must contain an approved management plan for the acquisition, installation, use and maintenance of all electrical equipment used at the mine, and

(ii) must be staffed by persons who are competent within the range of competencies defined in national competency standards frame works, to fulfil their roles in the system.

Qualifications of mine electrical engineer

7. (1) In the case of any mine at which the total equivalent electrical power at the mine exceeds 1000 kilowatts, or where the Chief Inspector by notice to the manager of the mine so requires, a person shall not be appointed as the mine electrical engineer unless the person is the holder of a certificate of competency as mine electrical engineer.

(2) In the case of a mine at which the total equivalent electrical power does not exceed 1000 kilowatts, the mine electrical engineer shall be qualified under clause 9 (1) or 9(2) to be appointed as an electrician and shall have had not less than 2 years' experience as an electrician at an open cut mine. Being experience in effecting the installation, examination, testing and maintenance of electrical equipment

(3) Nothing in this clause shall prohibit the continued employment of any person who, on the commencement of this Regulation, was employed as a mine electrical engineer.

General supervision by mine electrical engineer

8. The mine electrical engineer shall control the duties of all persons at the mine who have a duty to supervise or effect:

(a) the installation of electrical equipment;

(b) the examination and testing of electrical equipment before it is put into use, after installation, re-installation or repair;

(c) the maintenance of electrical equipment, in safe working condition when in use and in accordance with all requirements imposed by or under the Act; and
(d) the systematic examination and testing of all electrical equipment in accordance with the scheme in force at the mine under section 103 of the act.

Qualifications of electricians
9. (1) Any person appointed by the manager of a mine as an electrician shall be the holder of one of the following qualifications:
(i) an electrician's licence valid in the Commonwealth of Australia
(ii) an electrical trades certificate valid in the Commonwealth of Australia.
(2) A person shall not be appointed to be a supervising electrician unless the person is qualified under subclause (1) to be an electrician and has had not less than 2 years' experience as an electrician at an open cut mine.
(3) Nothing in this clause shall prohibit the continued employment of any person who, on the commencement of this Regulation, was employed as a supervising electrician or electrician.

Electrical staff to carry out electrical work
10 Persons working on or with electrical equipment must be competent to do so.

Defective equipment
11 The mine manager must implement a defect management system to identify any defects on electrical equipment used at the mine, that may affect its safety. The management system must provide for:
(a) the prevention of the use of the defective equipment until any defect has been repaired;
(b) the recording of the details of any defect; and
(c) the recording of any actions taken to remedy the defect.
Records made pursuant to sub-clauses (a) and (b) must be maintained for the life of the equipment.

Restoring power to a mine
12 (1) The manager of a mine shall make rules with respect to the removal and restoration of power from and to the mine or parts thereof.
(2) For the purposes of section 104 of the Act, the subject-matter referred to in subclause (1) in respect of which a manager of a mine is required to make rules is a prescribed subject-matter.

Unsafe work
13 No person at a mine shall do any work upon or in the proximity of an uninsulated electrical conductor which is part of a circuit in which the operating voltage exceeds 60 volts unless the mine electrical engineer, a supervising electrician or an electrician has ensured that the conductor is not energised and has taken any necessary steps to ensure that it will remain in that condition while the work is being carried out.

PART 3 STANDARDS OF ELECTRICAL EQUIPMENT

Division 1 Specific requirements for certain equipment

Mobile equipment.
14 Mobile equipment must comply with the electrical requirements of MDG15

Overhead power lines
15 (1) A zone shall be established by the manager of a mine beneath every overhead power line that traverses the surface of the mine, within which no crane or similar mechanical means for lifting shall be worked while the line is energised.
(2) Such a zone shall have a width of at least one and one-half times the height of the lowest line conductors, or 20 metres, whichever is the less.
(3) Where vehicles are required to pass beneath an overhead power line, adequate precautions shall be taken by the mine electrical engineer to prevent any contact by those vehicles with the power line.

Lasers
16 The mine manager must ensure that any laser in use at the mine is used in accordance with Australian Standards

Division 2 Earthing and electrical protection.

Earth conductors to be of low resistance
17. Equipment that forms part of an electrical earthing system is to be constructed, used and maintained in accordance with the relevant parts of AS3007.

Earth continuity.
18 The mine electrical engineer must ensure that any mobile equipment at the mine that is supplied with electricity through flexible cables shall be protected to ensure that the equipment is effectively earthed and that the connection thereto remains unbroken.

Restriction of earth fault current
19 (1) The mine electrical engineer must ensure that an electrical system at the mine supplying mobile equipment through trailing cables and is such that the current from a single fault to earth cannot exceed:
(a) 5 amperes, where the nominal voltage does not exceed 4 000 volts; or
(b) 50 amperes, where the nominal voltage exceeds 4 000 volts.
(2) On any system in which the earth fault current is restricted in accordance with subclause (1), the mine electrical engineer shall ensure that all equipment is connected between phases and the tripping ratio is at least 10.

Electrical protection
20 (1) The mine electrical engineer must ensure that electrical equipment used at the mine shall be protected and safeguarded to avoid danger from excessive temperatures, sparking, touch potential, exposure of live conductors or malfunction.
(2) Without affecting the generality of subclause (1), the mine electrical engineer must ensure that electrical protection is provided to interrupt the supply of electricity:
(a) in the event of a short circuit between any active conductors;
(b) in the event of a single fault to earth on mains fed equipment;
(c) to any hand-held tool in the event of an earth fault that causes a current exceeding 30 milliamperes to flow.

PART 4 GENERAL

Safeguards against lightning
21 In order to safeguard against danger arising from the effects of atmospheric electricity, the electrical installations must be protected in accordance with AS1768.

Notices to be posted
22 (1) The manager of a mine at which electrical equipment is installed must ensure that there is kept at the mine an accurate and up to date plan of the mine showing the location of all electrical equipment supplied through mains switch-gear
(2) the following notices which must be exhibited by the mine electrical engineer in every place containing mains switchgear:
(a) a notice illustrating directions as to the resuscitation of persons suffering from electric shock;
(b) a notice containing directions as to the procedure in case of fire; and
(3) Where a vehicle may pass beneath an overhead power line that crosses the surface of a mine, notices must be provided by the manager of the mine in a prominent position to warn of the presence and voltage of the overhead line.
(4) The mine electrical engineer must ensure that every switch and circuit breaker, except light switches, belt control switches and signalling control switches, used to isolate equipment is clearly labelled to indicate the equipment controlled or protected from that switch or circuit-breaker, as the case may be.
(5) All notices and labels provided pursuant to this clause shall be in accordance with AS1939.

Facilities for maintenance
23 (1) The manager of a mine must ensure that no person shall repair any flexible cable used at the mine to supply mobile equipment other than through an approved workshop.
(2) For the purposes of section 103 (2) of the Act, the implementation of a management plan for the maintenance of all electrical equipment at the mine is a prescribed matter with respect to a scheme prepared under section 103 (1) of the Act in relation to electrical equipment

Compliance with Australian Standards

24 Without affecting the specific requirements of the foregoing clauses, electrical equipment must comply with the requirements of Australian Standards.

Exemptions from compliance with provisions of Regulation

25. A manager of a mine may apply to the Chief Inspector in writing for an order under section 174 (5) of the Act that any specified provision of this Regulation:

(a) shall not apply to or in respect of any specified person or class of person or any specified act, matter or thing or class of act, matter or thing; or

(b) shall not so apply in specified circumstances.

PAPER 3

INDUCTION TRAINING FOR CONTRACTORS

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1.0 Background

In late 1994, the Mines Rescue Service NSW (MRS) made an approach to the collieries in the Southern Region to develop a course specifically for the induction of contractors for work in coal mines. This induction training was performed by the staff at each of the collieries for contractors prior to entry to the mine. The trainers providing this training commented that contractors represented a burden on their resources in terms of induction. The training resources at each pit became more and more critical as the internal training levels increased to meet the needs of work model and ongoing skills training.

The MRS convened many meetings with the training staff from the collieries in order to assess and define the level of competency required to induct a contractor ready for work underground. The same process took place at Hunter Valley for surface mines. A comprehensive list of areas, topics and skills was developed from which the MRS developed a number of modules that now represent the "Coal Mines Safety Induction For Contractors" course.

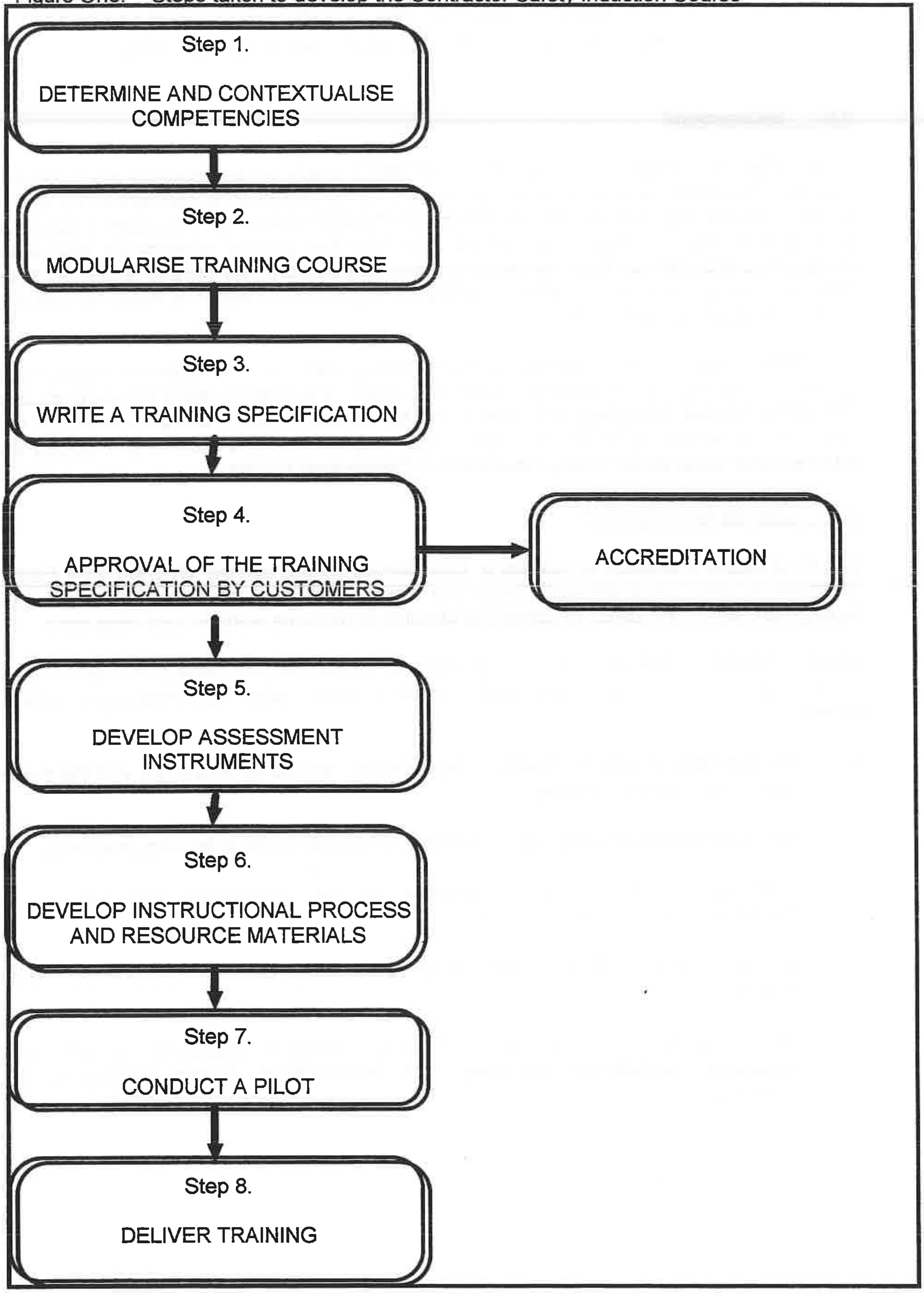
2.0 Course Development

The MRS began a process to develop a 'Competency Based' training program (See Figure One) designed to meet the expressed needs and expectations of Coal Mine Employers and UMFA representatives for the safety of personnel about to commence work on coal mine sites.

Competency based training (CBT) in this case is concerned with training to industry standards rather than an individuals achievement relative to some other less meaningful criteria. This means:

- being clear of the things people in the workplace should be able to do, and the standard to which they need to be done;
- focusing training on workplace outcomes, not on the inputs to training programs;
- being able to focus training provision on the performance gap between current competence and desired competence;
- providing training in those areas relevant to the things people in the workplace should be able to do;
- measuring the effectiveness of the training process by assessing the achievement of workplace competency outcomes.. not measurement against training or learning objectives.

Figure One: Steps taken to develop the Contractor Safety Induction Course



4.0 Course Structure

The training course comprises a number of small stand-alone training modules. The modules are expressed in competency outcomes, and participants will demonstrate competency to meet the assessment criteria of the module.

For flexibility, the training modules are in three categories:

4.1 Generic Training Modules.

These five modules are designed to cover the safety aspects of working on coal mine sites generally. The modules are:

G1. Personal Safety Responsibilities

Covering; personal protective equipment, hazards in the workplace, equipment safety, workplace safety, signage and chemical safety.

G2. Isolation of Plant and Equipment

Covering; types of isolation systems, responsibilities associated with isolation and principles of isolation techniques

G3. Manual Handling, Lifting and Slinging

Covering; detrimental effects of incorrect lifting, manual handling risks, use and selection of correct lifting equipment, signals when lifting and correct lifting techniques

G4. First Response

Covering; types and classes of fire, extinguishing methods and techniques, vehicle and plant fire hazards, selection and use of correct fire fighting equipment, location of equipment, basic life support methods and notification procedures

G5. Confined Spaces

Covering; types of confined spaces, hazards and risks associated with confined spaces, entry requirements and communications systems

4.2 Surface Training Modules.

These five modules are designed for the aspects of safety which are specific to surface coal mine work. The modules are:

S1. Surface Coal Mining

Covering; coal formation, characteristics and uses, mining methods and coal mining terminology

S2. Legislation and Duty of Care

Covering; the OH&S Act, Duty of Care, CMRA, Officials, accident notification and reporting, vehicle inspections and drug and alcohol policies

S3. Working at Heights

Covering; safety precautions, safety equipment, anchorage's and fastenings, selection and use of tools and equipment and use and erection of scaffolding

S4. Traffic Rules

Covering; types and characteristics of surface mining vehicles, hazards associated with surface vehicles, safety requirements pertaining to moving and stationary vehicles, licensing, traffic movement limitations, stopping distances and hazards of incorrect driving practices

S5. Explosive Materials

Covering; identification of explosives, blasting and firing procedures and mine personnel responsible for explosives

4.3 Underground Mine Training Modules.

These five modules are designed for aspects of safety training which are specific to underground coal mine work. The modules are:

U1. Underground Coal Mining

Covering; coal formation, characteristics and uses, mining methods and their implications for underground work, coal mine terminology, outburst and underground transport systems

U2. Legislation and Duty of Care

Covering; OH&S Act, Duty of Care, CMRA, Managers rules, officials, accident notification and reporting systems and drugs and alcohol

U3. Ventilation Systems

Covering; underground gases and their effects, purpose of ventilation, ventilation plant and equipment, operations, limitations and responsibility for ventilation and emergency procedures

U4. Underground Electrical Supply Systems

Covering; hazards and risks of electrical systems, voltage and cable color identification systems, location and hazards of underground cables, electrical switching, Statutory Approvals, electrical protection systems and fault reporting

U5. Going Underground

Covering; general reporting procedures at a mine site, correct personal protective equipment, cap lamps and self rescuers

All training modules are based on, and refer to, the Legislation, Acts or Regulations relevant to coal mining operations.

Assessment is undertaken against competency standards developed by the MRS in real or simulated conditions using actual equipment found in the coal mining industry.

The Induction Training Courses were accredited by the Joint Coal Board under Order 34, for contractors working on coal mine sites, on 21 September 1995. The MRS is currently seeking National Accreditation under the National Framework for Recognition of Training (NFROT).

Each module contains a learning outcome and the associated assessment criteria (See Training Module Outlines) aimed at ensuring the required competencies are developed and assessed for each participant on the course.

5.0 Application

Whilst the name of the course 'Coal Mines Safety Induction for Contractors' suggests it caters to contractors alone, the course has far wider application. The course can be effectively used as part of a companies long term training plan for employees. A new employee may attend the course prior to beginning work at a coal mine.

The course will equip the new employee with the basic skills and competencies to begin working underground and provide a base on which the coal mine can build through functional and operational training on site. The course fulfills much of the criteria of the Coal Industry Work Model Level One. It can also be used as a refresher for experienced miners to reinforce the basic skills that may have been forgotten over time.

6.0 Administration

On successful completion of the course a Statement of Competency is issued identifying the modules which were included in the particular course. An identification card and booklet will also be issued to each participant to be carried as evidence that their skills are current. The booklet will also enable each site to record that site specific information has been given to the participant.

The Identification Card will be accepted as proof that the participant has undertaken the required induction training and will therefore be permitted to enter all mine sites in NSW to perform work (with the required site specific training).

The Contractors will be 'Licensed' for 12 months at which time a competency assessment will be performed prior to renewal of the certificate. The Mines Rescue Service NSW will maintain all records of the status of participants and when the required renewal is due.

7.0 Benefits

Under the current site based induction arrangements, trainers from each mine perform induction courses varying from 1 to 5 days depending on the work requirements of the individual contractor and the areas in which they are required to work. These induction's are performed at each different mine site the contractor attends, as well as, each time the contractor returns to the site to perform other contract work. Contract companies by their nature tend to reallocate resources frequently between contracts and mine sites, a particular mine may induct 10 personnel for a particular contract and due to this turnover conceivably end up performing 15 - 20 induction's. This represents a time consuming duty that takes the trainer away from workforce based training.

From the contractors point of view their personnel may well visit 10 - 15 mines per year requiring they participate in 10 - 15 induction's. If the induction courses are only 2 days duration that represents 20 - 30 man days of induction training per employee per annum. This incurs a great cost both to the contractor and the mine.

The Mines Rescue Service NSW offers a course that can be attended once (plus yearly assessments) by the employees of the contractor gaining them more productive work days per annum. The mines have far less burden on their training resources enabling them to perform more workforce oriented training.

The MRS currently offers courses at all 4 Stations - Southern (Wollongong), Western (Lithgow), Newcastle and Hunter Valley (Singleton) - on an as required basis as well as regular courses each month.

8.0 The Author

Grant Douglas has a Bachelor of Engineering in Mining from Ballarat University in Victoria. He spent 7 years in Tasmania as Underground Manager - Development, Ground Support and Drill and Blast. He obtained a Master of Business Administration from London Business School. He spent 2 years as a Management Consultant with the Boston Consulting Group before taking up his present position as Manager - Southern Region, Mines Rescue Service NSW.

Training Module Outlines

The following Training Module Outline shows the cover page, learning outcomes and associated assessment criteria from the Instructor's Training Guides. Included is only the Generic Training Modules as an example, the same format is used for the Surface and Underground Training Modules.

Generic Induction Training Modules

Mines Rescue Service NSW

Coal Mine Safety Induction for Contractors

Generic Training Module

MODULE G1

PERSONAL SAFETY RESPONSIBILITIES

Module Information

Learning Outcome	Assessment Criteria
Identify and control risks and hazards to personnel associated with the workplace.	1. Personal protective equipment used in the workplace is identified, selected and worn, and its care described to company policy. 2. Hazards and risks in personal workplace are identified and eliminated. 3. Workplace equipment, guards and tools are safely used to relevant standards and Safe Operating Procedures. 4. Acceptable levels of workplace health and hygiene, including bath house rules, are identified and maintained. 5. Accident/incident notification Types of workplace signs are identified and interpreted to ensure safe working. 6. MSDSs are interpreted for given chemical hazards.

Mines Rescue Service NSW

Coal Mine Safety Induction for Contractors

Generic Training Module

MODULE G2

ISOLATION OF PLANT AND EQUIPMENT

Module Information

Learning Outcome	Assessment Criteria
Identify and apply the principles and practices of safe isolation of plant and equipment.	1. the principles of isolation are defined and applied to a given situation. 2. Types of isolation systems, procedures and devices are identified and applied to given plant. 3. employee/contractor responsibility in relation to isolated plant and equipment is clearly defined and its application demonstrated. 4. Situations where "excavation permits" are required are identified and described.

Mines Rescue Service NSW

Coal Mine Safety Induction for Contractors

Generic Training Module

MODULE G3

MANUAL HANDLING, LIFTING AND SLINGING

Module Information

Learning Outcome	Assessment Criteria
Identify, assess and control risks associated with manual handling, lifting and slinging.	1. The detrimental effects of incorrect manual handling are identified and described for given tasks. 2. Manual handling risks are identified and controls and correct manual handling techniques. 3. Lifting and slinging equipment is selected and correctly utilised for safe working loads to "Workcover" recommendations. 4. Recognised hand signals for lifting and loading are interpreted and demonstrated to "Workcover" requirements.. 5. Personal limitation on lifting and slinging knowledge is defined.

Mines Rescue Service NSW

Coal Mine Safety Induction for Contractors

Generic Training Module

MODULE G4

FIRST RESPONSE

Module Information

Learning Outcome	Assessment Criteria
Respond to fire and emergency.	1. Types and classes of fire and associated hazards and extinguishing methods are determined for given situations. 2. Hazards in vehicle and plant fires is evaluated and evacuation procedures implemented. 3. Fire fighting equipment and its location for class and type of fire is correctly selected and operated. 4. Basic life support methods are identified and described. 5. Appropriate personnel are identified, and the procedures for notification described according to relevant rules.

Mines Rescue Service NSW

Coal Mine Safety Induction for Contractors

Generic Training Module

MODULE G5

CONFINED SPACES

Module Information

Learning Outcome	Assessment Criteria
Identify confined spaces and describe the risks, hazards and responsibilities associated with them.	1. Types of confined spaces are defined. 2. Hazards and risks are identified and described for a given confined space. 3. Entry requirements into confined spaces are identified. 4. Types of communication systems found in the work environment are identified and their operation described and demonstrated.

PAPER 4

MANAGEMENT OF TRAINING AND COMPETENCY REQUIREMENTS FOR CONTRACT EMPLOYEES

Before we can manage anything we need to know what it is that is to be managed.

Then probably the first question to be asked is: what is a contract employee?

Contract employees can be divided into at least three groups:

1. Permanent employees or mine workers
2. Permanent part-time employees
3. Part- time or casual employees

A permanent employee is employed by a mining contractor on a full time basis, with little or no difference to an employee of a mining company.

A permanent part-time employee can be employed at the mine for full or part shifts on a regular basis. This class of employee can be self employed or an employee of an industry support company.

The part-time or casual employee again can be self employed or an employee of a support company. This type of employee is usually engaged for single shifts or part thereof.

While contract mining can be an efficient and cost effective method of recovering our coal reserves, the operation of a mine in N.S.W. by a contractor raises some interesting issues.

Firstly when a contractor operates a coal mine in N.S.W. the contractor is deemed to be the owner of the mine (C.M.R.A. Clause 5, Definitions).

Secondly "the owner" or superintendent are the only ones who can appoint the mine manager (C.M.R.A. Clause 36 (3)).

Thirdly the owner, superintendent or mine manager are the ones who can appoint the mechanical and electrical engineers (C.M.R.A. Cl. 44 (3))

So, if the contractor is the owner, etc,etc, it would seem that the contractor is well and truly locked in to the C.M.R.A. and that there would be no difference in training and competency requirements to that of a mining company.

In fact this is exactly the case. The mining contractor is required by law to have an approved training scheme and rules and schemes as is required by every coal mine in the state.

It appears that most training schemes are generally aimed at operators (after induction training) while maintenance staff are expected to have the required knowledge and skills to maintain the plant and equipment at the site in a safe and productive condition.

Permanent maintenance personnel are generally employed by any of us because of their background training, and the skills and knowledge they possess at the time of employment. These employees are also required to possess some of the qualifications described in the Mechanical or Electrical Regulations depending of course on their classification.

However, there are exceptions. At one contract mining operation the mining contractor was required to accept experienced underground workers to mine an open cut operation. The difficulties experienced were numerous.

In the maintenance area the problem of skills training appeared at the start of the contract to be just about overwhelming.

The mining contractor brought in skilled supervisors to provide hands on training and guidance to the maintenance staff.

One on one training was provided with support from the field service staff from the O.E.M.s.

Over time, the maintenance employees have become familiar with the plant and equipment at the site and are competent to perform the day to day maintenance required.

This particular situation is probably unique, and one that I have no doubt the contractor will not find themselves in again.

In the contract mining business there is probably the need to use outside contract employees in maintenance more than would occur in an operation run by a mining company.

Contract mining is a highly competitive business, and rest assured there is no scope for that little extra, that comfort zone that we as maintenance people like to have, such as the extra fitter to cover annual leave or the extra truck to cover the scheduled maintenance or breakdown.

In contract mining, if a fitter is absent, then you're a man short. If a truck is down, then you're a truck short.

Contract mining companies are therefore more likely to employ maintenance staff to perform scheduled maintenance tasks and call on outside expertise to assist with additional unplanned workloads and for the more specialised maintenance work, generally of a breakdown nature.

As previously stated there are several types of contract employee to be considered in the maintenance area.

We have already seen that the permanent employee will certainly have prescribed qualifications and hopefully the skills and knowledge we desire.

The abilities of permanent employees can be assessed on a daily basis with training needs addressed as required.

Similarly as new equipment or changes in technology are introduced onto the site, training focusing on these changes can be carried out as required with the permanent employee.

Equipment suppliers these days offer high quality, competency based training for there particular equipment systems. As well there are numerous specialised training organisations able to provide suitable training packages. In either case, training can be in-house or at the training providers premises.

Training records are kept at the mine site indicating the skills attained by each employee.

But what of the part-time contract employees?

Because a person is self employed as a specialist in a certain field or works for a support company, does that necessarily mean that the person has the qualifications, knowledge, skills and the tools required to safely and competently carry out the task?

Fortunately, in most cases it does mean the person meets our needs.

But to assume that this is the case can be dangerous and costly.

I have stated that part-time contract maintenance personnel are generally called in to assist with breakdown repairs, either diagnosis, or to actually carry out the repairs.

I'm sure we all have our preferred contractors. If we are dealing with self employed people then the question of competency and training is manageable.

Self employed contractors can generally undergo induction training at the site prior to being called to the first job.

They are generally able to have tools and equipment tested and approved for use prior to being called to use them on the site.

Similarly, the "small" business operator with a small number of employees can be managed in a similar way.

A record of induction training is kept at the mine office, as well as a register of inducted contract employees.

It would be pertinent to say at this point in time that the major problem experienced with the self employed and "small" contractor is the unsafe condition of electrical tools and leads.

It is the author's opinion that there is a less than adequate understanding (or disregard) of the requirements of the C.M.R.A. Electrical Regulations and indeed the relevant Australian Standards relating to electrical wiring and equipment and in particular, welding safety.

But what can we expect when a support company such as an O.E.M. is called?

If we are calling in the O.E.M. of the particular piece of equipment or plant we expect the best in specialised knowledge and tools.

Regrettably most of us are guilty of stealing the O.E.M.'s trained employees as our own need for increased manning occurred.

So where does that leave the support organisations that we as contractors ourselves so heavily depend on?

We, the people who pay high wages for shorter hours, more annual leave, more sick leave and a good superannuation scheme, put the organisations we depend on in a position where they are stretched to provide the quality support we think we are entitled to.

In short it puts us in the position of generally not knowing who is going to be there when we need them most.

This is the area in contract coal mining that presents us with the greatest difficulty in "the management of training and competency requirements".

The dilemma we get ourselves into is that we call for help, help arrives in the form of a trained person who has not been to the site before. The person may well have carried out good quality work for you at another site, but never worked at the site where you need him/her.

You've got several millions of dollars worth of machine parked up, a production supervisor breathing down your neck and hanging over your head, the requirements of the C.M.R.A. (Cl. 114.), and the Occupational Health and Safety Act (Cl.'s 15, 16, 17).

While it is certainly likely that at some stage we have all been faced with this type of situation, it can happen far more regularly in the contracting business for the reasons expressed previously.

We, in the contract mining business try to manage this type of situation by requesting certain personnel to attend the mine for the particular work to be performed.

Some O.E.M.s are presently allocating certain personnel to particular sites, which to date has probably been the best solution to the problem.

I'm sure there are many suggestions of solutions to this problem that we most likely face at some stage.

Our colleagues in the union movement would suggest "increasing the manning" and stop using contractors.

Others may suggest ensuring that all contractors are inducted (e.g. blanket induction of all the employees of an organisation).

Others may suggest to keep doing what we are doing.

What we are doing is manageable but don't turn your back on it or it will fail.

What we are currently doing to manage training and competency requirements is time consuming and therefore expensive.

It is an expense that would never have been included in the tendering process for the contract mining operation.

It is therefore an expense that must be dramatically reduced if not eliminated.

So, what's the answer?

If we had the answer we could save the contracting and the mining industry many, many manhours and dollars.

There is no doubt that we will continue to fulfil our legal obligations in the same manner that we have always done in the past.

In summary, The Management of Training and Competency Requirements for Contract Employees has several connotations when you are in the contract mining business.

1. Your own "mineworker" employees are contract employees.

   There is little, if any difference to the established meaning of a mineworker.

   Training and competency requirements do not differ for this class of employee.

2. The self employed or small contractor will generally have the skills required to provide the expertise needed at the time.

   This type of contractor appears not have a good understanding of the C.M.R.A. Electrical Regulation and appropriate Australian Standards.

3. The O.E.M. type contractor employee will generally possess the skills but not necessarily the site training required to immediately start work on the site.

   The condition of tools, particularly electrical, varies greatly from contractor to contractor.

4. Management of Training and Competency Requirements for Contract Employees covers at least three groups of contract employee, all ultimately the responsibility of the mining contractor when they are working on that contractor's mine site.

5. Management of Training and Competency Requirements varies from group to group and within each group.

6. Training and Competency Requirements need to be focused on the requirements of the C.M.R.A. and the O.H.& S. Act, more so than trade skills or equipment knowledge.

The dependence on specialist contractors in the coal industry is bound to increase as plant and equipment becomes more complex, more expensive and more reliable. The style of maintenance is changing with advances in technology. Condition monitoring will determine component life rather than hours worked. Maintenance tools will become more costly and less used than the set of spanners and the filter strap.

Maintenance is the second highest cost centre at most open cut mines. The cost of maintenance can be reduced by using contract employees who are highly skilled and have the specialised tools required.

Management of Training and Competency Requirements for Contract Employees is bound to become an important topic at every forward thinking mine site in the very near future.

The responsibility for ensuring contract employees are trained and competent lies with us, the end user.

This paper was written by:

Norman Greedy, Mine Mechanical Engineer, Mt. Owen & Cumnock South Open Cut Mines.

The opinions expressed in this paper are those of the author, and are not intended to imply that they are the opinions of any other person.

MANAGEMENT OF TRAINING AND COMPETENCY REQUIREMENTS FOR CONTRACT EMPLOYEES

1. The object of this paper is to give the attendees of this forum an insight into how contract miners manage training and competency requirements of contract employees.

It seems that the current buzz word around coal mining circles is contract mining. This can be evidenced in our district by the number of new contract miners currently operating in the Hunter Valley.

Contract mines are no different than any other mine in its operation as the bottom line is to mine coal safely and at a profit to both the mining contractor and the mine owner.

2. In essence overburden is removed, coal extracted and restoration operations are completed as in any other open cut mine. Historically plant was hired to mining companies on a dry hire basis, then plant and operators on a limited basis which then led into the situation where contractors supplied the equipment, the men, and controlled the running of the mine, albeit under the supervision and guidance of the mine staff.

Contract mining has evolved to the point where the staff from the mine manager to the bathhouse attendant is now supplied by the contractor.

Just around the corner the contract miner of the future will supply the complete infrastructure of coal loops, preparation plants and the like.

3. We need to differentiate between contract miners and contractors on a contract mine site.

We deem contract employees to be those who are not permanently employed by the principal contractor, the miner, at the mine site.

Often the difficulty of the permanent employees who are employed under the relevant awards and conditions and also bound by the CMRA is such they cannot accept that they are also contractors.

Whilst this paper was initially written independently of my colleague, striking similarities soon emerged between the two contractors.

That being that the operations personnel were constantly being trained on equipment so all types of earthmoving plant could be operated by the men, and the maintenance personnel were hired with the expectation that they could be able to maintain/repair all types of equipment without further training.

But in the real world this is not altogether possible as the spread of maintenance personnel over three shifts, and the introduction of some inexperienced underground personnel meant that the expertise pool had become diluted. Due to tight controls on the number of maintenance people employed, the luxury of having sufficient numbers to enable off or onsite training was not easily attainable.

Given these limitations it has been necessary to use OEM persons for their expertise, tooling and backup which is of prime importance to a contractor miner who must endeavour to stay within the constraints of a tight maintenance budget.

The contract miner generally does not have in the organisation a dedicated training officer whether for maintenance or production. Though schooling is provided for and attended by maintenance and production whenever a piece of new plant has been procured. Contract miners maintenance personnel are encouraged to attend TAFE courses and the like for additional skills and training as opposed to the onsite training often given at the larger mine sites by their dedicated trainer.

A central skills record is kept onsite and is updated accordingly as a persons skills increases.

OEM contractors that are used onsite are not given any training in their field as they are being used for their expertise and have had ample training at the place of work to achieve this expertise. However, to be able to work onsite they are instructed in the manager's rules regarding safety, transport rules etc, and their obligations regarding the CMRA. As Norm has stated, the contractor's ignorance of this (CMRA) is fairly universal and requires additional time to instruct and reinforce the importance of it.

Summary

1. Contract mines as far as mining operations are considered, are no different than the mining company mines.

Maintenance personnel are generally hired for their expertise and require only minimal training other than inductions to start work. Their expertise may be augmented by OEM training for new equipment technology and by courses completed outside their normal working hours.

Production personnel have ongoing training and not all are proficient in the operation of all equipment.

2. Contractors, as far as the contract mine is concerned is anybody not engaged at the mine for mining or maintenance purposes on a permanent basis.

All contractors require inductions and most are unaware of the implications and duties imposed upon them by the CMRA.

This paper was written and presented by:

David Whan, Mine Mechanical Engineer, Liddell Open Cut Mine.

The opinions expresssed in this paper are those of the author, and are not intended to imply that they are the opinions of any other person.

PAPER 5

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MECHANICAL ENGINEERING SAFETY SEMINAR

Friday 22 nd March 1996
Penrith Panthers Leagues Club

THE ROLE OF MECHANICAL CPs & AAAs

Greg Venticinque
Managing Director
Engineering Safety Services Pty Ltd

CONTENTS

1. INTRODUCTION

This paper reviews the assessment and approval requirements for mechanical equipment as used in New South Wales underground coal mines and the interaction of AAAs (Approved Assessing Authorities) and CPs (Competent Persons).

There are two major underground coal mining states in Australia, New South Wales and Queensland, other states have some underground mines, however, equipment that is certified or approved for use in NSW or Queensland is generally accepted in these other states. For many years, New South Wales has lead the way in the testing, assessment and approval of mechanical equipment. This lead has been based upon the political pressure developed from mining disasters, industry safety reviews, underground technology developments, corporate management priorities and workers compensation costs.

The approval system is driven by the Coal Mines Regulation act as it requires certain types of mechanical devices to be "Approved". It should be remembered that the approvals system is basically a quality assurance type checking and auditing process that ensures the following elements are present whenever critical mechanical devices are applied underground:

* All decisions that affect the safety of the equipment are made by persons that are:
  - Competent in the particular field
  - Experienced.
  - Conversant with the relevant standards

* The equipment is thoroughly tested to the relevant standards or guidelines

* Non compliance with relevant standards are adequately justified.

* Equipment or systems that are beyond existing technology or standards are adequately reviewed for safe operation

* Vital safety information is available to prospective user such that the equipment can be safely and correctly used underground.

* Operational, maintenance and service information is available before the machine is used.

* Sufficient information is available to allow the manufacturer to repeat the manufacture of the item as per the initial type tested and approved unit.

* A documented record is kept of the approvals process so that the information can be used in future alterations or modifications to the equipment.

* As new technology and safety practises are developed, these standards are immediately applied to any new equipment approvals.

The NSW DMR defines an approval as:

"Approval" Consists of attesting formally that a specific item conforms to the requirements of the Chief Inspector of Cal Mines. These requirements may take the form of Australian or other standards either in whole or part combined with assessment of the overall safety of the item for use in a coal mine in New South Wales.

2. CPs and AAAs

As per the CMRA (Coal Mines Regulation Act), the Chief Inspector of Mines in NSW can delegated the responsibility for the issue of approval to AAAs (Approved Assessing Authorities). These persons have been issued the right to sign approvals on behalf of the Chief Inspector.

There is a formal method for the assessment of approvals by AAAs and each AAA has an annual quality review conducted by the CMI (Coal Mining Inspectorate) of the DMR (Department of Mineral Resources).

It is possible for testing centres to be both the NATA certified testing centre and the AAA. In this case the test centre must have an accredited quality assurance system and must also demonstrate the ability to be impartial in both the testing and assessment features of the approval. To date the (LOSC) Londonderry Occupational Safety Centre is the only fully accredited AAA test station (Electrical only).

Primary approvals issued by either AAAs or the NSW DMR are issued directly to the approval holder and are later published in the New South Wales Government Gazette.

Approved Assessing Authorities are defined by the DMR as:

'Accredited Assessing Authority' is an assessing authority accredited by the Chief Inspector of Coal Mines to assess and issue approvals that may be deemed to be approvals issued by the Chief Inspector of Coal Mines.

Applications for approval must be submitted as per the requirements of MDG3001 "Applicants guide to obtaining approval from the Chief Inspector of Coal Mines in NSW Australia" and shall include the following documents:

- An application for approval from a CP (Competent Person Mechanical) This document includes
  - A description of the item.
  - A reference to the clause in the CMRA that approval is sought
  - The make and model of the machine.
- Test reports from either a NATA certified test station or a CP (Competent Person Mechanical).
- A letter of compliance from the CP indicating the standards used and any non compliance. This letter shall also justify the non compliance and indicate additional protections installed.
- A schedule of attached documents
- Complete sets of relevant information such as drawings, specifications, overseas test reports etc,
- The name and address of the local approval holder (Approvals can only be issued to organisations in Australia).
- If required an operational or design risk assessment
- If required an independent audit of the operational or design risk assessment

From the above process, it can be seen that the competent person is pivotal in the system. All of the testing, recommendations for approval, determination of options for non compliance and the coordination of the approval application is vested in this role.

The AAAs function is to audit the process and issue approval only if the following criteria are fully satisfied:

- All of the relevant documents are included in the application.
- All of the testing and assessing authorities are competent and are certified in the particular category
- The correct standards or guidelines been applied to the particular piece of equipment

* The included documents are correct

* An adequate risk assessment has been applied.

* The proposed barriers to any non compliance with relevant standards are acceptable

Based upon the above basic quality audit, the AAA and the CP liaise to determine the necessary actions required to achieve approval. Whenever, agreement cannot be made on any issue that may hold up approval, the mechanical engineering branch of the CMI acts as final adjudicators. The role of the AAA is **NOT** to reassess the machine but rather is purely an independent audit of the documentation and the process.

A Competent Person is defined by the DMR as:

'"competent person means a person who has been examined by the department in a specific category and has been issued a specific competent person approval number"

The specific mechanical categories that have to date been issued to individuals as AAAs and CPs include:

DEE Diesel Engined Equipment
DEL Diesel Engined Locomotives
DES Diesel Engined Systems
DEV Diesel Engined Vehicle
HEA Hazardous zone Electrical Apparatus (mechanical content only)
MEA Mobile Electrical Apparatus (mechanical content only)
ROP Roll Over Protection
CAN CANopies for continuous mines

Applicants for CP and AAA must show minimum educational requirements and have sufficient industry experience before they can sit for formal certification examinations (Written and oral). Examinations are held for each individual category applied for.

AAAs are basically CPs who have been further certified to an assessing role and have been issued authority to issue approvals on behalf of the Chief Inspector of mines.

Within the NSW approval system there is a requirement for new approvals to include a risk assessment before approval is issued. This allows for deviations from standards and inclusion of safety issues which may be outside of normal practice.

The CMI has determined that a Risk assessment is required for the approval of an item when it is;

* A prototype

* Has new qualities that may add risk

* Is not in accordance with published standards or accepted practice.

Two types of Risk Assessment may be required by the AAA

* Technical (DESIGN) Risk Assessment due to a new design.

* Operational Risk Assessment due to a new use or operation

The CP and the organisation seeking approval may be required to provide a documented risk assessment that has been carried out under the guidance of an accredited Risk Assessor and Audited by an Independent Risk Auditor.

The AAA, can accept appropriate test reports and "Certificates of Compliance" with relevant standards. This includes all JAS ANZ supported standards and as per the push by the Federal government overseas standards such as ISO, MSHA, BS etc.,

3. Approval requirements of the CMRA

The CMI (Coal Mining Inspectorate) of the NSW DMR (Department of Mineral Resources) have ultimate control on the issue of approvals for the use of mechanical apparatus in underground coal and shale mines. Approval is required in the Coal Mines Regulation Act (1984) and its regulations (1982) from the Chief Inspector of Coal Mines. There is a complete regulation (Approval of items) within the Coal Mines Regulation Act which addresses the full responsibilities of all parties within the system. The following definition of approval is issued by the NSW DMR:

'Approval' consists of attesting formally that a specified item conforms to the requirements of the Chief Inspector of Coal Mines. These requirements may take the form of Australian or other Standards either in whole or part, combined with assessment of the overall safety of the item for use in a coal mine in New South Wales.

All mechanical equipment requiring approval must be tested or assessed on a type basis to the relevant Australian or industry standard or guideline. If adequate safety is demonstrated, approval is issued as a type approval by the Chief Inspector of mines or on behalf of the Chief Inspector by an Approved Assessing Authority. After the approval is issued, the owner of the approval can reproduce and supply this piece of equipment on a routine basis with a letter of compliance referring to the type approval. There is no requirement for quality assurance of the manufacturer to produce further equipment to the type approval. This is currently under review and it is expected that in the future quality assurance will be required for approved items.

4. Interaction of CPs & AAAs and the DMR

The conduct of AAAs and the correct method for the creation and issue of approvals is defined in the Department of Mineral Resources Coal Mining Inspectorate & Engineering branch document AAAPROC2 *"Guideline for the Processing of and issue of approvals. (Accredited assessing authority approval process)"*. This document is the AAA bible as it gives the following important information:

* Objectives of the system
* Definitions
* Client Responsibilities
* Testing Authority responsibilities
* AAA responsibilities
* Approval documentation
* Approvals process
* Risk assessment requirements
* Auditing of risk assessments
* DMR requirements
* Approvals document assessment
* Submission to the DMR
* Auditing of AAAs

5. Critique of the system

The approvals system should not be seen as a dinosaur holding back development but rather a quality assurance system that applies checks and balances to new equipment before it is placed in service. The complexity of new equipment, the variety of standards and guidelines available to assess new equipment and in some cases the lack of standards makes it impossible for most mine mechanical engineers to be able to fully assess the true safety capability of new equipment. The approvals process offers a safety net whereby the following important issues are addressed:

* Machines are competently tested and audited to relevant standards or guidelines.

* Competent persons review the machines and commit to safety recommendations.

* Non compliance with relevant standards and guideline are adequately addressed.

* The safety performance of various machines in the same category are comparable as test and specification information is made available in the approval documents.

* Control is kept over all machines used underground. If a problems occurs all machines under the same approval can be modified to correct the problem.

* New technology is addressed by both the industry developing new standards and guidelines or through the use of the risk assessment process.

* Manufacturers and end users are to a large extent protected from Occupational Health & Safety litigation because of the "Independent" assessment and auditing of test results recommendations.

* Purchasers of equipment can be assured of a minimum safety standard.

With the implementation of the CP & AAA system, the approvals process has been privatised in as much that it is now a commercial arrangement between the owners of equipment, CPs and AAAs in the process of obtaining an approval. This arrangement has both advantages and disadvantages.

A disadvantage of privatisation is that it allows for competition in the approvals arena which may allow prospective approval seekers to "Shop around for the best deal". This problem is addressed by the CMI annual audit and by the ethical and legal requirements of the AAAs.

The advantages of the privatised system includes:

* Faster processing of approvals. If necessary approvals can be done the same day.

* Competent persons can be and are employees of a manufacturers or approval holders, thereby allowing for internal assessment and cost advantages

* The industry benefits from a base of highly skilled persons constantly contributing to relevant safety standards.

* Consistency in the approvals process minimises variation in the applied standard and thereby offers a " level playing field" for all suppliers. This process prevents the dumping of lower cost sub standard machines as the same safety features must be offered on all machines.

6. Future directions for the approval system

After the approval is issued, the owner of the approval can reproduce and supply this piece of equipment on a routine basis with a letter of compliance to the type approval. There is no requirement for manufacturer to have quality assurance to produce further equipment to the type approval. This is currently under review and it is expected that in the future quality assurance will be required for unlimited manufacture.

Both of the major coal mining states in Australia have different mining acts and widely differing approvals systems each with its own strengths and weakness. This variation in requirements between the states adds costs and confusion and the safety standard of machines supplied into Queensland and new South Wales can vary widely based upon approval and certifiaction requirements.

Governments no longer see themselves as industry safety leaders but rather the police for the system. Increasingly, Duty of Care Robens style legislation will push the responsibility for equipment safety to the manufactures, end users, Approved Assessing Authorities, Competent persons, test stations and repairers.

Currently, in NSW, the approvals process offers excellent protection from prosecution as the equipment is approved by the Chief Inspector and the safety emphasis is based upon accident review and modifications to machines to allow for future prevention rather than the use of prosecution as a big stick.

Pressures on governments to reduce costs has resulted in smaller safety departments and a move towards a user pay system. Both of the major test centres LOSC and SIMTARS started as government owned and run non profit test centres. They are now expected to attempt to cover costs and are operated on the basis of a corporation.

The control of the certification and approval process is moving towards Australian standards, JAS ANZ, NATA, AAAs and away from the government department. It is likely in the long term that as standards become available certification will become the method used in preference to approval for all states in Australia.

To summarise the move to the external approval or certification system has the following advantages:

* Approvals turn around time is faster. (Commercially driven).
* International standards are more acceptable (JAZ ANZ & ISO protocols).
* Australian testing and standards are more acceptable overseas.
* One stop approvals centre will become available when test centres achieve mechanical AAA status
* If the work load exists more test stations may be brought on line to speed up approval or certification. (Commercially driven).

Disadvantages:

* Equipment not covered by standards can be difficult to assess.
* If a Risk assessment is not included in the process. Hazards may exist associated with special use of the machine that the CP or AAA does not notice.
* The system is financially driven therefore possible abuses exists.
* There is no check of actual work done by the testing station or the competent person. AAAs, NATA and Australian standards only assess the processes and the test equipment only.
* Approvals costs have risen from low cost to expensive. Approval and Certification incurs costs from the test centre, NATA, Australian Standards, JAS ANZ, Competent person, AAA etc

The following documents were used as reference material for this report.

AAAPROC2 19/9/95
"Guideline for the Processing and Issue of Approvals (Accredited Assessing Authority Approval Process).
Department of Mineral Resources Coal Mining Inspectorate.

MDG3001 September 1994
"Applicants Guide to obtaining Approval from the chief Inspector of Coal Mines in New South Wales Australia.
Department of Mineral Resources Coal Mining Inspectorate.

PAPER 6

PRESENTATION: CJ PITZER

HUMAN ERROR - RISK INFORMATION PROCESSING MODEL PRIOR TO ACCIDENTS

The Management of Behavioural Risk

1. Safety Management Philosophies

Most companies follow the so-called "traditional" or "procedural-engineering" approaches to safety. Very few organisations achieve what is generally regarded as an advanced level of safety management: the management of the human factors in safety. The world's leading organisations in safety follow an approach where the safety culture, safety awareness, attitudes to safety and safe behaviour are the key focus.

Additionally, some of the latest research findings indicate that the identification of risk at the coal face is in many ways deficient, because of a number of perceptual problems that may exist with workers.
In one study conducted by Peters and Wiehagen (1988), it had been found that many accidents in coal mining, especially rockfall accidents, resulted because workers did not see the hazard, or only saw the hazard when it was too late. The proportion of accidents as a result of this can vary significantly be industry. For instance, in a study of sea ferries in the North Sea, almost 25% of accidents/disasters were attributed to lack of hazard perception. In the gold mining industry of South Africa, researchers found that up to 57.7% of fatal rockfall accidents was a result of failure to perceive, recognise, or respond to clues that would have forewarned the miners of danger.

2. Human error and accidents

Many safety researchers identified human error, or risk-taking, as the biggest contributor to accidents and incidents. One of the earliest safety management specialist, HW Heinrich, indicated that 85% of all accidents is "human-related". However, for many years after that the approach was mostly to train, instruct and to enforce rules - all to limit human error. Modern management theories state that "motivation of people" is the key to a successful organisation and also the key to safety improvement. Translating motivating people" into realistic and practical management systems is not an easy task.

The well-known Domino theory of Heinrich provides some key points. It states that there are six stages in the cause and effect process that precedes every accident: Although these are listed as sequential steps, it must be realised that accidents are extremely complex phenomena, which require dynamic solutions.

Stage 1: Management Control
The task of management in the organisation is to plan, lead, organise and control. If this function fails, the failures of the systems further "down" the organisation occurs:

Stage 2: Personal and Job Factors
Personal factor consists of lack of knowledge, improper motivation and physical problems, while job factors refer to issues such as inadequate work standards, design or maintenance, purchasing, abnormal wear and tear, usage etc.

Stage 3: Unsafe Acts (85%) and/or Unsafe Conditions (15%)
Unsafe Acts are varied and numerous - operating without authority, at improper speed, failure to warn or secure etc, while Unsafe Conditions are inadequate guards, protection, tools, equipment, substances, etc.

Stage 4: The Accident/Incident
Many unsafe Acts or Unsafe Conditions may occur before an accident/incidents happens. The total "risk exposure" may at some point "snap" and an accident, with or without an associated loss, may occur. The accident itself must be analysed, but should not be the main strategy of accident prevention. Many other acts and conditions may combine to result in accidents.

Stage 5: Loss of people and/or property
Once the entire sequence has taken place and there is a loss involving people or property, the results are usually chance events. The element of chance is involved in quality and production losses as well as those involved with safety, health and security.

The sources of risk-taking in the organisation are often not well understood or recognised. All the above stages are "embedded" in the safety culture of the organisation.

3. Risk-Taking Of Employees

Although the Unsafe Acts form 85% of the so-called "immediate causes", the more fundamental sources of that must be identified and eliminated. Why do people take risks?

Contrary to popular belief, conscious risk-taking happens only in a small number of accidents.

People take risks because of the following reasons:

- The risk or danger was not identified/recognised
- The risk was inherent in the task or job procedure
- There was no incentive to do the job safely or there was a negative result in avoiding the risk
- Other reasons may be behind the risk-taking

Some risk-taking behaviour can be eliminated by training to provide people with the skills to recognise dangers or to raise the awareness of people, while almost all other risk-taking can be traced back to Safety Culture. The first step in the change process is to make strategic changes to the culture of the organisation - to ensure that the social work environment of people at operator level is one of risk and loss avoidance.

4. The Management Requirement

The management of safety culture is essentially a change program - changing from a "traditional safety approach" to a modern, consultative one.

It should follow four Key Strategies:

- Leadership
- Risk Control
- Worker Involvement
- Communication

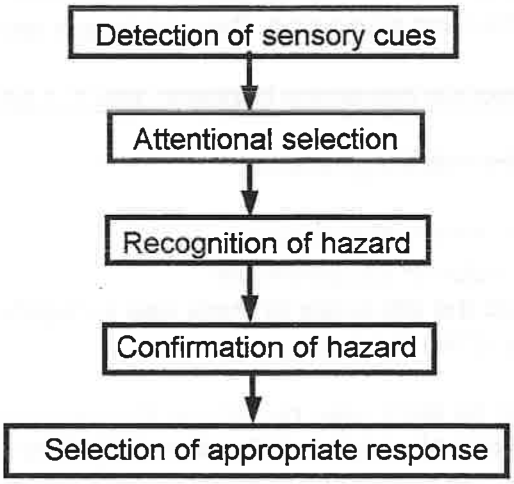
The following key areas of focus exist in the organisation, and the behavioural risk management process should affect all of them:

- Safety Culture
- Safety Awareness
- Safety Attitudes
- Safety Behaviour
- Safety Performance

It will be noted that the above levels are congruent with the stages described above - but focusing specifically on the human factors. It is on this aspect that the behavioural risk management process supplements other formal safety management systems such as NOSA or ISRS, by providing measurements, benchmarks, analysis tools and correction tools to manage human factors.

5. The perception of hazards

Hazard recognition is viewed as a complex task, with sensory, perceptual and cognitive components, and according to Perdue, Kowalski and Barret, a relatively simple model of that process makes further discussion of the task easier. The model is as follows:



5.1 **Detection of sensory clues**. This is normally some sort of a "signal" (or features of the environment)that should indicate to the perceiver that something in the environment is "at odds" with the normal, expected or the safe. An imminent rockfall may be forewarned by deterioration in rock structure, which may not be perceived as a result of illumination, colour or brightness contrast etc.

5.2 **Attentional selection** is the process of giving more attention to that subset of "different features" which appeared as a sensory clue.

5.3 **Recognition of hazard** is the actual diagnosis that the perceived features are in fact different from what should be there.

5.4 **Confirmation of the hazard** is the process of "testing the hypothesis", by searching further for confirming or disconfirming evidence. However, people have a natural tendency to "stick" with a hypothesis they hold, and often this results in a tendency to confirm that "there is no risk", especially in circumstances where complacency has developed.

5.5 **Select appropriate response** does not necessarily depend on the preceding process of identifying a hazard, because the person may, and often they do, regard the risk as not a threat (underestimate the risk) and may proceed with a risky action or fail to take avoiding actions.

6. A new classification of hazards

The above presupposes that there is a need to distinguish between the various levels of classifying a hazard, and the following is posited as a possible model for, example, the classification of a trip hazard:

A **deficient feature** of the environment (A discarded hand tool)

A **hazard** (hand tool is in a path way)

A **risk** (the hand tool is identified)

A **threat** (The hand tool, if recognised, will be avoided by travellers)

7. Summary

The presentation will demonstrate practical examples of deficiencies in human processing of risk information. It will indicate the type of problems that may exist in identifying and recognising hazards, and the type of deficiencies that may exist in our evaluation of a risk, namely the influence of personal and perceptual biases we have.

PAPER 7

Mechanical Engineering Safety Seminar

22nd March 1996

Endeavour Mine Explosion
28.6.95
Assessment of Mechanical Equipment

Paper prepared and presented by

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Coal Mining Certificate;
Inspector of Mechanical Engineering
Coal Mining Inspectorate

Footnote: The comments contained in this paper are those of the author and are not necessarily those of the Department of Mineral Resources.

Overview

The purpose of this paper is to inform Colliery Mechanical Engineers what can be expected if they become involved in a significant mechanical investigation.

I am not presently permitted to detail all my findings during the Endeavour Colliery Investigation, instead significant areas will be raised which could apply to you all.

Table of Contents

ENDEAVOUR COLLIERY

EXPLOSION IN 300 PANEL

MECHANICAL INVESTIGATION REPORT

1.0 INTRODUCTION

At approximately 9.50 a.m. on Wednesday, 28th June, 1995, an explosion occurred in the 300 Panel, located in Great Northern seam of Endeavour Colliery. The lives of eight men in the panel were put at risk as a result of this explosion.

The areas covered by the Endeavour report are generally as required by the Coal Mines Regulation Act 1982 No 67, with particular reference to Part 2 Administration Division 1, section 10 part 5 and Part 4 Mine Inspection and Safety Provisions Division 1, section 59 and 60.

2.0 THE EXPLOSION

300 Panel lies some 7 km from the entrance of the mine and 30 minutes travel is required to reach the face. Mining within the panel is termed partial extraction, whereby some areas are completely extracted and in others large pillars of coal are left. The purpose of this system of mining is to minimise surface subsidence, as 300 panel lies approximately 190m beneath Lake Budgewoi. The panel is separated from the neighbouring Munmorah Colliery by a 40m continuous barrier of coal.

Immediately prior to the explosion, the face crew who were located as detailed on ENDINV-10 were expecting a large collapse of goaf (worked out coal) to occur as detailed by the witness statements. At the first signs of the collapse beginning, those in the immediate face area ran for cover and a large fall occurred. The mining investigation indicates that the fall displaced a sizeable amount of air which rushed from the goaf, into the workings. It is assumed that the displaced air contained a significant quantity of methane.

The windblast knocked several workmen to the ground violently and raised a large cloud of coal dust into suspension, cutting visibility significantly.

Within seconds of the large windblast a much more violent and devastating concussion occurred. The concussion was caused by an explosion of a mixture of methane in air. The men were again bodily thrown about suffering cuts, abrasions etc. and some reported feeling intense heat and a smell of burning material, one saw sheets of flame, several sustained minor burns.

From the witness statements it has been established that the eight men in the panel found themselves disorientated in a dense dust cloud which limited their visibility. Calling out for each other they groped through the gloom and formed small groups and then moved away from the face. Most donned their self rescuer units. What followed was a difficult journey, made with limited visibility. During the journey several self rescuers were revealed to have became hot, indicating the presence of poisonous carbon monoxide (a product of combustion).

After a distance of approximately 14 pillars the atmosphere cleared sufficiently for the men to see some distance. They proceeded to the track end and notified the relevant personnel. The 8 men were subsequently evacuated.

In order for the mine to be recovered it was essential to establish that no on-going combustion was taking place. This was in part achieved by drilling a number of holes through the barrier from Munmorah Colliery and monitoring the atmosphere in 300 Panel.

Once gas analysis indicated that it was safe to re-enter the mine a series of inspections by mines rescue trained personnel, were conducted.

By Wednesday, 12th July, access had been gained to 300 panel and an investigation by Inspectors of Coal Mines Inspectors of Electrical and Mechanical Engineering into the causes of the explosion was initiated.

Investigation of the mechanical aspects of the incident could not be commenced until 25th July 1995.

3.0 Investigation

3.1 Investigation Philosophy

Whilst it may be expedient during this type of investigation to aim at identifying a single ignition source so that the one item can be improved upon, it is considered to be more appropriate to identify as many items as possible that could reasonably have ignited methane if they were exposed to methane in the explosive range.

Only by adopting the approach can:-

(a) a more realistic assessment be made of the effectiveness of the colliery management system in preventing ignitions of gas.

(b) a better understanding be gained of the overall level of risk associated with the mining methods being used.

(c) all significant hazards be identified and action taken rather than fix one area per significant incident such as this explosion.

3.2 Location of Zone of Ignition

The report by the U.S.A. experts states that there is a high probability that the zone of ignition is located in 21 cut through between No 1 and 3 headings heading as shown on drawing No ENDINV-10, 11 and 12.

The items of equipment identified as being located within the above area are the following:-

(a) a shuttle car cable
(b) 2 cable anchors
(c) 2 synthetic material connections between the anchors and cable
(d) a chain suspended from 1 cable anchor
(e) numerous synthetic material ties for holding the cable and hose clear of the floor
(f) a water/compressed air hose with both ends open and disconnected.
(g) numerous bolts and w straps supporting the roof.
(h) a MPV timber pod containing some props and wedges.

NOTE flying objects from the first windblast may also have collided in the vicinity of the probable ignition zone and then been blown out of the zone by the later explosion.

3.3 **Other Significant Equipment In the Panel**

The following list of equipment was also examined in some detail and witness statements have been used to identify equipment status:-

Continuous Miner	-	was not cutting coal - had just been pulled back.
Shuttle Car 620	-	was stationary - electric motor driving hydraulics either started or stopped close to when explosion occurred. i.e. power may have been on at the time of explosion.
Shuttle Car 465	-	was stationary
Shuttle Car 442	-	was out of service
StoneDust/Air System	-	stone duster was not operational, no air was being used.
Breaker Line Support	-	stationary
Breaker Feeder	-	may have been operating
Conveyor	-	may have been operating
Load Haul Dump Vehicle(Eimco913)	-	was stopped
Multi Purpose Vehicle(MPV)	-	was stopped
Miscellaneous Items		

4.0 **Investigation Methology**

4.1 **Potential Sources of Ignition**

As there was a considerable quantity of equipment located in the panel and there were a large number of potential sources for any ignition of gas it was resolved to use "brain storming" to list the potential ignition sources for each piece of equipment. The list includes N.S.W. historically reported mechanical fire ignition sources and any other sources of heat which may result in:-

(a) generation of a temperature of 160 degrees C which may lead to spontaneous combustion of coal fines which in turn can lead to a fire which could then ignite methane.

(b) generation of a temperature exceeding 595 degrees C which could ignite methane.

4.2 Overview of Site and Conditions

As a result of the site inspection on 25-7-95 it was identified that no set sequence could be determined for detailed examination of equipment due to potential conflict with the Electrical and Mining Investigations. It was resolved to first conduct detailed inspection of the equipment which did not involve the other investigations and maintain a high degree of flexibility on what was to be examined next.

4.3 Extent of Underground Examination of Equipment

The practical level of underground examination of equipment was determined from the list of possible ignition sources. Underground Examination was split into 2 areas:-

(a) equipment unpowered
(b) equipment powered

Some equipment was examined whilst powered both underground and later in more detail when on the surface

4.3.1 Unpowered Examination included the following

1. Identification of material that was not anti static
2. Oil levels in gearboxes, wheel units etc.
3. Oil levels in brake enclosures that are designed to be oil immersed for cooling
4. Brake wear/adjustment indication
5. Hydraulic oil levels which supply hydraulic pumps
6. Shuttle car cable reeling systems
7. Flameproof enclosures of diesel engines - gaps and cracks etc
8. Shuttle car brake oil analysis
9. Shuttle car brake friction surface removal and examination

4.3.2 Equipment Powered Examination included the following

1. Surface temperature after equipment was run long enough to reach a stable temperature.

2. Operation of low water shut downs and all other safety devices on diesel vehicles.

3. Operation of cable reeling systems on shuttle cars.

NOTE At my request the mine manager obtained the services of thermo view who conducted infra red examination of most of the mechanical equipment located in the panel at the time of the explosion. This is the first time this equipment has been used for a departmental investigation and its ability to reach inaccessible points on operating equipment makes it extremely useful for this type of examination refer to appendix 23.4 and 23.5 for further information.

4.4 Extent of Surface Examination of Equipment

Surface examination was confined to powered operation of the equipment combined with a physical surface examination, temperature checking of all potential hot spots and testing of critical safety devices.

5.0 Potential Ignition Sources

The potential ignition sources (excluding electrical power and those associated with the strata such as from miner picks) considered for the equipment are as follows:-

5.1 Cable Anchors - friction between steel spring and supports
Note - Dynamic testing of anchors is currently being conducted.

5.2 Free hanging chain attached to cable anchor striking W strap or conglomerate roof.

5.3 Air supply discharge hose - static charge potential

5.4 Continuous Miner
- brakes
- all rotating elements, bearing failure etc
- hydraulic pump/motor/failure
- points of excess friction
- motor cooling
- static charge potential on non metallic components

5.5 Shuttle Cars
- brakes (temperature can increase by 60 degrees C if oil level low)
- all rotating elements, bearing failure etc.
- hydraulic pump/motor/failure
- points of excess friction
- motor cooling
- static charge potential of non metallic components
- cable reel

5.6 Breaker Line Supports
- all rotating elements
- hydraulic pump/motor
- static charge potential of non metallic components

5.7 Breaker Feeder
- all rotating elements
- hydraulic pump/motor
- points of excess friction
- motor cooling
- static charge potential of non metallic components

5.8 Conveyor
- all idler bearings
- all pulley bearings
- all points of excess friction
- belt rubbing on structure or other stationary item
- static charge potential of conveyor belt
- drive motor/gearbox/brakes
- transfer blocked
- skirting material anti static potential

5.9 Load Haul Dump Vehicle and Multi Purpose Vehicle
- brakes
- hydraulic pump failure
- flameproofing of inlet system
- flameproof of exhaust system
  - water level
  - flanges, loose bolts
  - components
  - gaskets
  - gas leaks
- excess surface temperatures
  - engine
- ignition in sump
- release of dry soot from engine

5.10 **Static Electricity**

A number of standards state that the use of non anti static material should be limited to pieces smaller than 100 by 100 m.m.

Detailed investigation of the possible ignition potential from the various items of non anti static materials contained within the panel is beyond the normal scope of a Inspector of Mechanical Engineering to comment on.

Non metallic materials that exceeds the 100 x 100 mm dimensions that were in the panel at the time are as follows:-

1. Shuttle Cars
   - hungry boards
   - cable rollers
   - cable anchor webbing
   - cable reel covers - have been tested and identified as not anti static.

2. Air System
   - stone duster discharge hose - has been tested and identified as not anti static.
   - other air hose - has been tested and is anti static.

3. Breaker Line Supports
   - cable covers - have been tested and identified as not anti static.
   - shrouds around cable

4. Diesel Engines
   - air inlet pipe work

5. Continuous miner
   - bumper bar

6. Miscellaneous
   - PVC measuring sticks
   - PVC brattice props
   - oil drum pallet encapsulation
   - safety hats
   - some clothes

   - Cable and hose ties
   - Brattice

6.0 Equipment Maintenance

6.1 All 103 scheme records were reviewed.

6.2 The 103 scheme requirements for diesel engine maintenance were reviewed to check if they covered all the required areas and were also compared with the Departments Guideline for 103s. Possible heat sources were concentrated on during this exercise.

6.3 Shift to Shift hand over reports were reviewed.

6.4 Panel delay reports were reviewed.

7. Historical General Ignition Sources for Fires and Explosions

A literature search has been initiated to identify sources of ignition for fires and explosions. The results include information from actual underground case histories, experimental research and what can be reasonably expected.

The literature search is not yet complete but the following summary is provided:-

Explosion ignition sources are denoted as (E)
All others have or can initiate fires which in turn can ignite methane if it is present.
Research experiments are denoted as ®

NOTE Electric initiation is specifically excluded from the list although historically this is a significant cause of fires and explosions in the USA, UK and South Africa.

<u>Conveyors</u>
- belt rubbing on structure
- idler bearing failure
- pulley bearing failure
- motor bearing failure
- conveyor belt slip
- motor coupling rubbing on timber
- brake rubbing
- conveyor belt rubbing in fines
- conveyor scraper rubbing
- anti static charge from conveyor (a wheat silo) (E)
- coupling rubbing on guard

<u>Continuous Miner</u>
- frictional ignition from striking roof (E)
- bearing failure
- brake overheating
- motor bearing failure
- clutch slips

<u>Electric Shuttle Car</u>
- brake heating non oil cooled
- brake heating, oil cooled
- bearing failure
- motor bearing failure

<u>Stone Duster</u>
- static charge

<u>Breaker Line Support</u>
- motor bearing failure
- hydraulic pump failure

<u>Breaker Feeder</u>
- motor bearing failure
- bearing failure
- build up fines around fly wheel
- hydraulic pump failure

Diesel Vehicle

- engine not flameproof at joints/clearances
- exhaust conditioner not flameproof
- exhaust conditioner shutdown fails or is bypassed
- engine over temperature
- shut down fails or is bypassed or fails to operate
- Vee belts not anti static
- fan blade strikes another object
- drive shaft rubs
- bearing failure
- brake rubs
- air compressor overheats
- starter motor jams

Fans

- bearing failure
- friction of rotating surfaces (E)

Shearers

- frictional ignition from striking roof (E)
- bearing failure
- brake overheating
- motor bearing failure

Face Conveyor Blind End Bearing - failure

Gearboxes/Drives

- bearing failure
- fluid

Crushers

- bearing failure

Miscellaneous

- rock on rock and metal on rock collisions during roof falls.
- aluminium and rusted steel impact
- silumin and a rusted steel rotating disc ®
- steel and a rotating copper disc ®
- steel and a rotating brass disc ®
- welding/cutting
- vandalism
- pump and pump motor bearing
- roof bolter drive/friction
- compressor
- smoking

PAPER 8

NSW DEPARTMENT OF MINERAL RESOURCES

SIXTH MECHANICAL SAFETY SEMINAR

22 MARCH 1996

REVIEW OF FSV ACCIDENTS AT NSW UNDERGROUND COAL MINE OPERATIONS

PERIOD OF REVIEW 1988 - 1995

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ABSTRACT

This paper updates the accident statistical data related to the operation of Free Steered Vehicles operating in underground coal mines presented at the Third Mechanical Seminar in 1993 Coal Mines Safety Advisory Committee's Working Group in a paper entitled "Review of Recent Accident Experience related to Free Steered Vehicles."

The period of review covered by this paper is from July 1991 to September 1995.

INTRODUCTION

The intent of this paper is to ascertain whether the safety performance of underground Free Steered Vehicle operations has changed perceptibly since the commencement of the awareness program initiated by the Coal Mines Safety Advisory Committee following the fatal accident that occurred at Newstan Colliery in June 1991.

BACKGROUND

Prior to undertaking any reviews for a specific aspect of safety in coal mines such as FSV operations it is important to look at the industry's overall safety performance. This is necessary in order to achieve credibility for any review conducted into the specific aspect of safety performance as proposed by this paper.

The measure used in this review is the number of fatal accidents that have been recorded. Since 1984 the year that the Regulation's were promulgated under the 1982 Coal Mines Regulation Act a total of 54 fatalities have occurred in NSW Coal Mines, 44 of these occurred whilst underground mining activities were in progress.

The agencies attributed to the 44 underground fatalities and the number of fatalities for each agency are listed in Table # 1.

TABLE 1

TOTAL NUMBER OF FATALITIES - UNDERGROUND

1984 - 1995

Incident Type	**Number**
Fall of Roof	19
Noxious Gas	6
Mechanical	11
Transport	7
Electrical	1
TOTAL	**44**

In order to provide an appropriate weighting to the types of fatalities by factoring out the effect of multiple deaths, the number of incidents attributed to each agency are listed in Table # 2.

TABLE 2

TOTAL NUMBER OF FATAL INCIDENTS

1994 - 1995

Incident Type	Number
Fall of Roof*	16
Noxious Gas	4
Mechanical	11
Transport	7
Electrical	1
TOTAL	**39**

[* - One incident resulted in 2 fatalities, and another resulted in 3 fatalities]

The breakdown of the fatalities on an annual basis is shown in Table # 3.

TABLE 3

BREAKDOWN OF FATALTIES PER YEAR

Year	Fall of Roof	Transport	Noxious Gas	Mechanical	Electrical
1984 / 1985	2	3	1	-	-
1985 / 1986	1	2	-	1	1
1986 / 1987	3	1	1	2	-
1987 / 1988	1	-	-	-	-
1988 / 1989	2	1	-	1	-
1989 / 1990	1	-	-	-	-
1990 / 1991	7	-	-	1	-
1991 / 1992	-	-	3	3	-
1992 / 1993	2	-	-	1	-
1993 / 1994	-	-	1	-	-
1994 / 1995	-	-	-	2	-
TOTAL	**19**	**7**	**6**	**11**	**1**

From this breakdown a number of observations can be made.

- Fatalities associated with the operation of mechanical equipment in underground mines have been regular events for the period of review i.e 1984-1995. - 'MEC'

- Fatalities associated with the operation of FSV's are included in the MEC category and make up 7 of the total of 11 incidents each of which resulted in a single fatality.

- The agency categorised as TRA (Transport of Men/Material) traditionally associated with rail track operations has not recorded a fatality since December 1988.

- The FOR (Fall of Roof) category has recorded the occurrence of 1 only incident since the triple fatality incident at Western Main in May 1991. Unfortunately the sole incident at Ivanhoe resulted in 2 fatalities.

It can clearly be observed that the occurrence of fatal accidents involving FSVs has not changed markedly over the review period.

Note: Fatalities in themselves are not a true arbitor of industry safety and for information re this indicator the Fatality rates for all NSW coal mines and NSW Underground Coal Mines for employment numbers and tonnes produced have been attached as Appendices 1 & 2.

FREE STEERED VEHICLE SAFETY PERFORMANCE

Clearly from the above review of the fatalities that occurred in underground operations that the regular occurrence of FSV accidents warrants close scrutiny.

At the Third Mechanical Safety Seminar held in April 1993 a paper presented by a Working Group formed by the Coal Mines Safety Advisory Committee provided a detailed assessment of the "D" Forms submitted to the Joint Coal Board for period July 1988 to March 1992. This assessment identified the frequency and severity of the differing agencies that contribute to FSV accidents and resulting injuries excluding those involving the operation of shuttle cars. Primarily the types of vehicles covered by the review were diesel engine powered types including men and materials transporters and LHD vehicles.

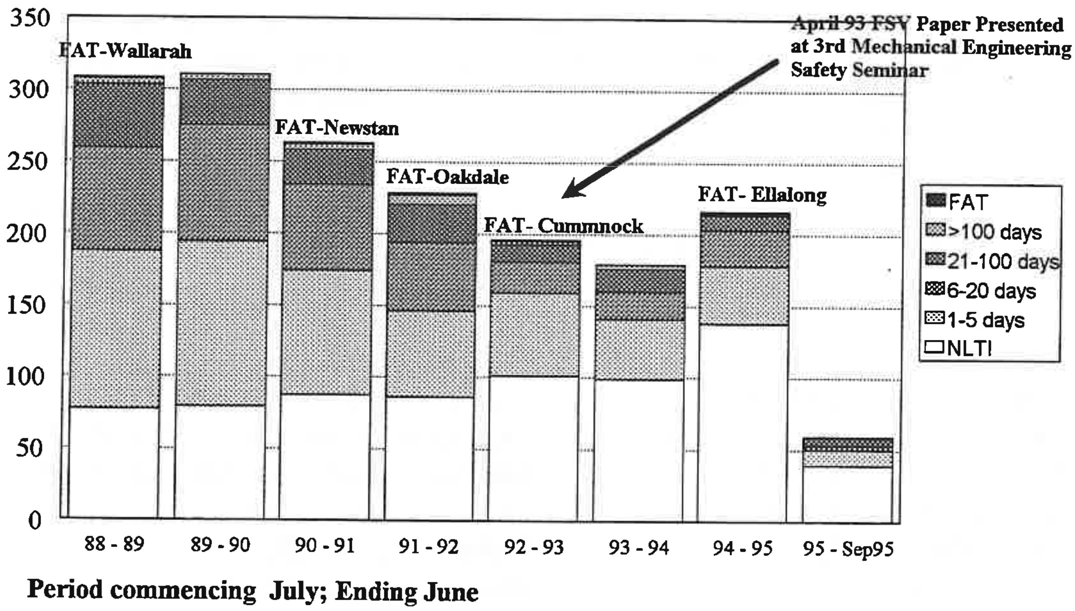
At the time that the above paper was prepared a total of $3,385,000 had been paid out for the 1026 injury reports received by the Joint Coal Board.

This paper extends the review period covered by the original paper to include a full 7 years thus enabling an assessment of what the trend is with regard to the operation of the above vehicle types. This data has been attached into yearly periods and the results are shown in Graph #1

GRAPH 1

Total Underground Mine FSV Incident

Period July 1988 - Sept 1995



Graph # 1 shows a steady decline in the total number of accidents for the four (4) years commencing 1990/91.

The number of accidents recorded for 1994/95 reversed this trend. This change in the trend is attributed to the escalation in the number of No Loss Time Injury claims recorded for that year. In fact whilst as mentioned up to the 1994/95 year the total number of claims decreased from the first two (2) years this occurred against a steady increase in the NLTIs for the full seven (7) year period.

For details of the fatalities noted on Graph # 1 refer to Appendix 3 which provides details of all six (6) fatalities recorded since 1984.

It is to be noted that the most recent two (2) fatalities were caused through inadvertent movement of unattended vehicles that resulted in fatal injuries to the persons that had recently alighted from the driver compartment. In both instances it would seem that the parking brake was in the released state as these mechanisms were found to be in a satisfactory condition when the vehicles were subsequently thoroughly inspected. The installation of automatic park brake systems to Free Steered Vehicles was promoted by Inspector of Mechanical Engineering Mr R Hoerndlein with a paper also presented at the 1993 Seminar.

Perhaps in hindsight if all underground coal mines had heeded the advice provided within that paper as suggested with the following extract: "I now recommend you have another good look at your machines and make sure you've got this problem covered, or take steps to do so;' that in all probability those (2) fatalities could have been avoided.

This issue was considered to be of significance by the Coal Mines Advisory Committee following the Ellalong incident that the installation of an automatic park brake system to all diesel engine powered vehicles was made mandatory. All such vehicles now require to be fitted with this system by 23 October 1996.

The severity and type of injuries of FSV incidents for the 4.25 year period from July 1991 to September 1995. have been categorised in accordance with the range of agencies utilised in the CMSAC Working Group's paper. These categories are as follows:

Driving over Coal/Stone (DC)
Driving over Bumps/Hoes (DH)
Hitting Seam Roof (DHR)
Driving into Water (DIW)
Driver Error (DR/E)
Entering Machines (EM)
Entering Machines - Greasy (EMG)
Equipment Failure (EQ/F)
Flying Debris (FD)
Housekeeping (HK)
Leaving Machines (LM)
Leaving Machines - Slip Coal (LMC)
Leaving Machines - Greasy (LMG)
Leaving Machines - Step in Hole (LMH)
Machine Moved Unintentionally (MMU)
Miscellaneous (MISC)
Radiator Burns (RB)
Repairing Machine (RM)
Slip/Jump off Top of Machine (S/JM)
Slipping in Bucket (SB)
Slipping near Machines (SL)
Unloading/Loading Material (ULM)
Vehicle Design (VEH)

Table # 4 which summarises the 879 'D' Forms extracted from the JCB records provides a breakdown of all FSV incidents in the above categories for each annual period together with the totals for the 4.25 years review period.

As for the previous study, the injuries were classified in the following order of severity based on the number of days lost for each category.

No days lost	
One to Five days lost	1 - 5
Six to Twenty days lost	6 - 20
Twenty One to Hundred days lost	21 - 100
Over Hundred Days Lost including fatalities	100+

TABLE 4 Total Underground FSV Incidents - Period July 1991 to Sept 1995

July 1991 to June 1992

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI	4	23		1	5	2		6	3	8	6					3		11	4	1	1	4	4	86
1 to 5	2	8			7	3		1	3	3	4		1		2	4		4	4	1	2	6	5	60
6 to 20	6	9			2	2				1	9	1	1		2	2		4	2		2	4	1	48
21 to 100	1	3			1	3				4	4							2	3	1		4		26
> 100		2			2			1			1							1						7
FAT					1																			1
TOTAL	13	45	0	1	18	10	0	8	6	16	24	1	2	0	4	9	0	22	13	3	5	18	10	228

July 1992 to June 1993

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI	4	17	4	5	7	4		6	6	5	6				2	3		19	4		1	4	4	101
1 to 5	1	20	1		2	2			4	5	5	2	1			1		3	5	2	2	1	1	58
6 to 20	1	7			1	1		2	1	2	2					1		2			1		1	22
21 to 100		4			3			1		1								1		1		1		12
> 100																		1					1	2
FAT					1																			1
TOTAL	6	48	5	5	14	7	0	9	11	13	13	2	1	0	2	5	0	26	9	3	4	6	7	196

July 1993 to June 1994

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI	7	20			5	3		2	2	9	9				3	7		7	9	1	3	9	3	99
1 to 5	4	9		1	7	2	1	2		3	3				1	1		5	1			1	1	42
6 to 20	2	9			1	1					2					1			2		1			19
21 to 100		7			3						1					1		1				1	2	16
> 100		1								1						1								3
TOTAL	13	46	0	1	16	6	1	4	2	13	15	0	0	0	4	11	0	13	12	1	4	11	6	179

July 1994 to June 1995

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI	7	42	1	1	10	8	1	5	1	2	10		1		3	8		10	11		5	10	2	138
1 to 5	2	12			3	1		2		3	2				1	3		3		2	1	5		40
6 to 20		6	2		1	2		2		1	2				1	1		1	2	1		1	2	25
21 to 100		4			1	1		1		1	1									1		1		11
> 100		2																						2
FAT					1																			1
TOTAL	9	66	3	1	16	12	1	10	1	7	15	0	1	0	5	12	0	14	13	4	6	17	4	217

July 1995 tp Sept 1995

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI		8	1		2	2		2	1	5	4				2	2		3	4		1	2		39
1 to 5	2	3		1	2					1	1								1					11
6 to 20		1																		1	1			3
21 to 100		2			1						1					1		1						6
> 100																								0
TOTAL	2	14	1	1	5	2	0	2	1	6	6	0	0	0	2	3	0	4	5	1	2	2	0	59

TOTAL

	Coal	Bump	Roof	Water	Driv Error	Entering Machine	Enter Mac Greasy	Equip Failure	Flying Debris	House Keeping	Leaving Machine	Leav Mac Slip Coal	Leav mac Greasy	Leave Mac Step Hole	Moved Unintent	Miscell	Radiator	Repair	Slip Jump	Slip Bucket	Slip near Machine	Unload Load	Vehicle Design	TOTAL
NLTI	22	110	6	7	29	19	1	21	13	29	35	0	1	0	10	23	0	50	32	2	11	29	13	463
1 to 5	11	52	1	2	21	8	1	5	7	15	15	2	2	0	4	9	0	15	11	5	5	13	7	211
6 to 20	9	32	2	0	5	6	0	4	1	4	15	1	1	0	3	5	0	7	6	2	5	5	4	117
21 to 100	1	20	0	0	9	4	0	2	0	6	7	0	0	0	0	2	0	5	3	3	0	7	2	71
> 100	0	5	0	0	2	0	0	1	0	1	1	0	0	0	0	1	0	2	0	0	0	0	1	14
FAT	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
TOTAL	43	219	9	9	69	37	2	33	21	55	73	3	4	0	17	40	0	79	52	12	21	54	27	879
	5%	25%	1%	1%	8%	4%	0%	4%	2%	6%	8%	0%	0%	0%	2%	5%	0%	9%	6%	1%	2%	6%	3%	100%

In order to permit ease of review of the types of injuries recorded for the above period with that for the period considered by the Working Group the information has been reformatted as Graph #2.

The graphed results from the earlier study have been attached as Appendix #4 to permit assessment of for both periods to be undertaken.

As in the previous study injuries attributed to vehicles driving over bumps/holes (DH) were the category that recorded the largest number ie. 25% of all injuries

The total amount of compensation paid out by the JCB for FSV related injuries as at the time of preparation of trhis paper is $3.12M. This is approximately the same as quoted in the Working Group's paper. It needs to be realised that in both instances the sums quoted are not the final amounts.

It is also observed that no injuries were associated with radiator burns or with loose materials entering the lower part of LHD operators compartments. This validates the directives issued by the Inspectorate on these issues some years ago.

In 1995 the Inspectors of Mechanical Engineering formally promoted the introduction of an upgrading program for diesel engine powered FSVs. The industry's response to this initiative to improve the quality of the safety aspects of the vehicle fleet using MDG #1 as a guide has been mixed. Adverse criticism was received from some coal mines in that such an upgrade program would not eliminate any of the types of injuries as referred to previously.

This is disputed with those types of injuries considered relevant issues within MDG 1 have been identified with an * on Graph # 2

Certainly the prepared upgrade program would not be a panacea for all types of injuries and that other factors with operation of FSVs in underground coal mines also exist.

These factors are listed as:

1. Roadway conditions including surface and clearance issues.

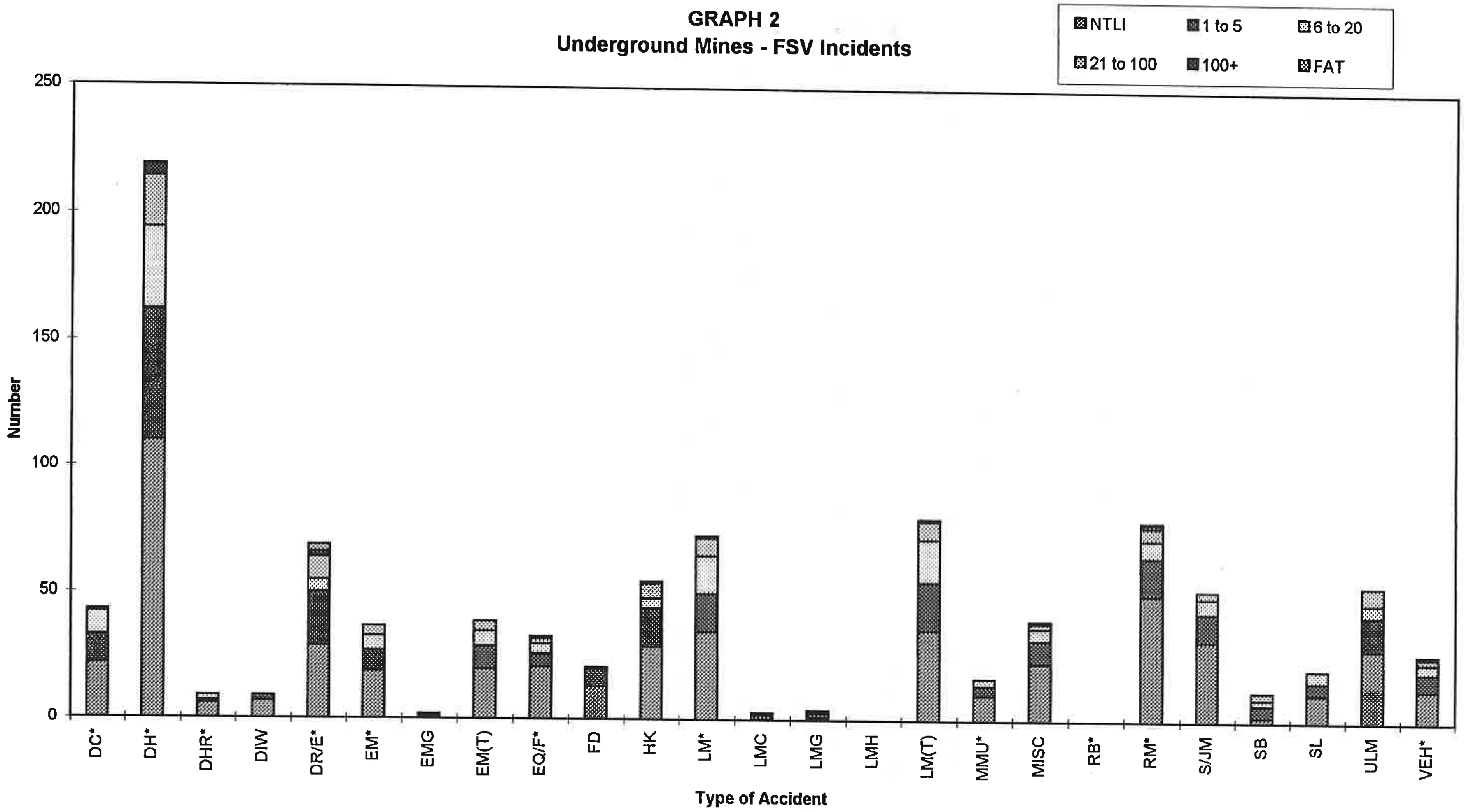
2. Competency of FSV Operators.

3. FSV fleet Management System.

Optimal safety for FSV operations will only be achieved when all four (4) factors are being effectively managed. It is difficult to comprehend that criticism of the upgrade program could be warranted by those in the industry when there is little evidence of the issues presented by the other three (3) factors as being addressed.

NOTE: For those that may be seeking information regarding Operator Competencies the Mt Isa Mine paper presented at the 1993 Seminar has been reprinted and included in this Seminar's proceedings.

GRAPH 2
Underground Mines - FSV Incidents



Note: Those accidents with (*) are effected by MDG 1

From July 1991 to Sept 1995

CONCLUSIONS

Major events in the form of fatalities have occurred on a regular basis since 1984 associated with the operation of Free Steered Vehicles and Shuttle Cars. These events have been masked by fatalities caused by other more traditional types of events such as roof fall, outburst and locomotive runaways. Preventative measures have been undertaken that have reduced those traditional events. It is of course recognised that this may not manifest itself as a permanent outcome.

Improving the fitness for purpose with FSV design has been undertaken by vehicle manufacturers however the industry in general has not recognised the benefit of this by upgrading old vehicle design types when overhaul programs are undertaken.

Compensatable injury payouts have been in the order of $ 1M /year since 1988.

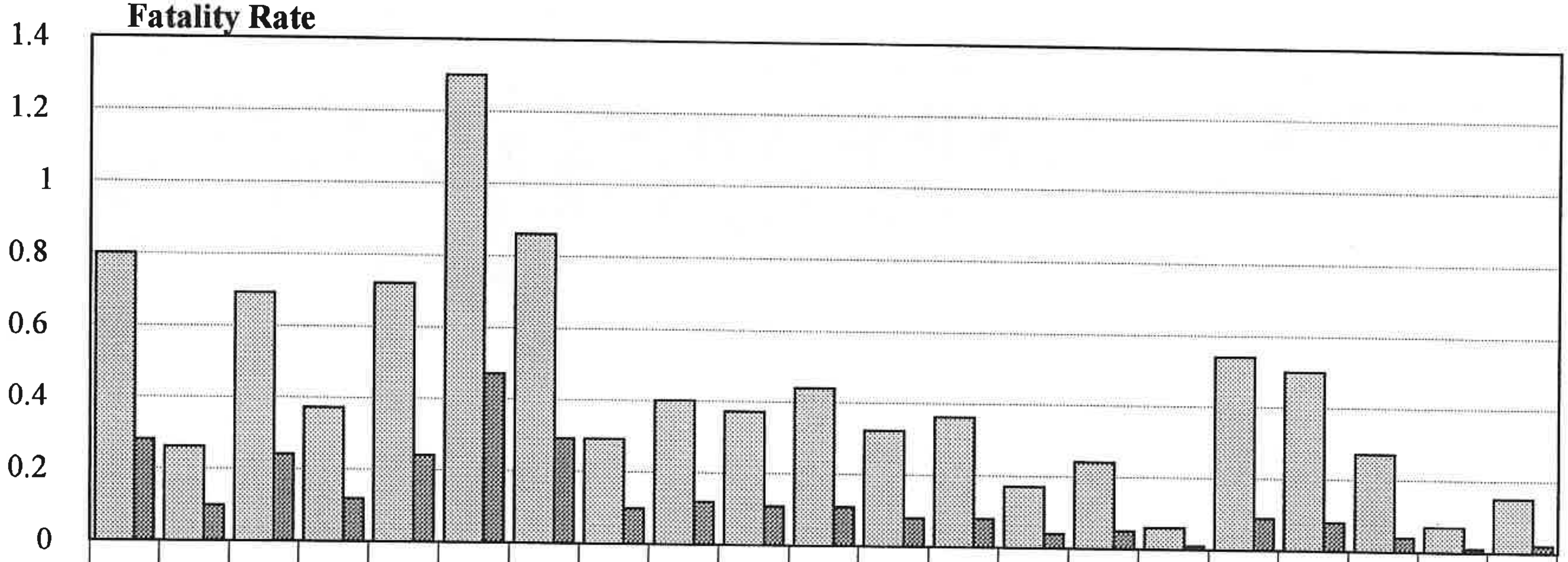
879 injuries were reported to the Joint Coal Board for 4.25 years from July 1991 to September 1995 as against 1026 injuries for 3.75 years from July 1988 to March 1992. However the number of FSV incidents recorded for 1994/95 has reversed the downward trend that commenced 1990/91.

There is no doubt that a vehicle fleet upgrading program would be effective in improving the safety of operators and personnel working in the vicinity of FSVs.

Underground coal mines should review operator competency requirements, for adequacy, improve the roadway conditions that interface with the operation of FSVs and closely scrutinise their Vehicle Operation Management System through a formal audit process.

APPENDIX 1

FATALITY RATE
NSW COAL MINES



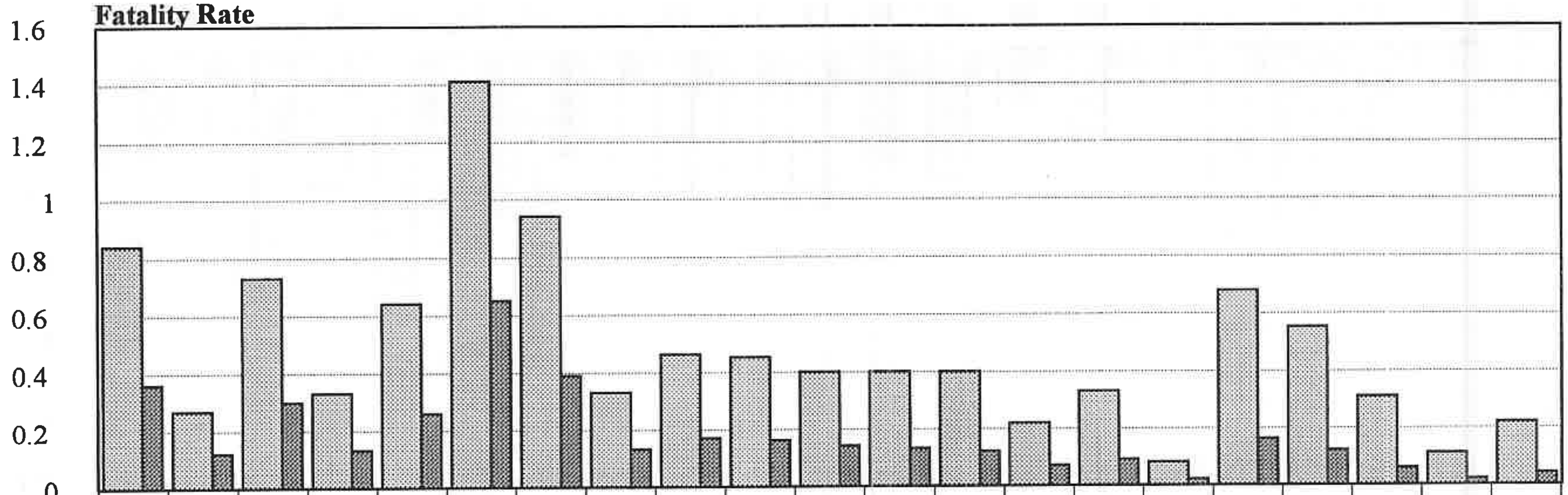
	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
FAT/1000Emp	0.8	0.26	0.69	0.37	0.72	1.3	0.86	0.29	0.4	0.37	0.44	0.32	0.36	0.17	0.24	0.06	0.54	0.5	0.27	0.07	0.15
FAT/MTonne	0.28	0.1	0.24	0.12	0.24	0.47	0.29	0.1	0.12	0.11	0.11	0.08	0.08	0.04	0.05	0.01	0.09	0.08	0.04	0.01	0.02

Year Ended June

FAT/1000Emp FAT/MTonne

APPENDIX 2

FATALITY RATE
NSW UNDERGROUND COAL MINES



	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
FAT/1000Emp	0.84	0.27	0.73	0.33	0.64	1.41	0.94	0.33	0.46	0.45	0.4	0.4	0.4	0.22	0.33	0.08	0.68	0.55	0.31	0.11	0.22
FAT/MTonne	0.36	0.12	0.3	0.13	0.26	0.65	0.39	0.13	0.17	0.16	0.14	0.13	0.12	0.07	0.09	0.02	0.16	0.12	0.06	0.02	0.04

APPENDIX 3

PRECIS OF FREE STEERED VEHICLE /SHUTTLE CAR FATALITIES

Mine: Myuna
Date: 3/12/86
A machineman suffered fatal crush injuries when caught between a shuttle car and the boom of a continuous miner. The accident occurred on a crest of a seam floor undulation which made it diffiecult for the shuttle car driver to determine the situation at the face.

Mine: Wallarah
Date: 22/5/89
A deputy was crushed between the rear of a cable reel shuttle car and the coal rib. The injuries sustained proved fatal. At the time, the shuttle car was carrying a load of coal from the continuous miner to the section conveyor belt. As it was negotiating a left hand turn, the rear of the shuttle car swung towards the rib and struck him. Four wheel steered vehicles behave in a different manner from two wheel steered vehicles as they are negotiating corners and shuttle cars, with an overhang in excess of 1.8 metres present a very real danger because the rear of the machine moves quickly in a direction opposite to that in which the vehicle is steered.

Mine: Newstan
Date: 26/6/91
A machineman sustained fatal injuries when crushed between the rib and the steered wheel of a dual seat MPV at the bottom of the men and material drift. The deceased was moving the MPV forward, off a flat top, and down a ramp while seated in the incorrect driving seat for the direction of travel and with his back to the closest rib line. The rib had been undercut over a period of time allowing the driver's compartment of the MPV to pass under the protruding rib, thus trapping the driver.

Mine: Oakdale
Date: 3/392
A contractor sustained fatal injuries when his head was crushed between the mine roof and the driver's compartment of an Eimco 913 LHD machine. The deceased was the driver of the Eimco 913. He was in the process of loading out a fall of roof stone at the worksite. There were no witnesses to the accident as the deceased was working alone. His body was discovered slumped in the driver's seat by other workmen who arrived at the site. The Eimco had been "back blading", ie, pulling stone back from the fall by inverting the bucket and reversing away from the fall to form a ramp which the Eimco could negotiate later to allow roof support work to be carried out from the Eimco

bucket. The stone dragged back by the back blading operation considerably reduced the floor clearance at the lip of the fall cavity. It was at the reversing the Eimco under the lip. The Eimco was not fitted with any protective device to prevent the driver's head from coming into contact with the mine roof.

Mine: Cumnock
Date: 1/10/92
A deputy was driving a 'Domino Mines Mobile" through a double set of ventilation doors at 35c/T Main South Headings. The Deputy was at the second ventilation door when crushed against the door by the machine he had just been driving. It appears that the Deputy died from crush injuries to the chest and/or abdomen. It has not yet been determined why the machine rolled forward, early possibilities are incorrect park up procedure or analysis is being and will continue to be conducted

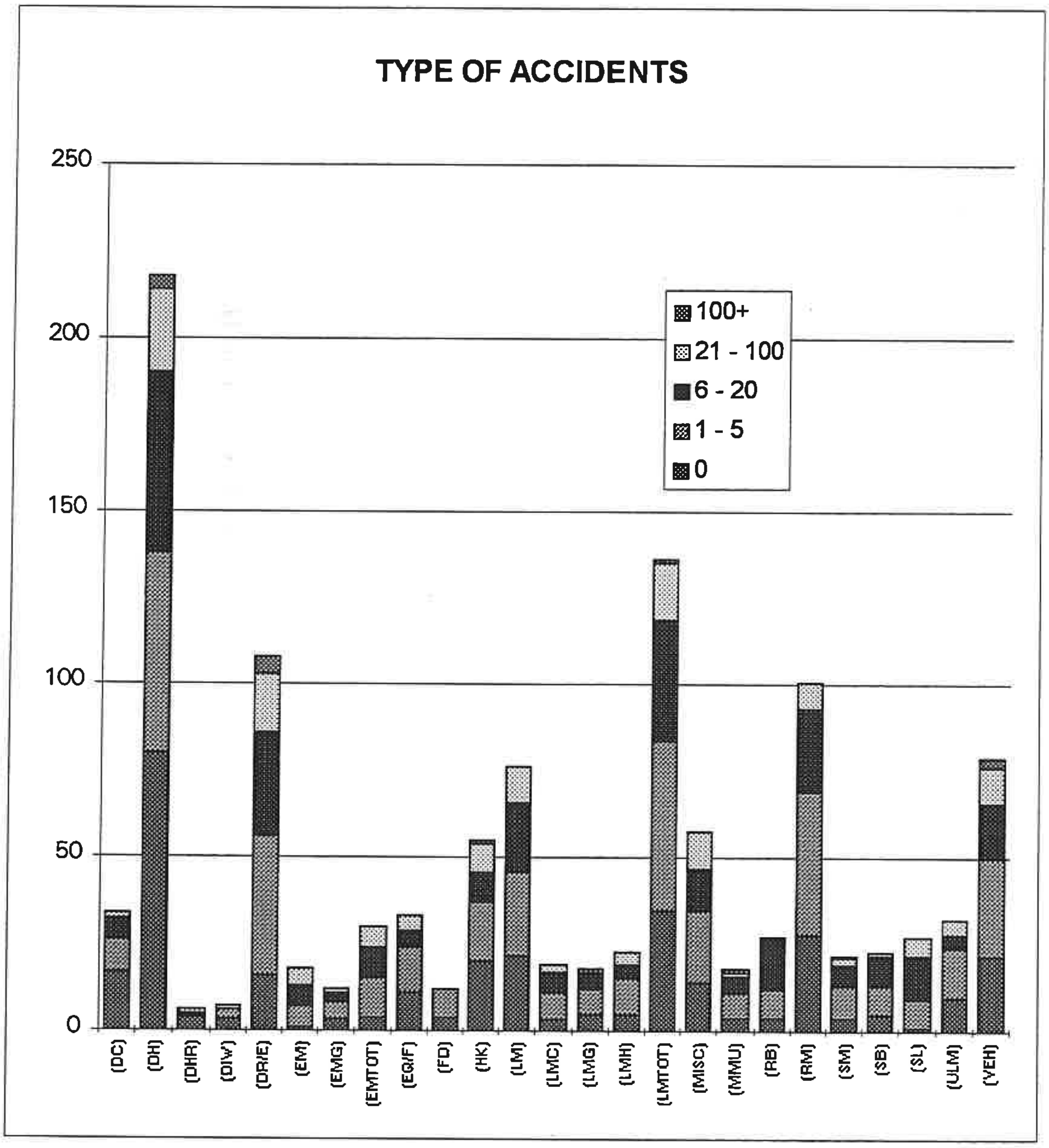
Mine: Ellalong
Date: 26/4/95
A fitter received fatal injuries after an Eimco LHD ran over him. It appears that the fitter had moved the Eimco to a position up hill of an out of service P.J Berriman prior to working on the sump of the PJB. It appears that the fitter failed to apply the Park-brake of the Eimco. While the fitter was lying on the ground between the Eimco and the PJB, the Eimco ran away, the bucket passed over the top of the fitter, the PJB was pushed further down the hill. The fitter was found between the two front wheels of the Eimco. Failure to correctly secure a parked vehicle. Working on the down hill side of a vehicle. Mixed parked vehicles being repaired and serviced. Severely Sloping Floor in a repair /service bay. Investigation pursuant to the CMRA leading to the coronial process. The DICM issued two notices pursuant to S63 CMRA:- Requirement for all rubber tyred diesel vehicles at the mine to be fitted with a brake which automatically applies when an operator leaves the cab and when the engine stops. Requirement for the Mine to construct two underground garages to a specification consistent with C134 mechanical UG regs with additional specs added by the DICM. It is recommended that all UG mines in the state act on these two Sections 63.

APPENDIX 4

GRAPH OF TYPE AND SEVERITY OF ACCIDENTS

PERIOD JULY 1988 TO MARCH 1992

(Reprint from 1993 Third Mechanical Engineering Safety Seminar - Titled "Recent Accident Experience Related to Free Steered Vehicles- Paper prepared by Coal Mines Safety Advisory Committee Working Group)



PAPER 9

David Spears
Engineering Manager

Long-Airdox Pty Ltd

SIXTH MECHANICAL ENGINEERING SAFETY SEMINAR PENRITH 1996

BATTERY POWERED FREE STEERED VEHICLES -

MECHANICAL MAINTENANCE REQUIREMENTS FOR HAZARDOUS ZONE OPERATION

CONTENTS

SYNOPSIS

The ever increasing demands to increase production, provide greater flexibility and improve the overall ergonomics of underground machinery presents new demands on O.E.M suppliers.

To facilitate these requirements has lead to improved machine designs with greater maintenance diagnostic information available to operators. Machine ergonomics has become a major consideration for equipment designers with operators often spending there entire working shift within the confines of the vehicle, not to mention the statuary requirements under the occupational health and safety act.

1.0 INTRODUCTION

The use of battery power equipment is not new to the Australian coal mining industry, such equipment as man transport / material locomotives and support equipment have been in use for a number of years. These vehicles have predominantly work outbye of the hazardous zone and the battery power source has been limited in size, battery charging has for the main part been completed on the surface. In today's economic climate the mine owners and mine managers demand increases in productivity often with less mining personnel. This has resulted in colliery engineers looking for capital equipment and services that are able to meet these demands. The Australian coal mining equipment supplier must continually look at improving the performance of there products to provide the reliability, safety, flexibility, operator comfort, production and operating criteria that is specified by the coal mining industry.

2.0 REVIEW OF THE POTENTIAL HAZARDS WITHIN A ZONE ONE AREA

There a number of safety hazards in an underground coal mine, often with large machinery moving around in relatively small spaces, visibility is limited because of the environment in which mining personnel are working within. For the purpose of this paper we will concentrate on the main hazards within the zone one area in conjunction with free steered vehicles.

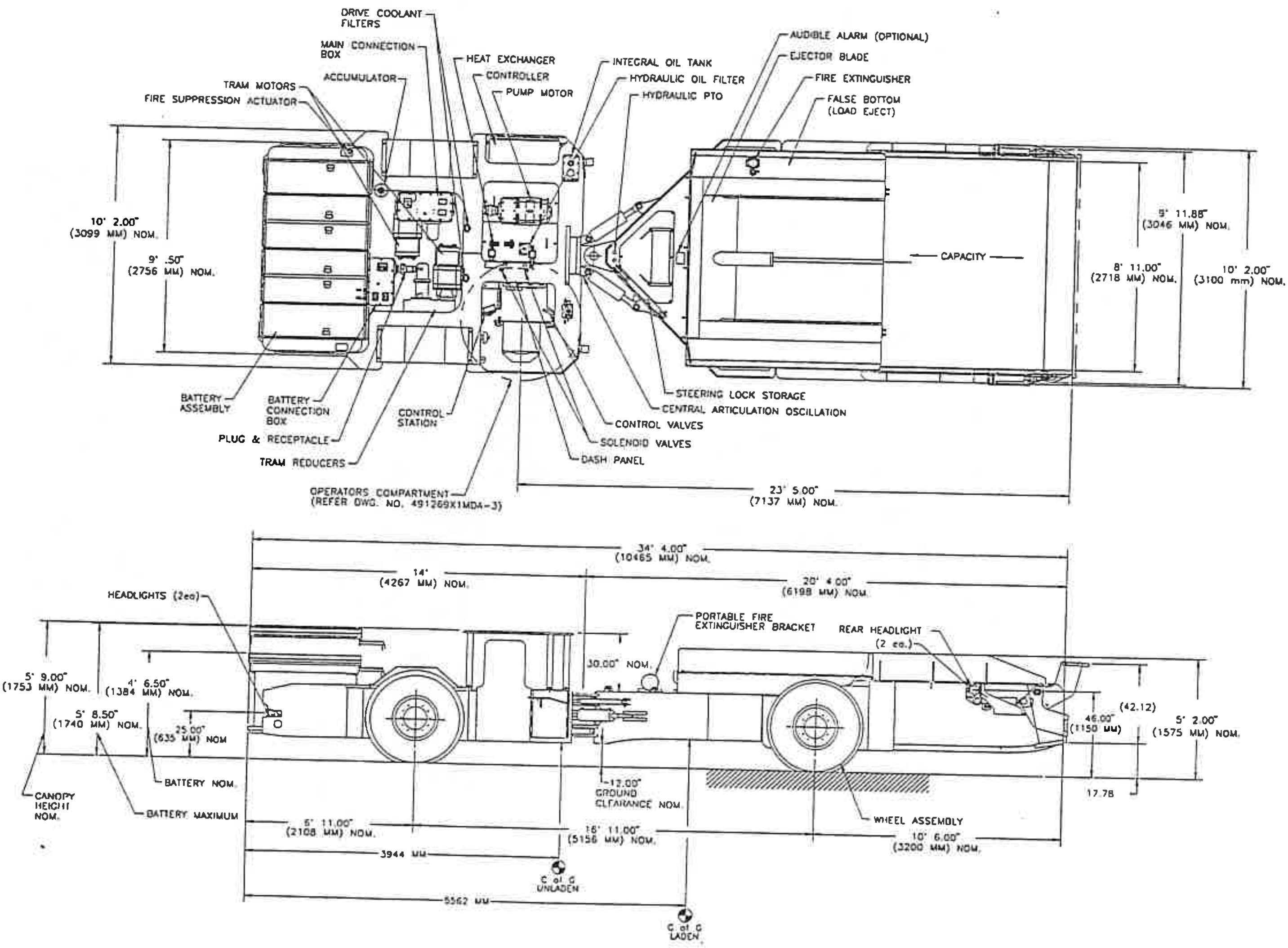
- Roof fall and or rib spaw
- Collision with other equipment
- Gas Outburst
- Fire or underground explosion (excessive heat or spark)
- Personnel injury by moving vehicles
- Electrical shock of operator caused by faulty equipment.

Before we review the effects of these potential hazards have when using battery powered equipment within the zone one area it is important to look at the vehicle layout construction.

3.0 TYPICAL BATTERY POWERED FREE STEERED VEHICLES

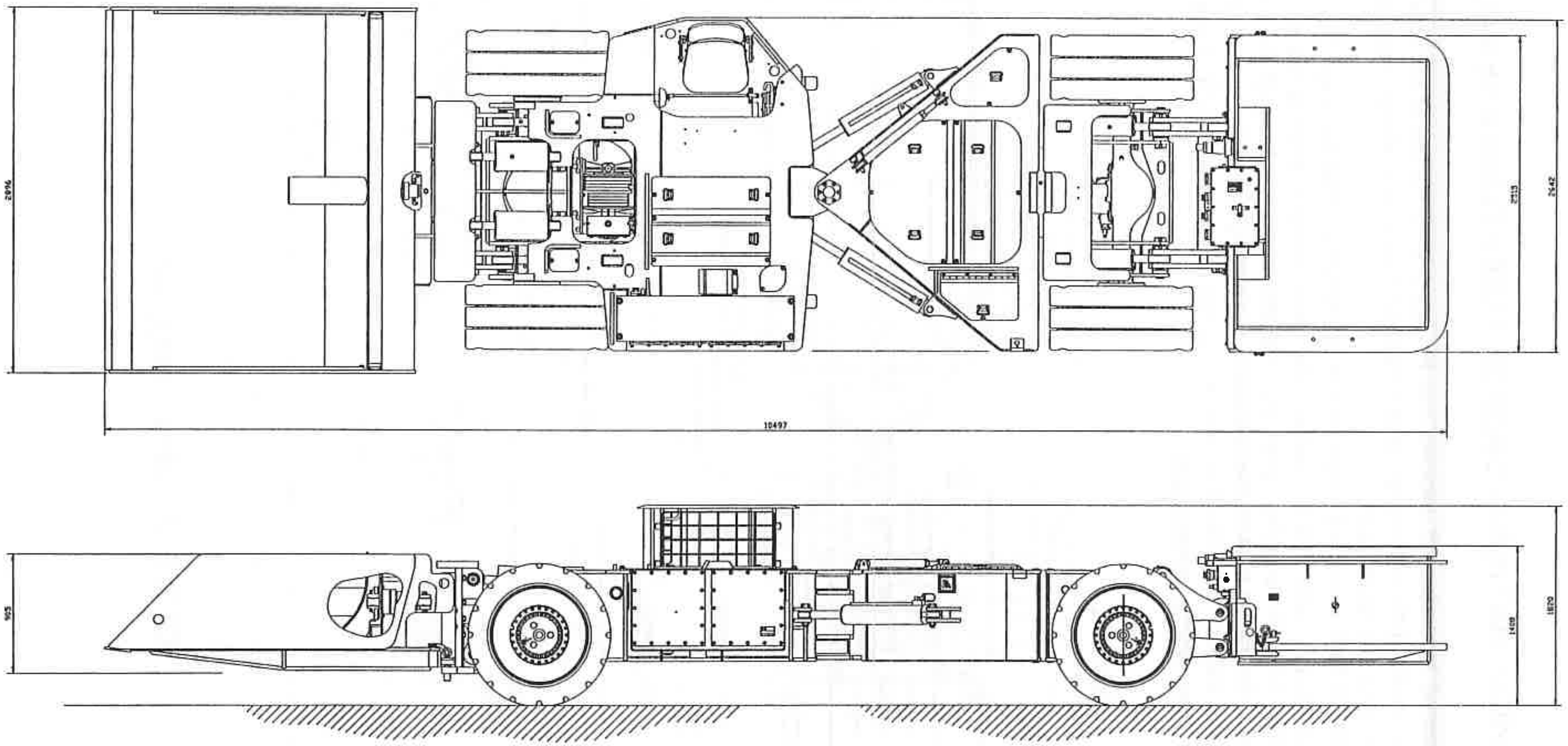
Battery powered free steered vehicles can be used for a variety of purposes including removal and installation of longwall face equipment, coal or material haulage, roadway maintenance and man transport.

Below is vehicle that would be used for the transport of coal between the continuous miner and conveyor boot end or feeder. The main traction drive is via dc flameproof electric motors through reduction gear unit, the operating functions of the machine are done through a hydraulic system these include such things as steering and braking. The power source (battery) on this machine is located at the drivers end of the vehicle as are the main mechanical components.



CHA 818 UN-A-HAULER

E.O No	REV	REASON FOR REVISION	CKD	DATE
908	0	RELEASE		



SURFACE FINISHES	
Micro m	DESCRIPTION
0.1	PRECISION POLISH
0.2	FINE POLISH
0.4	COMMON POLISH
0.8	GRIND OR EQUAL
1.6	SMOOTH MACHINE
3.2	COMMON MACHINE
6.3	ROUGH MACHINE
12.5	HEAVY ROUGH
25	EXTRA HEAVY ROUGH

UNSPECIFIED MACHINING TOLERANCES

Angular: LENGTH OF CHORD Y TO COMPLY WITH LINEAR TOLERANCES

Linear DIM	TOL
0-30	±0.2
30-120	±0.3
120-315	±0.5
315-1000	±0.8
1000+	±1.2

THIRD ANGLE PROJECTION

DO NOT SCALE IF IN DOUBT,ASK

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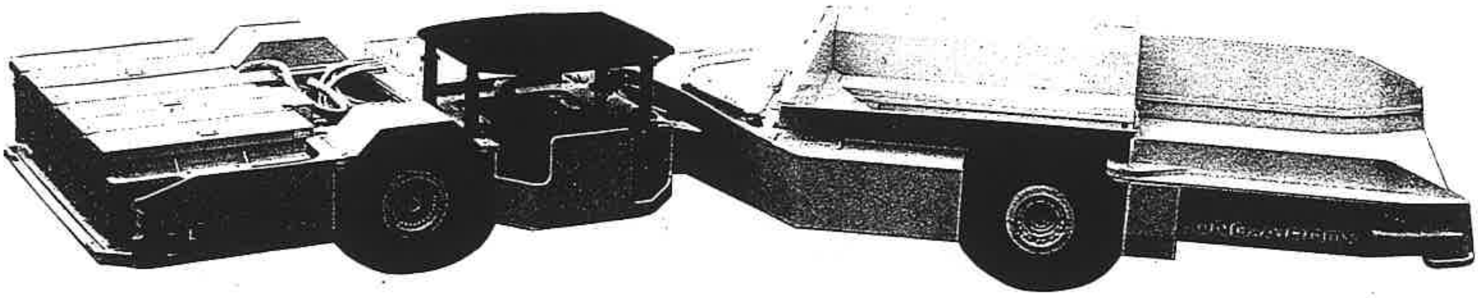
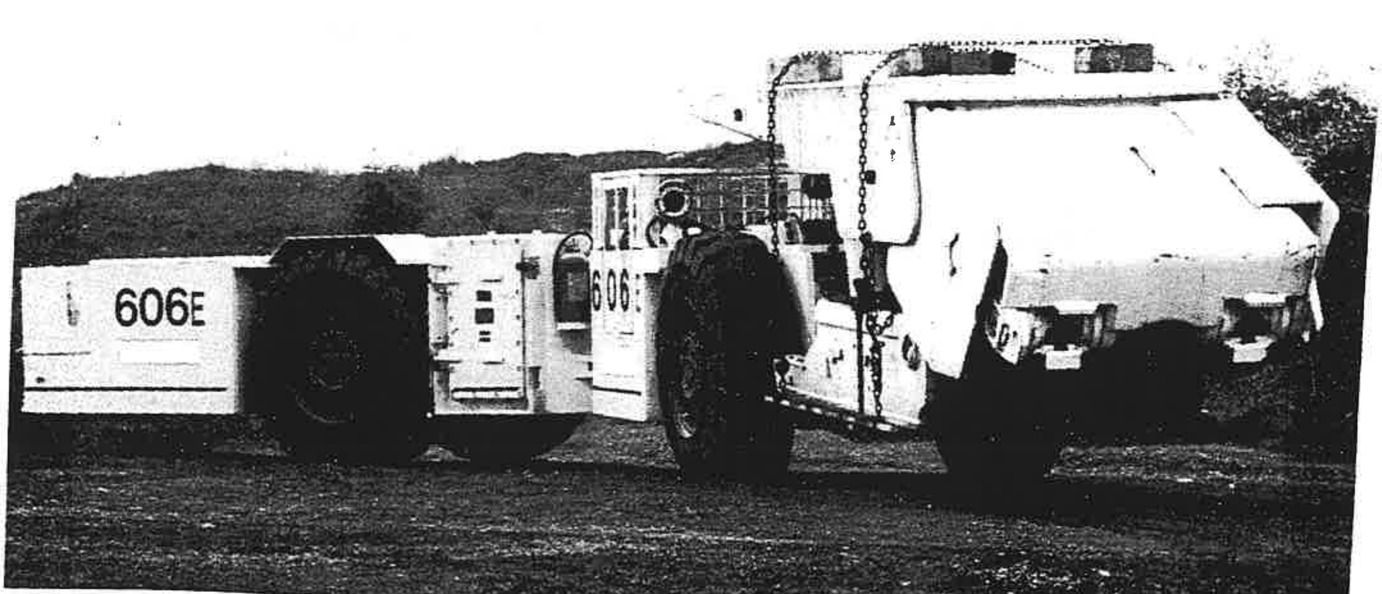
Scale | Drg N° XM 5411 | Sheet of | A2

UN-A-HAULER.
UNIQUELY LONG-AIRDOX.



606 E BATTERY POWERED FSV



3.1 MACHINE DESIGN

To reduce and were possible eliminate the risks or hazards associated with free steered vehicles (this not limited to battery powered equipment) operating within a zone one area. The machine designer should incorporate the following design features.

- The vehicle should be fitted with overhead and rib operator protection of sufficient capacity to provide protection against roof fall or rib spaw.

- The operator should be elevated so his line of sight is not impeded by the surrounding machine, lights of adequate lux density need to be fitted.

- Methane monitor to detect gas levels (max 2%).

- Temperature switch / indication fitted Electric motors.

- Electrical enclosures designed to Ex-1a standard.

- Batteries not to changed in the zone one area.

- Electrical motors to be flameproof.

- Audible warning devices fitted.

- Earth leakage protection.

- A system for towing the machine if it becomes disabled.
- Adequate ventilation and insulating protection against battery arcing.

- All maintenance work on the machine should be performed outside the hazardous zone.

NOTE
If the level of gas approaches a dangerous amount or the machine is disabled then it should be removed immediately outside the zóne one area.

4.0 MECHANICAL MAINTENANCE OF BATTERY POWERED EQUIPMENT

The general construction of these is not dissimilar to what is currently used within the Australian coal mining industry. The main difference being the power source which is delivered by a lead acid battery of sufficient size and capacity to provide the required power for a complete production shift (minimum eight hours).
The mechanical maintenance of the machine is not greatly effected by the zone one area, however a routine maintenance plan must be developed, implemented and followed by trained maintenance personnel.

NOTE -: The machine electrical system is not covered in this paper, however this must comply and be maintained to the relative statuary / Australian Standards.

The following is recommended as a minimum -:

* Pre-shift inspection completed by operators.
* Physical inspection of hydraulic hoses, fittings and valves.
* Hydraulic oil level checked daily.
* Check for machine physical damage, control linkages levers.
* Machine lubricants checked for leakage.
* Fire extinguisher charge indicator checked to ensure correct level.
* All stone and coal dust spillage build up removed especially around electrical enclosures and motors.
* Pumps and motors checked for noise or excessive heat.
* Hydraulic filters changed as per indicator.
* Wheels and tyres checked at regular intervals for damage and specified manufactures torque setting maintained.
* Vibration analysis / oil sampling can be used as a preventive fault finding medium
* Warning devices such as operators bell or siren, methane gas detection and battery earth leakage (test), require to be checked prior to machine operation.

FOOT NOTE

The benefits of using battery powered equipment within an underground coal mine are they produce no toxic gases carbon dioxide / monoxide into the confined surrounding atmosphere they operate under normal conditions between 82 to 89 DBA. There are no trailing cables given greater flexibility to mining production sequences and no down time from damaged cables or flashes.

Battery powered equipment is currently used all around the world including the United States, United Kingdom, South Africa and China. There are over nine thousand of these vehicles in use today around the world. There has been a general trend to move away from diesel and cable vehicles around the world, however it is the opinion of the writer that both diesel and cable vehicles still have there place in the Australian underground coal mining industry given certain applications and conditions.

PAPER10

EVALUATION

OF

70'S DESIGN

FLAMEPROOF DIESEL ENGINE SYSTEM

TO AS 3584—1991

by

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SUMMARY

The science (some may call it an art) of flameproofing diesel engines to a standard acceptable to regulatory authorities for use in underground coal mines has undergone many significant changes during the past two decades. Standards and techniques are being continually upgraded as dictated by the results of ongoing research and evolutions in engine design.

This paper briefly summarises the main changes that a 70's design flameproof diesel engine would require to undergo to upgrade it to the 1991 issue of Australian Standard AS 3584.

INTRODUCTION

Prior to the issue of AS 3584—1988 *Diesel engine systems for underground coal mines*, flameproof engine systems were assessed through the requirements prescribed in the following documents:-

1. N.S.W. Department of Mineral Resources Testing Memorandum DE100
2. N.S.W. Department of Mineral Resources Design Requirements for Flameproof Diesel Engines and Vehicles

With the issue of the 1984 Coal Mines Regulations, the *Transport—Underground Mines Regulation* was also used as an authoritative document for certain aspects of the engine design.

AS3584 was again revised after 1988, and the current 1991 issue incorporated several changes which were found necessary during application of the standard during the design and testing stages of engine systems, and also as a result of field experience on the use of these engines. A third revision is in progress which will bring the standard in line with current world wide best practice methodologies.

DESIGN REQUIREMENTS

The main changes in requirements are given in the following table.

Previous Requirements	Additional or Changed Requirements in AS3584-1991
Inlet and Exhaust Systems	
All joints to have adequate flamepath lengths, approved gasket materials, and bolts of correct grades and minimum number of threads engaged. Be able to withstand 900 kPa hydrostatic test pressure in flamepaths, 250 kPa in coolant paths, and 350 kPa for conditioner. Inlet system to be fitted with approved flametrap, air shut-off valve, tapping point for inlet vacuum measurements.	Joints reclassified as *open* or *fixed* joints. Open joints assessed by allowable gaps which vary with flamepath lengths. Fixed joints (gas tight) assessed by explosion tests with ethylene/air mixture. Air shut-off valve no longer required, blocked filter indicator required. Pressure determination tests with methane/air mix to obtain hydrostatic test pressures. Test pressure in any case not to be less than 1

Previous Requirements	Additional or Changed Requirements in AS3584-1991
Exhaust conditioner to be effective flametrap as determined by Propane Burner Test at ± 15° about longitudinal and ± 7½° about lateral axes.	MPa. Conditioner explosion tested to determine limiting water levels at which it no longer is an effective flametrap at ± 15° about *both* axes. Factor of safety then applied to set the minimum shutdown water level. Low water test drain valve now required.
Engine	
All joints to have adequate flamepath lengths, approved type gasket materials, bolts of correct grades and minimum number of threads engaged. F.R.A.S. transmission belts and non-sparking or F.R.A.S fans belts to be fitted.	Joints reclassified as *open* or *fixed* joints. Manual fuel shut off valve required to back up automatic shutdown system.. F.R.A.S. belts to comply with AS 2784.
Dynamometer Tests	
Surface temperatures limited to 150°C, fuel and water consumption rates at full load to be recorded, exhaust emissions at high and low idle, full power and at 400 RPM below full power not to exceed specified limits. Retested with inlet vacuums set at 40 mmHg, and again with 1% CH_4 injected into intake air. Emission limits: CO ≤1500 PPM, NO_x ≤1000 PPM, gas exit temperature ≤77°C. Effectiveness of shutdown sensors tested.	Tests at 400 RPM below maximum power replaced by tests at maximum torque conditions. Smoke levels now measured, and limits apply. Emission limits: CO ≤1500 PPM (2000 PPM with methane), NO_x ≤750 PPM, gas exit temperature ≤77°C, smoke as per Table 2.1 of AS 3584-1991. Tests to see whether engine ran on with 5% CH_4 in intake air, and effectiveness of air shut-off valve are no longer required.
Shutdown System	
Fitted with shutdown sensors for:- (i) loss of oil pressure (ii) loss of cooling water pressure, and high coolant temperature (iii) low conditioner water level	(i) Low oil pressure sensor to operate when pressure drops below 70 kPa or engine manufacturer's specified minimum, which-ever is greater. (ii) Thermal sensor also required in each of separate cooling circuits. (iii) Thermal sensor for exhaust gas temperature also required. This can be replaced by a secondary low water shutdown system. Water level at shutdown must not be below *minimum flameproof* water level. Engine shall not be able to be restarted after shutdown. However, override allowed for low oil and low water pressures only.

Previous Requirements	Additional or Changed Requirements in AS3584-1991
General	
Aluminium or light alloy parts not allowed in exposed positions. May be covered with approved coating or shielded. Electrical equipment may be fitted, but shall comply with the Seventh Schedule of the 1912 Coal Mines Regulation Act. Maximum of 32 volts allowed.	No aluminium or light alloy parts allowed unless no reasonable, practical alternative available. A practical method for assessing protective coatings now included. Non-metallic materials to be kept to a minimum and shall comply with specific requirements. Thermal insulation not permitted. Electrical equipment to comply with appropriate Australian standards. Sampling points required for engine condition monitoring. Air compressors to be liquid cooled. Hoses connected to delivery port shall be PTFE steel wire reinforced. Routine testing of production engine systems now specified. Parameters for cooling system design has also been specified.

TYPICAL ENGINE UPGRADE TO AS3584—1991

A typical engine system which was designed to the flameproofing requirements of the 1970's, prior to the issue of DES (Diesel Engine System) numbers, is the Perkins 4.182 engine used to power the Baldwin Personnel Car used in many collieries. This engine was re-submitted last year for full assessment to AS3584—1991, by Mine Technik Australia Pty Ltd.

To enable the engine system to meet the new requirements, the following modifications were carried out:-

1. Removal of air shut-off valve and flexible tube in the intake system to allow the system to be classified as a fixed joint.

2. Redesign of safety shutdown system to comply with engine restart requirements

3. Installation of a secondary shutdown sensor for low conditioner water. A second float was fitted outside the conditioner.

4. Increasing the number of bolts securing the conditioner inspection plate to withstand hydrostatic test pressure without leaking.

5. Issue of new set of dedicated approval drawings containing the information required in AS 3584.

The biggest hurdle faced by Mine Technik Australia was the that the only engine available for type approval testing was a tired old unit which could pose problems with meeting exhaust emissions and surface temperature limits. However, the modified engine system subsequently met the requirements of the more stringent test regime without registering any non-compliances.

Acknowledgments

The assistance of Mr. Allan Brown, Sales Manager, Mine Technik Australia Pty Ltd, is greatly appreciated, in the provision of information on the design changes to the Perkins 4.182 engine, and for allowing the information to be reproduced in this paper.

PAPER 11

"Punch Mining - Control of Risks Associated with Maintenance Activities"

(This presentation will be predominantly by video, followed by questions and answers)

Current highwall mining practice in Australia involves a number of employees working in close proximity to both the highwall and the hazardous area directly in front of the entry being mined.

Arch Mineral Corporation has taken an original Russian patent for a continuous chain conveyor and modified it for use in an automated highwall mining system named the *Archveyor*™. [1]

In both maintenance and mining the *Archveyor*™ has been engineered to reduce risks to personnel by removing the need for them to work long periods near the highwall or in front of the entry being mined.

General Description

The *Archveyor*™ automated high wall mining system is currently operating in Wyoming at Medicine Bow Mine. It is computer controlled, capable of mining in excess of 200m into the highwall at high productivity rates. It is an integrated system currently using a modified Joy 12CM miner followed by the continuous haulage *Archveyor*™. It dumps on a loadout vehicle which elevates the coal to load 110 tonne haul trucks.

Continuous Miner

Any continuous miner can be used to suit mine conditions. The miner is linked to the *Archveyor*™ and loadout vehicle by computer controls. The miner is programmed to advance a set distance before the *Archveyor*™ moves up behind it. The miner automatically sumps, shears down, sumps, and shears up in a continuous cycle. The miner's boom position and distance from the *Archveyor*™ is monitored to transfer coal without spillage.

Conveyor Haulage

In the configuration suitable for the Medicine Bow Mine, a large cross-section 840mm wide, flight conveyor is used for tramming and conveying. The conveyor is raised up off the ground to convey coal using hydraulic lift cylinders providing 120mm ground clearance. Flights are spaced at 730mm centers with a chain speed of 53 metres per minute. 30kW drive motors are used, spaced at 7.5m intervals along the *Archveyor*™.

Tramming

The same flight conveyor is used to tram the *Archveyor*™ forward to follow the miner or to retreat from the entry upon completion. For tramming, the hydraulic cylinders are raised. This drops the machine to the ground and places the full length of the return side or bottom of the flight conveyor in contact with the floor for tramming in either direction.

---

[1] *Archveyor*™ is a trade mark of Arch Mineral corporation used under licence in Australia by Arch Australia Pty Ltd and Peabody Resources Limited trading as *Archveyor*™ Mining Services

The *Archveyor*™ is trammed forward after the conveyor clears about 2.5m of coal at the hopper end or front of the machine. That prevents coal from being spilled behind the miner as the system advances.

Controls

Allen-Bradley controls are used to sequence the miner, *Archveyor*™, and the loadout vehicle. A ring-laser gyro, Gamma detectors and inclinometers are used to keep the miner on-heading and in-seam. Motor currents are monitored for all drive motors on the *Archveyor*™ and for the cutter head motors on the miner. System current is monitored on the loadout vehicle's power center. Critical system functions such as miner heading, pitch, projected cuts, and move up's are displayed for the operator. The development of a mapping system capable of displaying plan and long section (in real time) of the entry being mined and of previous entries, is nearing completion.

Technology Advancements

Safety, lower costs, and higher productivity are driving efforts to utilise the *Archveyor*™ underground. Resources are dedicated to refining the *Archveyor*™ technology into an automated underground mining system. Machines are being designed to mine low, medium and thick seams with 1000 volt or 2300 volt electrics capable of mining in excess of 300m of penetration.

PAPER 12

Specific fire hazards in surface coal mining plant and equipment

by

John Waudby
&
Ray Smith

NSW Department of Mineral Resources
Coalmines Inspectorate & Engineering Branch
Singleton

Specific fire hazards in surface coal mining plant and equipment

J. F. Waudby
Department of Mineral Resources, NSW, Australia.

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Abstract: This paper considers fires associated with the use and maintenance of mobile equipment and mine infrastructure, and tyre explosions in NSW open cut coal mines. Firstly the statistics of fires in NSW mines are put into context. Then a broad overview of the NSW open cut coal mining industry is given, followed by the Department of Mineral Resources, Coalmines Inspectorate and Engineering Branch (CMI) statistics on fires. From this the issues of design, maintenance and operator competence are identified as important factors in any strategy adopted for minimising the risk of fires. The philosophy adopted by the CMI for minimising the risk of fires is introduced and is illustrated by specific examples, concentrating on design. Tyre explosions are discussed by referring to a specific example. The paper concludes by asserting that; good common sense engineering design, will reduce the probability and consequence of fires. Also, as a consequence, maintenance costs can be reduced significantly.

1 STATISTICS

There are large variations in the reporting and investigation requirements of fires between different regulatory authorities, states and countries. To fully understand and make proper use of the statistics given in this paper; it is necessary to recognise the impact of these variations.

In NSW open cut coal mines, any fire, regardless of its severity, or duration, is reported to the CMI, and duly investigated.

In the USA any fire must have a duration of thirty minutes, or cause serious injury before regulatory authority investigations are conducted.

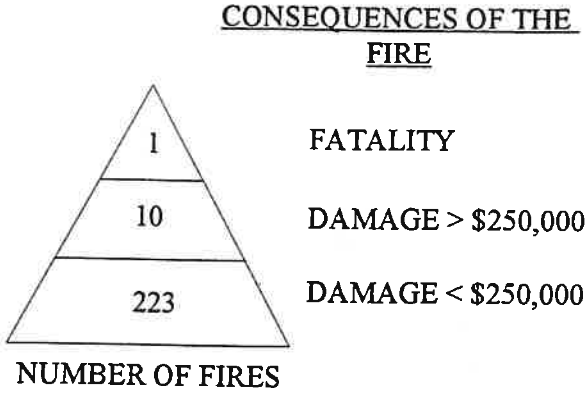
The significance of this difference is clearly demonstrated by considering the fire severity ratio triangle shown in Figure 1. This fire severity ratio triangle is analogous to a number of accident ratio studies[1] and is derived from the CMI statistics on open cut fires, between 1989 and the present.

In the USA investigations concentrate on the middle level of the triangle. In NSW the investigations try and concentrate on the lower level of the triangle. The large disparity between "known" fires in NSW and elsewhere is largely as a consequence of the CMI working at the lower level of the fire severity ratio triangle.

The CMI believes that if the lower level is properly managed, then this will have a significant impact on reducing the numbers and consequences of the more severe fires.

When considering the triangle it should be realised that one could still have a fire causing a fatality without having any severe fires at all.

Figure 1. Fire severity ratio triangle.



The vast majority of open cut mining equipment used in NSW is designed and manufactured in the USA. Hence the large variation in reporting and investigating requirements between NSW and the USA indicates that caution should be applied to the selection of equipment with regard to operator safety, when considering fires.

2 NSW OPEN CUT COAL MINES

Open cut coal mining in NSW is concentrated in the Hunter Valley with operating mines also at Ulan and Gunnedah.

Table 1 shows production figures for open cut mines from 1989 to 1994.[2] Production has risen by over 28% over this period. To increase production there has been an increase in the amount of mining equipment used.

Table 1. Open cut coal mine raw coal production statistics.

	1989/90	1990/91	1991/92	1992/93	1993/94
No. of open cut coal mines	17	20	20	20	22
Raw Coal Production. (10^6 Tonnes)	42.845	45.563	51.488	52.475	55.164

In 1990 there were: 38 drills, 30 shovels and excavators, 305 rear dump trucks, 61 front end loaders, 71 dozers, 10 draglines.[3]

In 1994 there were 49 drills, 36 shovels and excavators, 330 rear dump trucks, 68 front end loaders, 91 dozers, 12 draglines.[4]

The figures for the equipment in use do not include; service vehicles, water carts, scrapers, graders, light vehicles, in-pit pumps, lighting plants and other infrastructure. The numbers and capacity of this other equipment has also increased.

2.1 FIRES IN OPEN CUT COAL MINES

From July 1989 to April 1995 there have been 269 fires investigated by the CMI. Table 2 shows the broad categories of the agent of the fires. Of the 269 fires, 233(87%) of fires occurred on equipment, due to some failure of the equipment.

The main causal factors of the 233 fires due to some failure of the equipment are shown in Table 3. Of those 233 fires the major causal factors are:

- *MAINTENANCE, 139 (60%).*
- *DESIGN FAULTS, 87 (37%).*
- *OPERATOR ERROR, 46 (20%).*
- *MULTIPLE FACTORS 35 (15%)*

Design faults and maintenance often coincided as major causal factors, hence the above percentages do not total 100%.

Table 2. General categorisation of the agent of fires.

AGENT OF FIRE	NUMBER OF FIRES						
	89/90	90/91	91/92	92/93	93/94	94/95	TOT.
MECH.	46	31	28	13	21	26	165
ELECT.	7	3	5	6	7	5	33
AUTO ELECT.	7	2	7	8	5	6	35
OTHER	7	9	4	10	2	4	36
TOTAL	67	45	44	37	35	41	269

MECH = Mechanical, typically burst hydraulic hoses, fuel lines, brake lines, brake failure.
ELECT = Electrical, typically at voltages of 240 volts and above.
AUTO ELECT. = Automotive electrical, typically 24 volt dc systems on earth moving equipment.
OTHER = Anything not in the above categories, typically fires caused by cutting and welding, and spontaneous combustion.

Table 3. General categorisation of major causal factors of fires

CAUSAL FACTOR	NUMBER OF FIRES						
	89/90	90/91	91/92	92/93	93/94	94/95	TOT.
DESIGN	22	9	13	13	15	15	87
MAINT.	43	20	20	16	14	26	139
OPERAT.	7	12	7	10	4	6	46

DESIGN = typically this is poor location of electrical wiring with respect to hydraulic hoses.
MAINT. = maintenance, typically, a tradesman failing to detect leaking hoses or damaged electrical cables.
OPERAT. = operator error, typically a rear dump truck driver overspeeding. Tradesman cutting and burning adjacent to combustible materials.

The above figures suggest that to effectively minimise the risk of fire, equipment has to be:

- *WELL DESIGNED (FIT FOR PURPOSE).*
- *PROPERLY MAINTAINED.*
- *OPERATED BY COMPETENT OPERATORS.*

3 A PHILOSOPHY FOR MINIMISING THE RISK OF ACCIDENTS

The CMI, developed a philosophy of minimising the risk of accidents by adopting the system safety concepts described by Vincoli.[5] That is, in order of effectiveness:

- *DESIGN FOR MINIMUM RISK.*
  (PREVENTION IS BETTER THAN CURE)
- *INCORPORATE SAFETY DEVICES.*
- *PROVIDE WARNING DEVICES.*
- *DEVELOP PROCEDURES AND TRAINING.*
- *RISK ACCEPTANCE.*

3.1 RISK CONTROL

What is risk and how can it be quantified?

RISK = *f*(PROBABILITY, CONSEQUENCE)

The probability of a fire can be categorised as high, as evidenced by the statistics on fires. In the worst case, fires result in death, serious injury and extensive property damage. Hence the consequence of fire is categorised as high. This is demonstrated by some of the case studies outlined later, and a fire on a coal stock-pile in 1990, which led to the death of an operator of a tracked dozer. With high probability and high consequence of fires the risk of fire is in the highest category of risk.

The CMI believes that to effectively reduce risks in the highest categories, at least two hard (engineering) barriers are required.[6] Any single barrier can either reduce probability or consequence or both. A simple example illustrates this concept:

To minimise the risk of fire on earth moving equipment due to automotive ignition sources, electrical wiring should be physically protected by suitable conduit (one engineering barrier). The conduit should be located and harnessed away from fuel sources, abrasion points and discrete vibration points (second engineering barrier).

3.2 A PHILOSOPHY FOR MINIMISING THE RISK OF FIRE

The nature of fire itself influences and supports the system safety concepts. To initiate and sustain a fire the three elements required are, oxygen, fuel and heat.[7] Under normal operating circumstances equipment will be operating with oxygen present. Hence any fire risk minimisation strategy has to concentrate on keeping fuel sources from heat (ignition) sources (prevention is better than cure). Only in the event of a fire should we consider displacing oxygen. Oxygen displacement will only be effective if either the heat source or the fuel source is removed, either before or during oxygen displacement.

The CMI philosophy concentrates on the engineering features of fire risk minimisation (prevention is better than cure). Experience has shown that if basic common-sense engineering is used, it is possible to make maintenance easier and more effective. Also procedural activities can be made more reliable by making it easier to "do the right thing." This then forces engineering design to concentrate on the lower level of the fire severity ratio triangle, and even at the level below this (near misses).

The CMI also realises that in the event of a fire, operators must stop the engine of any equipment, or remove any other motive power such as electricity, before initiating any fire suppression systems. The main tenets of the philosophy are:

3.2.1 Design features

- *DESIGN TO MINIMISE THE RISK OF FUEL SOURCES COMING INTO CONTACT WITH HEAT SOURCES.*
- *DESIGN EQUIPMENT TO FACILITATE EASY INSPECTION AND MAINTENANCE.*
- *DESIGN EQUIPMENT TO GUARANTEE THE INTEGRITY OF SAFETY DEVICES.*

3.2.2 Safety devices

- *PROVIDE EMERGENCY STOP DEVICES.*
- *PROVIDE PROTECTION TO DISCONNECT ENERGY SOURCES IN THE EVENT OF A FAULT.*
- *PROVIDE FIRE SUPPRESSION SYSTEMS.*

3.2.3 Warning devices

- *PROVIDE FIRE ALARMS.*
- *PROVIDE ALARMS FOR EQUIPMENT MALFUNCTION.*

It should be noted that the CMI has developed a mechanical design guideline, MDG15[8] for surface mobile and transportable equipment. It provides useful information for minimising the risk of fire, as well as other desirable safety features.

4 SPECIFIC EXAMPLES OF FIRES[9]

A number of examples of fires are given to demonstrate how the design features of equipment contribute to fires. The examples also show how minor modifications to the design can minimise the probability of fire, and/or minimise the consequences of fire.

4.1 DESIGN TO MINIMISE THE RISK OF FUEL SOURCES COMING INTO CONTACT WITH HEAT SOURCES

4.1.1 Mechanical

4.1.1.1 Turbocharger

Cause of fire: A severe fire occurred on a rear dump truck when a hydraulic steering hose fitting failed. Oil sprayed on the hot turbocharger and caught fire. The operator stopped the engine. However oil continued to feed the fire due to the steering circuit being fitted with an accumulator to provide for emergency steering.
Design defect: The ruptured hose fitting was installed under a mudguard and was exposed to stone damage. The accumulator could not be discharged from ground level.
Design modification: Re-position the hose fitting and install guarding for the hose fitting. Install an accumulator bleed down facility at ground level.

4.1.1.2 Hydraulic lines / engine

Cause of fire: A fire occurred on a front end loader when a universal joint on a pump drive shaft failed due to lack of lubrication. The failed universal joint caused the shaft to flail and damage

hydraulic oil lines. The failed hydraulic oil line caused oil to be pumped over the hot engine and cause a severe fire.
Design defect. Lack of physical protection of hydraulic oil lines in the vicinity of the universal joint and shaft.
Design modification. Mount a protective guard around the drive shaft to minimise the risk of damaging hydraulic oil lines in the event of shaft failure.

4.1.1.3 Brakes
Cause of fire: A fire occurred on the brakes of a near new electric face shovel, with a retrofitted compressed air driven cable reel. The brakes dragged whilst the cable reel was operating.
Design defect: The air line from the rotating frame through to the track frame was too small in diameter to supply both the cable reel and tramming brakes simultaneously.
Design modification: Larger diameter compressed air lines installed.

4.1.1.4 Injector lines
Cause of fire: Over the past seven years 43 fires have occurred on one manufacturer's front end loader. The fires occurred when injector line support brackets failed, causing the injector lines to rub through and spray diesel fuel on hot engine parts.
Design defect: Although the manufacturer recommended maintenance procedures, the injector line installation and bracket design made routine visual inspections difficult to effectively carry out.
Design modification: Modifications to the injector line clamping methods are currently being made.

This particular example demonstrates how different reporting requirement's for fires effects whether solutions are implemented or not. The injector line problems identified in NSW were allegedly not a problem in the USA.

4.1.2 Electrical

Cause of fire: A severe fire destroyed an electric face shovel. It is suspected that a hose supplying cooling oil to an inductor in an electrical inverter circuit failed. The lack of cooling oil through the inductor caused the inductor to rapidly overheat and ignite the leaking oil. The fire rapidly spread to other electrical cabinets. The coolant oil fed the fire by gravity.
Design defect: The coolant oil hose to the inductors was typical garden style hose. The hose connection to the inductor was via a ribbed section of the inductor and held in place by a screw compression clamp. The hose and connection were of fragile design for the application and susceptible to failure. There were no contingency arrangements for loss of coolant to the inductors. The oil feed was assisted by gravity.
Design modification: The shovel was scrapped.

4.1.3 Mechanical / Automotive electrical

4.1.3.1 Hydraulic hose / 24 volt cable
Cause of fire: A severe fire occurred on a front end loader when insulation on a 24 volt electrical cable supplying an emergency steering motor failed due to vibration. The arcing from the exposed conductor burnt a hole in a hydraulic hose. Oil from the hydraulic hose came into contact with a hot engine and was ignited.
Design defect: The electric cable supplying the emergency steering motor was clamped with the hydraulic hose and did not have any physical protection to prevent insulation damage.

Design modification: The electrical cable was enclosed in conduit, harnessed in a proper electrical engineering manner and run separately from hydraulic hoses.

4.1.3.2 Hydraulic hose / 24 volt cable

Cause of fire: A severe fire occurred on a diesel driven overburden drill, when a short circuit from a 24 volt electrical circuit ignited diesel soaked dust and rags. The fire propagated when hydraulic hoses caught fire, ruptured and released more oil to feed the fire.
Design defect: The faulty electric cable did not have any electrical protection. Electric cables and hydraulic hoses were run together and poorly harnessed.
Design modification: Install electrical protection and physical protection for electric wiring. Modify the fuel fill system to prevent accumulation of spillage.

4.2 DESIGN EQUIPMENT TO FACILITATE EASY INSPECTION AND MAINTENANCE

4.2.1 Mechanical

Cause of fire: Fires caused when injector line support brackets fail, causing the injector lines to rub through and spray diesel fuel on hot engine parts.
Design defect: Injector line installation and bracket design made routine visual inspections difficult to effectively carry out.
Design modification: Modifications to the injector line clamping methods are currently being made.

4.2.2 Electrical

Cause of fire: A fire occurred on a diesel/electric rear dump truck, when a short circuit occurred in the vicinity of the alternator terminals.
Design defect: The connection point for the alternator cables and the converter supply cables was difficult to inspect and the harnessing of the connections was non existent.
Design modification: Provide a proper harness at the connection point. Maintain adequate clearance between each insulated connection. Design the harness and connections so they are easily inspected.

4.2.3 Automotive electrical

Cause of fire: A fire occurred on a grader when insulation of electric cables was damaged due to vibration. The cables ran between the engine and the engine belly plate, connecting batteries on either side of the engine. The arcing to the frame of the grader ignited accumulated grease, oil, diesel, coal and dirt between the engine and the engine belly plate.
Design defect: The cables had no physical protection other than the cable insulation. It was extremely difficult to inspect the condition of the cables where they passed under the engine.
Design modification: Enclose the cables in conduit. Position the conduit so it is readily inspected.

4.3 DESIGN EQUIPMENT TO GUARANTEE THE INTEGRITY OF SAFETY DEVICES

4.3.1 Mechanical

Cause of fire: A severe fire occurred on a water truck when a hydraulic hose leaked oil onto the turbocharger, this oil fire caused the fibreglass engine cover (deck) to catch fire. The fibre glass engine cover burnt violently, collapsing onto the engine. The heat was so intense that engine parts melted and the operator's cab was totally destroyed. The operator was lucky to get out of the cab alive.
Design defect: The fibreglass engine cover was not fire resistant.
Design modification: Fire proof engine covers were fitted.

Approximately six weeks after the fire another fire occurred in the same region and the fireproof engine cover did not catch fire. The fire was extinguished with minimal damage to the truck.

4.3.2 Electrical

Cause of fire: A 5MVA 66/11kv transformer exploded and an 11kv switchroom was destroyed by a fire.

A phase to phase short circuit occurred on an 11kv aerial air break switch. Electrical sensing devices sensed the fault, but due to a loss of the battery supply to the tripping coil the fault was not cleared. The fault rapidly developed, melting 11kv cables, 11kv switchgear and eventually causing the transformer to explode. The local supply authority protection eventually tripped the 66kv supply.
Design defect: Four (4) circuit breakers, (2 x 66kv and 2 x 11kv) were capable of clearing the initial fault, each with three methods of detection. Also there were 3 transformer protection devices, designed to trip off the 66kv supply. The trip coils for the four circuit breakers were shunt trip devices (non-fail safe) fed from a common 48 volt battery/battery charger. An open circuit in one cell of the battery and a blown battery charger fuse effectively negated ALL electrical protection.
Design modification: Increase the integrity of the trip supplies by having separate trip supplies for the 66kv and 11kv circuit breakers. Provide under voltage release to trip off the power if the battery voltage falls below a certain level. Improve maintenance of battery supplies.

A few days after power was restored to the mine, a trip battery failed and the battery undervoltage release tripped off the power.

4.3.3 Automotive electrical

Cause of fire: A fire occurred on a front end loader when fuel injector lines ruptured and diesel soaked coal/stone dust in the engine valley caught fire. The electrical engine shut down systems failed to stop the engine because the fuel solenoid cables were burnt through during the fire.
Design defect: The fuel solenoid electrical supply system was not designed to provide a high level of integrity.
Design modification: The fuel solenoid electrical circuit has been redesigned incorporating an increased safety philosophy by; relocating cable away from possible heat sources and abrasions, enclosing the cable in conduit and harnessing cable properly. The circuit is a dedicated circuit using oversize cable.

5 TYRE EXPLOSIONS

Tyre explosions to date have been initiated by rear dump truck dump trays coming into contact with bare overhead power lines. A typical example is described below.[10]

Description of the incident: Whilst tipping top soil in an open cut reclamation area, the raised tray of a rear dump truck contacted a 33kv overhead power line. This contact with the power line was not noticed by the truck operator. After returning to the loading area, a distance of approximately 600 metres, the tyres began exploding. Four tyres exploded, severely damaging the vehicle and projecting rim and other truck components up to 100 metres.

Cause of the explosions: The explosions resulted from the vehicle's contact with the power line. The electrical current passed from the power line, through the truck body and tyres to earth. The electric current caused burning to occur on the interior of the tyres. This burning caused flammable gases to be liberated within the tyre. When the concentration of the flammable gases reached their explosive limit, the explosions occurred. The time taken for the explosion to occur appears to be related to the energy levels dissipated through the tyres. The reactions can take place many hours after the initiation of combustion within a tyre.

Considerations:

- FLAT TYRES CAN STILL EXPLODE.
- VEHICLES THAT HAVE BEEN IN CONTACT WITH OVERHEAD POWER LINES SHOULD BE ISOLATED AND NOT APPROACHED (300 METRES IS THE RECOMMENDED DISTANCE) FOR AT LEAST 24 HOURS.
- OPERATOR EVACUATION PROCEDURES SHOULD BE IMPLEMENTED.
- CAREFUL CONSIDERATION OF THE EXPLOSION RISK SHOULD BE TAKEN BEFORE FIGHTING ANY FIRES ON THE VEHICLE.

Tyre explosions may also be initiated by:

- Severe fires in the vicinity of rear dump truck wheels.
- Cutting and burning on wheel rims with the tyre insitu.
- Welding of wheel rims with the tyre insitu.

6 CONCLUSIONS

During the period 1989 to the present, raw coal production has risen 28% and the amount of equipment in use has risen in the region of 14%. Over the same time period the number of fires due to equipment failure has fallen 38%. The number of fires with design as a major causal factor has fallen 32%. The number of fires with maintenance as a major causal factor has fallen 40%. The number of fires where operator error has been a major causal factor has remained approximately constant.

The fall in the incidents of fires has coincided with a concerted effort by mine electrical engineers, mine mechanical engineers and the inspectors of electrical and mechanical engineering, particularly in the Singleton/North-West region to implement good common sense engineering design solutions. These design solutions concentrate on prevention instead of cure.

The statistics provided indicate, the number of fires and the consequences of fires in open cut coal mines can be minimised if engineering design features consider:

- MINIMISE THE RISK OF FUEL SOURCES COMING INTO CONTACT WITH HEAT SOURCES.

- FACILITATE EASY INSPECTION AND MAINTENANCE.

- GUARANTEE THE INTEGRITY OF SAFETY DEVICES.

- PROVIDE EMERGENCY STOP FACILITIES.
- PROVIDE PROTECTION TO DISCONNECT ENERGY SOURCES IN THE EVENT OF A FAULT.
- PROVIDE FIRE SUPPRESSION SYSTEMS.
- PROVIDE FIRE ALARMS.
- PROVIDE ALARMS FOR EQUIPMENT MALFUNCTION.

Anecdotal evidence suggests that where this approach has been adopted, availability has improved and maintenance costs have fallen due to requiring fewer inspections and making those inspections easier to do.

The authors know of at least one mine where 250 hour inspections of rear dump trucks have been extended to 500 hour intervals. This is as a direct consequence of rear dump truck manufacturer adopting the above philosophy. Practically this was achieved by rigorously applying the requirements of MDG15, "Guidelines for surface mobile and transportable equipment for use in coal mines."

The views expressed are those of the authors and not necessarily those of the NSW Department of Mineral Resources, Coalmines Inspectorate and Engineering Branch.

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NSW OPEN CUT
COAL MINING

22 MINES

PRODUCE 70% OF NSW COAL

220 MILLION CUBIC METRES OF OVERBURDEN P.A.

55 MILLION TONNES OF RAW COAL P.A.

600 MAJOR ITEMS OF EQUIPMENT

2000 ITEMS OF ANCILLARY EQUIPMENT

MAJOR
CAUSAL FACTORS
OF FIRES

MAINTENANCE - 60%

DESIGN - 37%

OPERATOR ERROR - 20%

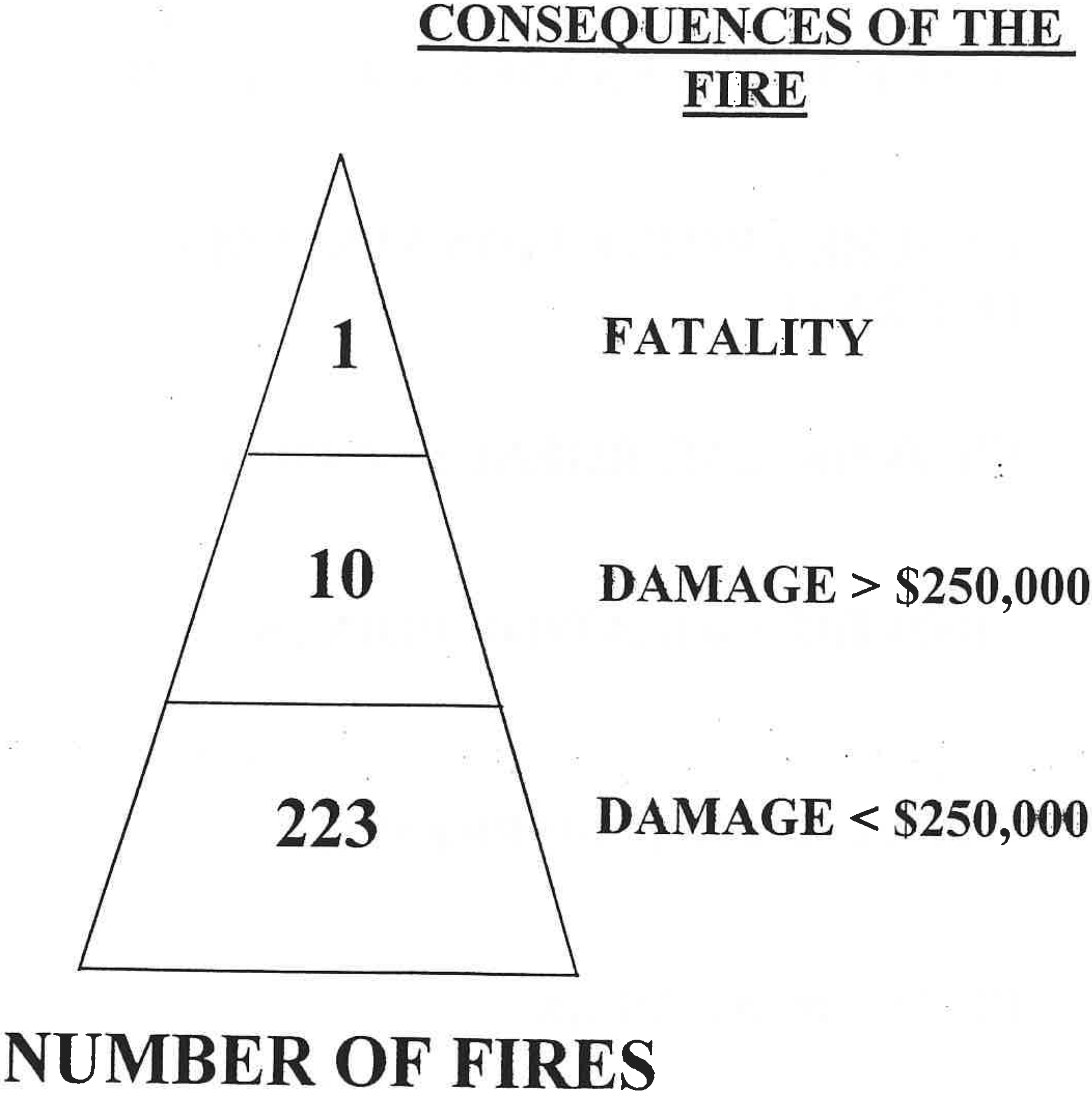
COMPARISON OF STATISTICS
1989 AND 1995

PRODUCTION	**+ 28%**
EQUIPMENT	**+ 14%**
TOTAL FIRES	**- 38%**

FIRES DUE TO :

MAINTENANCE	**- 40%**
DESIGN	**- 32%**
OPERATOR ERROR	**0%**

FIRE SEVERITY RATIO TRIANGLE



MINIMISING FIRE RISK

KEEP FUEL SOURCES AWAY FROM IGNITION SOURCES

MAKE MAINTENANCE EASY TO DO

ENSURE PROTECTION SYSTEMS OPERATE

PROVIDE EMERGENCY STOP'S

PROVIDE ISOLATION POINTS

PROVIDE FIRE SUPPRESSION

PROVIDE ALARMS

PAPER 13

DEPARTMENT OF MINERAL RESOURCES
NEW SOUTH WALES

MECHANICAL ENGINEERING
SAFETY SEMINAR

ASSESSMENT OF MDG15
RE: CONTRACT MACHINERY
MAINTENANCE AND REBUILDS

DAVID FLYNN
SALES MANAGER - MINING
SOUTH EAST REGION

MARUBENI CONSTRUCTION & MINING EQUIPMENT

22 MARCH 1996

PENRITH PANTHERS LEAGUES CLUB

As a distributor of large open cut mining equipment we have often found ourselves embroiled in the controversial issue of what the manufacturer considers "STANDARD EQUIPMENT - ADEQUATE PROTECTION - MEETING INDUSTRY STANDARDS etc" and on the other hand a client and his representatives who have an entirely different opinion as to these interpretations.

The result of this difference of opinion is often not realised until the piece of machinery has been manufactured, shipped into Australia and commences assembly on the minesite.

Then the problems start. Who is responsible for the associated costs to add, change, modify, reroute or remanufacture what has come from the factory?. It does not stop here. What is the net effect of extended assembly times and late delivery to the purchaser and the probable claim on the distributor for late delivery default penalties. All of this tends to put strain on the partnership from the outset.

The introduction of MDG15 has to a large extent, resolved this situation by providing an industry standard guideline which when adopted as the basis for equipment manufacture, has a clearly defined level of commitment expected in today's market place. LeTourneau Incorporated have been doing since the end of 1992.

The effect on equipment maintenance and rebuilds in relation to MDG15 has to be encouraging albeit that there are significant costs involved to produce and to retrofit large equipment to meet the requirements of MDG15. However in Australia, I believe it is proving to be a cost that is not only justified by the purchaser, but has in fact resulted in measurable savings in the area of safety, equipment reliability and reduced maintenance costs.

This is not necessarily considered an important issue in some countries throughout the mining world and the cost of implementing something like MDG15 imposes a pricing disadvantage to an equipment company which employs this level of manufacture as a standard feature and is why it has taken as long as it has for the MDG15 requirements to be implemented at factory level.

It is worthy to note that LeTourneau consider any piece of equipment which meets the requirements demanded in the Hunter Valley Coal Fields will exceed any other world wide regulation or statutory requirement.

Improved safety for operational and maintenance personnel has come about through attention to detail in fire hazard reduction, access systems, improved serviceability and general ergonomics of equipment layout and operators cabin which has in turn resulted in improved machine mechanical availability and reliability.

Maintenance, servicing and troubleshooting has been significantly enhanced with the adoption of MDG15. With greater attention being applied to the identification and segregation of electrical wiring harnesses and components, replacement of typical fuses with resetable circuit breakers and the improvement of mechanical protection of electric cables and hydraulic hoses are but a few of the advantages gained from MDG15.

In summary, it is to be expected that equipment which complies to the guidelines set down in MDG15 should generally be expected to return better availabilities with a reduction in cost and time out of production to carry out major rebuilds and overhauls.

PAPER 14

This paper was presented at the Third Mechanical Engineering Safety Seminar on 6th April, 1993, and has been reproduced for your information.

OPERATOR TRAINING AND CERTIFICATION PROCEDURES, FOR OPERATION OF "RUBBER TYRED " MOBILE UNITS AT MOUNT ISA.

ABSTRACT: This paper describes the methods of training, licensing, monitoring and retraining members of the Underground workforce in skills associated with "rubber tyred" mobile unit operation, as required in the Mount Isa Mines operations at Mt Isa North Queensland.

1. INTRODUCTION

The Mount Isa Mine is one of the largest underground mines in Australia, and a major producer of copper, silver, lead and zinc.
Employing an underground workforce of some 1200 personnel, working in five distinct mining environments. The mining methods range from sub-level open stoping to sub level cut and fill benching, using "rubber tyred" mobile electric/hydraulic drill rigs, teleoperated and remote diesel powered load haul dump units, manually operated diesel and electric load haul dump unit (to 50 tonne capacity) and diesel powered service/personnel transporter units.
At present there are some 400 "rubber tyred free steering" mobile units servicing the underground workings.
The operating environment extends along a network of roadway systems which include "1 in 7" declines and inclines and horizontal excavations also used by rail track equipment.

2. TRAINING STRUCTURE

To facilitate operator training, a Mining Stream Training Structure is charged with suppling competent operators to meet the demands of the various mining areas. This structure is serviced by area Training Co Ordinators who manage and develop Workplace Trainers drawn from the various work areas.

Workplace Trainers are selected using a criteria which ensures people are motivated towards training, that they have credibility within the workplace, and that they have demonstrated high levels of work skills both with production and safety.
Nominees reach accreditation as Workplace Trainers after completing a structured training program centred around "one to one" instructional skills training.

Workplace Trainers are not full-time trainers, but are practising operators, who perform to contract or bonus intensity for a majority of their working time, and are used to train and accredit people in skills that they currently practise.

To ensure work standards are maintained, Workplace Trainers use training modules which consist of training guidelines, resource material and performance criteria. Training modules are developed in-house and reflect the skills accepted across the mining lease.

3. TRAINING PROCESS

Trainees are accepted into a training program only after they have met certain pre-requisite skills as listed in the various career path structures.
The mining operator career path structure consists of five skill levels.

For example:

1. An individual selected to be trained to operate a "rubber tyred " personnel transporter vehicle would need to be:

(a) The holder of a "A" class license for a manually driven motor vehicle.
(b) Successful in completing Underground and Area Inductions.
(c) Medically assessed as capable to perform the task.

2. A trainee requiring training on a mobile unit, associated with a higher level of activity in the career path, would be expected to satisfy more stringent pre-requisite assessments.
For example:
A trainee being considered for the position as a teleoperator of a load haul dump unit would be assessed on conventional remote operation duties (both theory and practical demonstration), and would be required to perform a personal aptitude test.

Only after satisfying the pre-requisite assessment to the required standard, would the Workplace Trainer train the trainee in the higher skill.

Training programs are complemented by locally produced "in-house" training videos, and the class room instruction is carried out in Underground training centres.

Workplace Trainers in consultation with area Training Review Committees give final accreditation.

4. REFRESHER TRAINING

Refresher training is the responsibility of the area Training Co Ordinator, and this process is carried out on a scheduled basis to meet the area Training Plan.

Personnel operating large mobile units are regularly assessed and retrained.

For example:
Personnel operating 3 to 6 cu metre load haul dump units are reassessed on an annual basis, and would be scheduled to attend structured training workshops which highlight, damage control, operator practise and operator maintainer skills.

4. MONITORING STANDARDS

The Underground Mobile Demerit Point System is a process designed to monitor mobile unit operator standards.
This is a form of disciplinary code introduced to highlight infringements of operating procedures relating to underground mobile equipment.
Operators are allocated a maximum 10 points and they loose points for infringements. The loss of 5 points for example, would require the operator to be scheduled into a refresher training program.

5. RECORDING OF TRAINING HISTORY

Recording of mobile unit training and certification is the responsibility of the area Training Co Ordinator, who uses a computer generated Skills Management Program.

Individual unit operator Log Books are also updated as new skills are acquired, and are kept by the operators.

All licenses are reviewed on an annual basis.

6. CONCLUSION

Mount Isa Mines training and certification procedures for underground mobile unit operators are centred around a competency based training program, which employs local area knowledge for the development and delivery of structured training.
Monitoring and recording being controlled by a service department linked to each operating area, via a Training Co Ordinator and accredited Workplace Trainers.
The training programs are self paced and regulated by frequent reassessment and a disciplinary action code.
Individual operator awareness is promoted by their possession of a regularly updated Log Book and Computer Managed Skills Management Program.
The right to operate mobile units being dependant on demonstrated ability with respect to the current work standards, as determined by area needs.

Stewart Battisson
Training Systems Co Ordinator
Mount Isa Mines Limited

Mount Isa Mines Limited

Mining Employees Classification Structure

CLASSIFICATION STRUCTURE
FOR MINING EMPLOYEES

INTRODUCTION

The Restructuring process has been in progress at Mount Isa since April 10 1990. The formation of the Joint Consultative Committee (JCC) and four sub-committees - Labour Turnover, Award Modernisation, Incidental and Peripheral and Skills Analysis - marked the commencement of the formal process. After a period of determining goals, process, etc., the project teams at the Copper Smelter, X41 and Hilton were established. Subsequently a team was set up at R62. The purpose of the teams were to act as facilitators to the workforce to aid the process of communication and change. This report details the progress with developing a framework for skill levels.

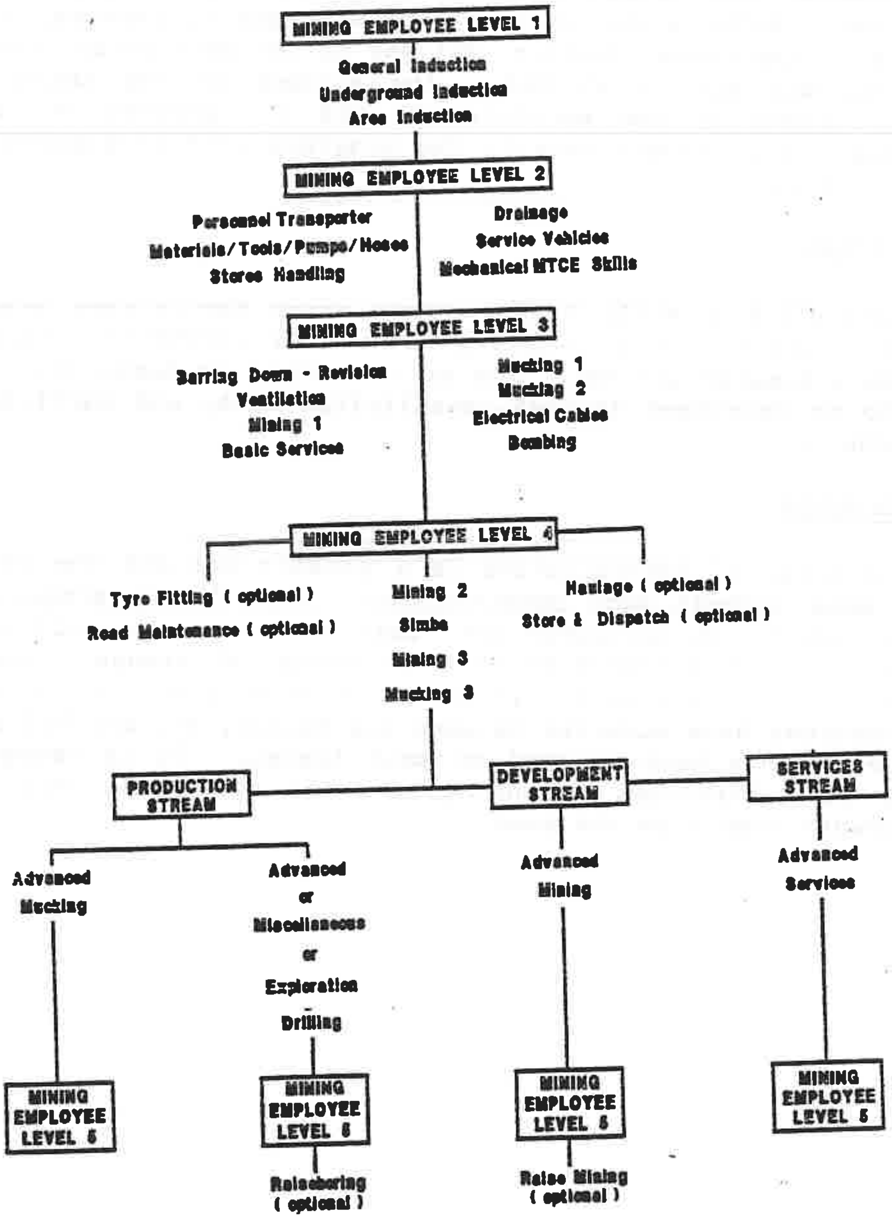
OBJECTIVE

To establish a skill level matrix which facilitates greater flexibility cross-skilling and up-skilling within the workforce. Career paths are to be more clearly defined. The matrix should be based solely on skills. It is to be developed through consultation with, and participation from, the workforce.

CONCLUSION

The process of restructuring is a dynamic one and the skill level matrix has gone through many permutations. The 'final' product, as defined in this report, is certainly not 'cast in stone' and will need modification over time, in conjunction with technological change. However, since the structure is skill based, it should be able to be applied across the lease. Discussions have occurred between the Hilton, X41 and R62 project teams and agreement has been reached on most issues. It is recognised that there will be differences depending on area specifics, but that the skills framework should be the same.

CAREER PATH FOR COPPER MINE & HILTON MINE MINING EMPLOYEES



FOR A DETAILED BREAKDOWN OF THE TRAINING MODULES PLEASE REFER TO MINING CLASSIFICATION AND STRUCTURES BOOKLET

MINING MODULES

M101 GENERAL INDUCTION

M102 UNDERGROUND INDUCTION

All employees who are to work underground are required to undertake underground induction. This should involve all general work and safety procedures. A specific mine induction should be incorporated for our 3 current underground areas (X41, Hilton, R62). This specific induction would involve a theory/practical tour of all aspects of the surface/underground workings for the particular mine (e.g. workshops, crushers, shafts and orebodies). In the case of an underground worker a First-Aid Certificate should be attained at this time and a refresher course run at suitable intervals.

M103 AREA INDUCTION

Area induction is designed to introduce new employees to their workmates and their specific work environment. It should reinforce some of the topics touched on in the underground induction, and also at this time topics such as Mobile Unit awareness, Sub-station safety and general working conditions will be covered.

M204 PERSONNEL TRANSPORTER (Learners Ticket)

This is the first mobile unit ticket an employee can receive. The employee can not receive instruction until he/she has been underground for a minimum of two weeks. Instruction will include all aspects of the units operations e.g. fuel store, blocklights etc.

Part of the ticket involves workshop exposure - assisting in unit servicing and damage identification.

It is envisaged that after structured training and testing a learners ticket will be issued. This requires an open ticketed person to accompany the learner at all times. Testing for an open ticket is part of the competency test. This prevents abuse of the system.

M205 MATERIALS/TOOLS/PUMPS/HOSES

This module gives the employee the opportunity to identify materials used in a mining environment, also handling and storing methods, tools, lubricants and explosives used. A working knowledge of service reticulation systems, an understanding of pipes, hose repairs and pumps is obtained along with an open personnel transporter ticket. House keeping should be emphasised as a safety issue in all modules, but is particularly important in this area.

M206 STORES HANDLING

The employee is being introduced to more responsibility and will now learn all the facets of stores handling.

M207 DRAINAGE

Along with basic pipe-fitting skills an awareness of the dangers associated with fill-bulkheads should be given to an employee in this module. There will also be an introduction to air-tools e.g. disc cutters.

M208 SERVICE VEHICLES

Tickets are obtained for area specific service vehicles (e.g. Fox, Normet), in this module. As part of the ticket the employee has to assist with a service of the vehicle, which will help with parts recognition.

M209* MECHANICAL/MAINTENANCE SKILLS

The employee is now getting tickets on a number of units and should be exposed to the maintenance environment. A better understanding of how units work and an ability to do minor repairs will result in higher unit availability. Mechanical aptitude should be developed at this level and an introduction to more complex air tools, pump maintenance, Mechanical/Electrical safety and lubrication should help achieve this objective. A work platform ticket is introduced at this line.

M310 BARRING DOWN REVISION

The trainee will be exposed to Geology input giving explanation of ground conditions and will be revised in the task of barring down.

M311 VENTILATION

The repair and installation of Ventilation tube would be covered.

M312 MINING 1

Before any drilling equipment is used an understanding of explosives and statutory requirements is necessary. The blasting ticket would be similar to the existing secondary blasting ticket, however butts and misfires would need to be included. Barring down would need to be revised. Hand held machine and rising feed operation and use would need to be addressed. Basic installation of pins for barricades, electrical boxes and pipe hangers would be an envisaged consequence.

M313 MUCKING 1

This module is an introduction to the first steps the trainee will need to complete to become competent in the task of mucking.

M314 BASIC SERVICES

The purpose of this module is to give a broad background into the construction side of the mine, covering brickwork, concrete, pressure vessels, air saw, auger and vertical opening procedures. The second part of the 3 part mucking module is also incorporated here.

M315 MUCKING 2

This module is the next step taken as the trainee progresses and gains competence in the task of mucking.

M316 ELECTRICAL CABLES

It is also envisaged that production personnel would be hanging and joining dead electric cable.

M317 BOMBING

This module is an introduction to mechanical mining as well as advanced bombing techniques.

OPTIONAL

M418 HAULAGE

As well as the operation of locomotives this module also includes chute/tipple/guard operations. Destructive cutting/heating is included to assist in basic chute maintenance.

M419 ROAD MAINTENANCE

This module gives an employee a grader ticket, he is then capable of all road maintenance including building of roads.

M420 STORES AND DESPATCH

There are three parts to this module, Stores Receiving/Despatching, rigging Ticket and Surface Forklift (Government Ticket). To complete the module two of the three alternatives must be passed.

M421 TYRE FITTING

M422 MINING 2

An understanding of ground support principles including why and how certain systems are installed is the primary objective, this would also include the maintenance of any equipment being used. It is also envisaged that production personnel would be hanging and joining pipes and installing fans.

M423 SIMBA

M424 MINING 3 (Prerequisite Mining 2)

This module concentrates on mining skills. It is hand-held mining and covers all aspects of the cycle: bore, charge and muck. The final part of the Mucking module is also included along with electric blasting systems which also includes the hanging of firing lines.

M425 MUCKING 3

This module introduces the mucker to more complicated tasks involving the use of a mucking unit.

M426 ADVANCED SERVICES OPTIONAL

M427 ADVANCED MUCKING OPTIONAL

M428 ADVANCED MINING OPTION

M429 ADVANCED DRILLING OPTION

M430 MISCELLANEOUS DRILLING OPTION

M431 EXPLORATION DRILLING OPTION

<u>NOTE:</u> One of the above optional training modules must be taken to reach Level 5.

M532 RAISEBORING (CROSS SKILL)

M533 RAISEMINING (CROSS SKILL)

UNDERGROUND MOBILE EQUIPMENT
DEMERIT POINT SYSTEM (D.P.S.)

1. The demerit point system will apply to underground mobile equipment operators. The system is based on positive corrective action and will be <u>in lieu of</u> the normal disciplinary code.

2. The system will apply to <u>ALL</u> employees who operate mobile equipment underground. Staff will be licensed to drive vehicles they use in performing their jobs. They may be required to use other equipment in an emergency for which they may not be licensed.

3. Fully competent operators will be allocated the maximum quota of 10 points.

   New or inexperienced operators will be allocated 8 points when obtaining their licence for one or more types of units. If the licence holder operates incident free for 3 months, points will be allocated at a rate of 1 point/3 months.

4. Loss of points will occur as a result of any infringement of the operating code in accordance with the demerit point chart (see attachment). Up to 5 points can be lost for a safety/damage related incident, depending on the circumstances and potential of the incident.

5. The Supervisor will take action by counselling the employee on the infringement and applying the appropriate demerit points in lieu of the normal disciplinary code (viz. caution/reprimand/final reprimand/suspension).

6. An accumulated loss of 5 points will facilitate a computer generated letter detailing the employee's driving record. This will be discussed in some detail with the Foreman in an attempt to 'win the man' and correct sub-standard practices. The Foreman will <u>ensure</u> that the operator attends Diesel School at the earliest opportunity for which the employee will be paid in the normal manner.

7. An accumulated loss of 7 points, whether or not the employee has been counselled by his foreman will result in a computer generated letter (yellow) requiring the operator to 'show cause' why the licence should not 'restricted' (e.g. to a service vehicle). The aim at this stage is to formally serve notice to that employee that he could lose his licence and hence his earning capacity.

   The employee would appear before the Operating Standards Committee which has an advisory role to the Registered Underground Manager. It consists of the:

   - Underground Manager
   - The Foreman of the employee
   - Two Award representatives (skilled mobile equipment operators)

The committee would review the individuals driving record and advise what remedial action is appropriate.

- Retraining through:
  - Diesel school
  - Retake licence
  - Reinstruction on unit of normal operation.
- Restriction of current licences and subsequent retraining.

The Underground Manager will decide the action to be taken and detail the limited opportunities that exist in the mine in the event of the total loss of points.

8. A total loss of points will result in the individual losing his licences from a minimum period of 3 months to a maximum period of 6 months.

   Retraining and testing would proceed after this period the same as for new or inexperienced operators.

9. Other disciplinary action may be taken in conjunction with the demerit point system in the event of a flagrant disregard of safety regulations or where gross negligence is proven.

10. Multiple infringements of the code will only attract demerit points for the most serious violation.

11. The aim of the code is to encourage personal responsibility by self regulation and to correct sub-standard behaviour by corrective action (training). The grievance procedure is available at any time to resolve any conflict that may arise.

UNDERGROUND MOBILE EQUIPMENT
DEMERIT POINT CHART

- Points system applies to ALL employees.
- All infringements are based on standards detailed in the Underground Safety Instruction Booklet, or the Standard Work Procedures.
- The reallocation of lost points will occur at a rate of 1 point/3 months incident free for persons with 8 or more points.
- For persons with less than 8 points, the reallocation will be at a rate of 2 points/6 months incident free.
- Violations of the operating procedures fall into two categories:
  - Safety
  - Damage

Examples of the type of infringement are detailed overleaf.

Safety	Demerit Points
Not wearing required personal protective equipment while operating.	1
Failing to use block lights correctly.	1
Driving through flaps without stopping.	2
Failing to install/replace mucking barricade.	2
Failing to close haulage gates.	2
Failing to give way to a pedestrian.	2
Failing to turn off motor when refuelling.	2
Sub-standard pre-start check.	3
Driving at excessive speed.	3
Unlicenced/unauthorised use of vehicles.	3
Incorrect parking on decline.	4
Failing to replace orepass barricade.	4
Removal of unit involved in an accident.	5

Damage	Demerit Points
Operating errors resulting in minor damage (e.g. running over material).	1
Driving through unopened vent doors, or damaging installation by careless operating.	2
Changing unit direction without stopping.	2
Sub-standard shutdown check.	2
Damage to equipment due to insufficient care (e.g. collisions with sidewall).	3
Damage to trailing cables.	4
Negligent operating causing significant damage (e.g. collisions between vehicles).	5

Other sub-standard practices (SSP's) which are safety or damage related should be considered relative to those specified.