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Safety and Welfare of Mine Employees in Australian Black Coal Mines

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ABSTRACT: This paper outlines the status of Australian coal mining industry with respect to safety and welfare of the mine employee. The impact of tie longer shift hours and compressed working week are discussed in relation to workers safety and employment levels. Longer shift hours and compressed works have shown to be a benefit to miners, both in safety and socially. The paper also examines the role of each of government organisations, the mining and manufacturing industries on the issue and goes on to descnbe the various environmental control measures introduced to the Australian coalmines to ensure high safety standards are maintained. Dust monitoring and control, noise pollution control, and diesel particulate control measures have been targeted vigorously and as a result there has a continual drop in the coal mine related diseases as well as a decline in the workers lost time injury claims.

1 INTRODUCTION

Worldwide, there has been an increasing awareness of the health and safety of mine employees İn the mining industry. This emphasis is now recognised and keenly pursued in Australia by all parties concerned including, the mining companies, mining machinery manufacturers, the miners union and, above all, the government organisations responsible for the safety and welfare of mine employees such as the Joint Coal Board and the Department of Mineral Resources in NSW and similar organizations in other states in the Australian federation.

Increased mechanisation, mining thicker seams, increased production, improvement in productivity, the continuing decline in the workforce and the high costs of legal litigations have provided a sound platform for all the parties concerned to deal effectively with the safety and welfare of the mine employees.

It is not uncommon in mines today to see the mining companies rules and guidelines appearing alongside the rules laid down by legislators of a particular state. This commitment to mine safety was further reinforced in a recent Joint Coal Safety Forum held at Wollongong, on 12 July, 2000, where the key representative from the coal mining industry, the mine workers union met both the NSW Minister of Mineral Resources and the Queensland Minster for Mines and Energy. Key issues discussed at the forum were regulatory reform, work practices, training and education, compliance and enforcement strategies, investigation procedures and protocols. Both Minsters agreed the forum provided the opportunity for both states to identify key safety issues and greatly assist the practical implementation of better safety practices.

The recent trend on the workforce downsizing, because of the increased efficiency of the modern mining machinery and technologies, would likely to dnve the miner away from the profession, with the ultimate consequences of the future shortages of the skilled miners. Thus, it is necessary to provide a climate that would maintain the skilled workforce in the industry by recognising the side effects of heavy mechanisation and increased production. Issues to be addressed include increased mine dust levels, increased diesel emissions, increased noise levels, possible mcreases in work related injuries of high severity, and worker's compensation.

In Australia the safety and welfare of the mine employee are protected by various laws and agreements under the powers constituted by the Australian Commonwealth and the states, and through various organisations such as The Joint Coal Board of NSW. This paper examines various aspects of mining operations which has a direct impact of the miners welfare and safety. Dust control, diesel emission, management practices, miners welfare and the role of governmental bodies such as the Joint coal board is discussed together with the consequences of increased work hours and compressed working week. The compressed working weeks is defined as reducing the number of

days worked per week as a result of increased shift hours and adherence to the agreed total hours worked per week.

2 ROLE OF GOVERNMENT AND INDUSTRY ORGANISATIONS

In each state of the Australian Commonwealth there are a number of government organizations which are engaged in a variety of issues related to the mine workers safety and welfare. These range from setting legislations and implementation to research. These bodies include;

Government:

- Departments of Mines and Energy (Queensland)
- Safety in Mines Testing and Research Services- STMT ARS (Qld)
  Department of Mineral Resources (New south Wales),
- Joint Coal Board (NSW)
- Departments of Mineralsand Energy (WA)
- Department for Industry, Science, and Resources (Australia)

Industry:

- Queensland Mining Council
  New south Wales Mineral Council
  Western Australian Chamber of Mines
  Minerals Council of Australia
  Australian Coal Association Research Program (ACARP)

In the State of NSW the role and responsibilities of two such organizations are as follows:

2.1 *The Joint Coal Board*

In NSW the Joint Coal Board is constituted under an arrangement between the Governor- General of Australia and the Governor of the State of New South Wales made pursuant to the provisions of the Coal Industry Act 1946 (Commonwealth) and the Coal Industry Act 1946 (NSW).

The powers and functions of the board are stated in identical provisions of the Commonwealth Act, Sections 23 to 27 and the new South Wales Act Sections 24 to 28 and are as follows (JCB annual report 1999-2000):

- To provide occupational health and rehabilitation services for workers engaged in the coal industry including providing preventive medical services, monitoring workers* health and investigating related health matters,
- To collect, collate and disseminate accidents and other statistics related to die health and welfare of workers engaged in the industry,
- To refer matters related to the safety of workers engaged in the coal industry, as it thinks fit, to the Chief Inspector of Coal Mines or the Commonwealth Minister and the State Minister for consideration,
- To provide courses in the production and utilisation of coal under international development assistance programs sponsored or administered by the Commonwealth Government or approved by the Commonwealth Minister and the State Minister,
- To report to the Commonwealth Minister and the State Minister as it thinks fit, or when requested by either Minister, on matters related to the health or welfare of workers engaged in the coal mining industry, or on any other matter concerning or arising out of the Board's powers of functions,
- To publish reports or information of public interest concerning or arising out of the Board's powers and functions, and
- To promote the welfare of workers and former workers in the coal industry in the State, their dependants, and communities in coal mining areas.

Until such time as the Commonwealth Ministers and the State Minister direct, the Board has the following powers and functions:

- To monitor, promote and specify adequate training standards relating to health and safety for workers engaged in the coal industry;
- To monitor dust in coal mines; and
- To collect, collate and disseminate statistics related to the coal industry, other than statistics related to the health and welfare of workers.

The Australian Government has acknowledged the activities of the Joint Coal Board as being a State of NSW function. A draft bill by 'the NSW Government was released in 2000 detailing a new statutory corporation, comprising the Joint Coal Board, NSW Mines Rescue and NSW Coal Superannuation. This new organization İs expected to be enacted in 2001.

2.2 *NSW Department of Mineral Resources (DMR)*

The Occupational Health and Safety Act 1983 (OH&S Act) is the primary legislation for the regulation of occupational health and safety in all NSW industry, including mining. The OH&S Act 2000 is to be introduced in 2001, which is a restructure of the 1983 Act but containing the same duties.

Mining engineering, including mines inspection, environment and related issues are brought together in the Mine Safety & Environment Division. Coal mine safety is administered by the DMR through the OH&S Act and the Coal Mines Regulation Act 1982 (CMRA). New regulations were introduced İn September 1999. Coal Mines (General) Regulation

1999, the Coal Mines (Underground) Regulation 1999 and the Coal Mines (OpenCut) Regulation 1999. An additional regulation, the Coal Mines (Investigation) Regulation 1999 was also created to provide support for changes to the CMRA, relating to investigations and inspections.

The DMR is undertaking a review of the 1982 CMRA with an aim of providing the most effective regulatory framework. The new legislative framework is planned to have a mix of the revised Act(s), regulations, codes of practice and guidelines. It is proposed that the coal mining industry will operate under safety management systems and major hazard management plans. The DMR proposes monitoring industry through inspections and audits, and investigations and reviews. To improve industry safety practice, the DMR may issue reports, provide education, issue notices and, where appropriate, prosecute.

The DMR recognises that the workforce has a right to be involved in decisions which impact on health and safety in the workplace. At present, the generally accepted ways through which the workforce plays a part in decision making are OH&S committees, Check Inspectors (Workforce Representatives), and İn some instances consultation on the development of the systems under the new regulations. The mining industry must recognise that workforce involvement needs to expand where decisions affecting health and safety are concerned.

3 INJURIES AND FATALITIES

Table 1 shows coal production, employment, lost time injuries, claims and number of mines in NSW between 1990 and 2000. As can be seen from Table 1 and Figures 1 ,2, and 3, that there is a 40% increase in production, a 36 % reduction İn employment, 35% drop in workers compensation claim lodgement and 76% drop of in lost time injury frequency rate. Clearly, there is a general improvement in the industries overall operation both in productivity gains and in safety at the expense of reduced manpower.

4 EFFECT OF SHIFT WORK ON SAFETY PERFORMANCE

A recent study conducted by Cliff, Beach and Leveritt (2000)have shown that increasing working shift hours to 12 hours in conjunction with compressed work weeks can provide a significant benefit to the worker. Figure 4 shows the mean LTIFR for 8, 10 and 12-hour shift lengths. Currently the 12-hour shift is the most common shift length in Queensland mining industry as shown in Table 2. Cliff, Beach and Leveritt (2000) have also indicated that the shift length alone does-not provide the real answer to improvement to increased safety. Other factors such as ratio of days on to days off, number of shifts worked in succession, start time of the shift and shift rotation onto nights, can have a significant effect on safety performances as shown in Table 2. The average hours worked per compressed week was 40 hours. Other benefits of the compressed working week is die opportunity of the employee to spend longer quality time with family, which in rural locations can have significant impact on family life stability and cohesion.

Table 1. Production, employment, lost time injuries, claims and number of mine in NSW between 1990 and 2000 (JCB annual report 1999-2000).

Year Ended 30th June	Utiils	1990	1991	1992	1993	1994	J995	1996	1997	1998	1999	2000
Raw coal production	ml	93.9	96 7	101.2	102.9	1019	107.8	113 1	123.6	134	1314	132 9
Employment No	No	17200	17000	16600	15100	14700	14300	14473	14793	13522	11064	10150
Workers Compo Claim Lodged	No	7979	7510	6616	5903	5690	6231	5533	5095	4651	3552	3285
Lost Time Injury Fret). Rate	No	168	143	108	78	68	73	5fi	48	52	39	34
Severity rate	Days	N/A	2546	1878	1210	1128	1332	1050	999	1215	1079	954
Lost days/ employee due to WC	Days	S.3	4.7	4	34	3.6	4.1	3.7	3.3	3.2	3.5	3.3
Fatalities	No	1	9	7	4	1	2	2	6	2	3	3
No of mines	No	70	72	70	67	68	69	72	68	66	64	58

Fatalities: Those injuries which result in the death of the worker
Incident rate: The number of injuries occurring for each 100 persons employed.
Lost-time injury (LT1): A work injury which results in the loss of a day (7 hours) or more off work.
No of LT1 : Where the injured worker has less than 7 hours as a result of the injury. Includes medical expense claims.
Disease claims: where the worker has contracted or aggravated a disease in the course of employment and to which the employment was a contributing factor.
Occupational Disease: Diseases contracted or aggravated in the courses of employment and to which the employment was a contributing factor.

5 ENVIRONMENTAL ISSUES

5.1 *Dust Control and Monitoring*

The system of dust monitoring in mines is the responsibility of each state. In NSW, the Joint Coal Board carries out dust monitoring in all the coal mines, and in Queensland it is done by Department of Mines & Energy andSIMTARS.

In 1954 the NSW Joint Coal established an expert advisory body, the Standing Committee on Dust Research and Control, which comprised representative of the colliery proprietors, mining unions, government departments and Joint Coal Board medical and technical personnel. The main roles of the committee are to:

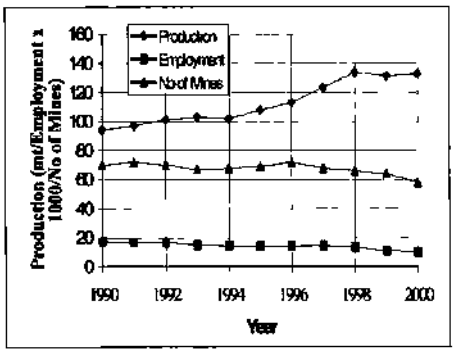

Figure 1 Production, mployment and number of mines m NSW between 1990 and 2000

- Monitoring dust sampling results,
- Evaluating dust hazards
- Encouraging improvement to dust control methods, and
- Disseminating information and educate mine personnel

The Standing Dust Committee meets bi-monthly and conducts the majority of its meetings at mine sites. Monitoring of the dust in the coal industry is carried out using two approved types of instruments. These include, the DuPont P2500, a constant flow sampler combined with a Cassella 25 mm cyclone sampling head for routine personal sampling tests and Hund Instantaneous Dust Monitor for general and mine environment dust concentration monitoring.

The specified limit for respirable dust in die underground mine environment is 3rng of respirable dust (i.e., < 5 microns, (im) per *m?* of air sampled. The specified limit for quartz containing dust is 0.15 mg of respirable quartz per m^ of air sampled. Normally five people are sampled from the production crew on all production shifts for continuous miners once per year; and on all production shifts for longwalls twice per year. All other locations in the mine, monitoring is carried out once per year. These include, other underground workers (eg drillers, transport, etc) and surface washaries, loading and crushing plants, and open cut mines (Cram and Glover, Feb. 1997, and Glover and Cram Dec. 1997, and Cram June 2000).

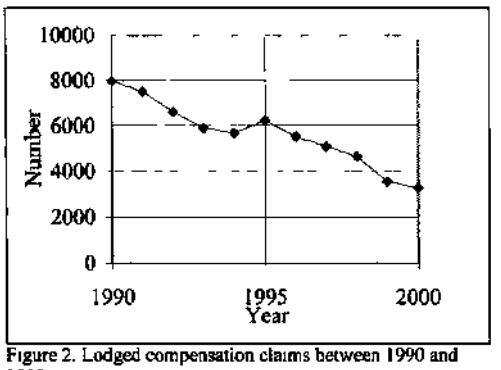

Figure 2. Lodged compensation claims between 1990 and 2000

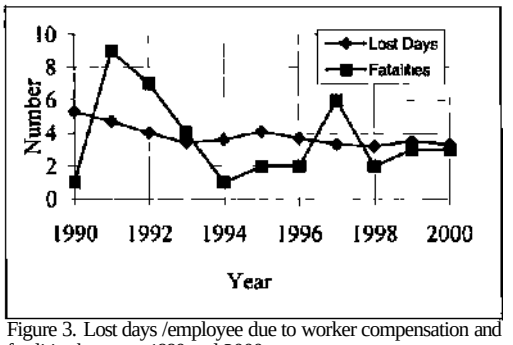

Figure 3. Lost days /employee due to worker compensation and fatalities between 1990 and 2000.

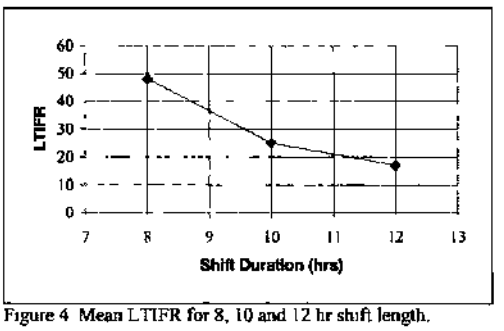

Figure 4 Mean LTIFR for 8, 10 and 12 hr shift length.

In NSW sample collection commences at the time of leaving the crib room at die start of the shift and ceases on arrival at the crib room at the end of the

shift. The sampling period is normally not less than 5 hours. The integrity of results is guaranteed by the Board's dust samplers who are present in the workplace during the sampling shift recording such information as ventilation quantities, blocked sprays, operator location, water pressure or anything which may affect the results. The sample monitoring results are forwarded to the mine manager, and senior government inspector, district check inspector and included in the Joint Coal Board data base. If the results exceed the specified limit a resample İs generally taken within 7 days or when changes are made to reduce the dust exposure. Table 3 shows the results of dust monitoring surveys that have been conducted in NSW mines since March 1984. Up to May 2000, and after over 15 years of sampling, over 38 000 personal dust samples, excluding re-samples, have been collected from over 8 000 mining locations. Sampling locations were 30 % underground longwall faces, 65% other underground operation (mainly continuous miner operations in non longwalling mines and longwall roadway development), and 5 % open cuts and coal preparation plants. Out of the 10 800 (30% of total) samples monitored from longwall faces, 6.28% exceeded the limit, where only 1.4 % of 24 900 (65% of total) exceeded the limit from non-longwalling operations and only 0.7 % of 2 400 (5% of total) tests exceeded the limit from opencut /coal preparation plants. The results show that the area of main concern remains to be at the longwall mining operation.

Table 2. Frequency of Rosters with 8,10 and 12 hour shift length.

Shift length (hours)	rosters	Percent	Valtd %	Cum %
8	54	24 3	24 3	24 3
10	31	16 8	16 8	41 1
12	109	58 9	58.9	100
Total	185	100	100	

- Monitoring dust sampling results,
- Evaluating dust hazards
- Encouraging improvement to dust control methods, and
- Disseminating information and educate mine personnel

Figure 5 shows the dust monitoring survey along the longwall face by longwall occupation between 1984 and May 2 000. The percentages exceeding the limit of 3 mg/m3 is also shown in the graph. A significant improvement has been achieved in the % exceeding the limit. Peaked at over 18%. Post 1990 reduction in dust concentration was attributed by various initiatives by coal mining companies. These initiatives included the methods of coal cutting, better water sprays, the adoptions of good ventilation practices and the introduction of effective dust suppression practices.

Table 3. Respirable Dust Results (Excluding re-samples) 1984-May 2000 (Source)

Mining Methods	Number of Personnel Samples (excl Re-samples)	Number >3mg/m3	% Exceeding Limit
Longwall Faces	10 800	679	6 3
Other Underground	24 900	356	1.4
Open Cut / Washenes	2400	16	0.7

It should be noted that two significant changes has occurred in the past 15 years. Firstly, the number of longwall faces had doubled and the average daily longwall face output increased from 4 000 tonnes to over 8 000 tonnes / day.

5.2 *Occupational Noise*

Noise Induced Hearing Loss (NIHL) is the most prevalent compensable industrial disease in Australia and entails substantial economic costs. It is believed Ůıat there is substantial under-reporting of this disease and that the data on compensation for NIHL therefore represents only a proportion of the actual problem Table 4 shows the number of claims for NIHL in NSW (Joint Coal Board Occupational Disease Statistics 1999/2000).

During 1995/1996 the NSW Government introduced a hearing loss threshold, below which no compensation is payable. As a result, there was a significant drop in claims lodged. Deafness claims account for most claims. In 1999-00 of the 300 occupational disease claims lodged, 184 or 61.3% were for deafness (NSW Joint Coal Board, Statistics 1999/00). Excessive exposure to noise have been found to contribute to increased absenteeism, lower performance and possible contribution to accidents, which can be considered as an additional and unrecognisable cost. NIHL is irreversible and leads to communication difficulties, impairment of interpersonal relationships, social isolation and a significant degradation in the quality of life for the employee.

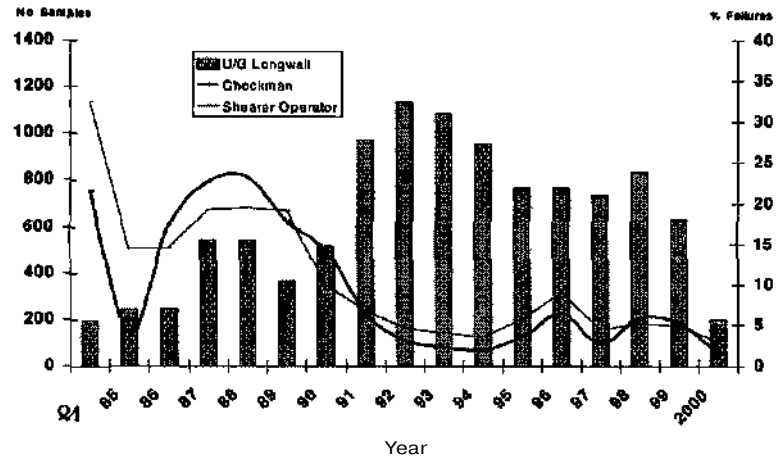

Figure 5 Dust monitoring survey along the longwall face by longwall occupation between 1984 and May 2000

Table 4. NSW Coal Industy-Number of claims.

Year (Ending June)	NSW Coal Industry Occupational Disease Deafness Claims
1991/92	541
1992/93	652
1993/94	806
1994/95	714
1995/96	514
1996/97	211
1997/98	259
1998/99	215
1999/00	184

The national standard for exposure to noise in the occupational environment is an average daily exposure level of 85dB(A) over an 8 hour period. The exposure to noise is taken to be that measured at the employee's ear position without taking into account any protection which may be offered by personal hearing protection.

In May 1996, the Work Cover Authority of NSW issued a Code of Practice-Noise Management and Protection of Hearing at Work. The Code of Practice applies to all places of work other than mines within the meaning of the Coal Mines Regulation Act 1982 and the Mines Inspection Act 1901 and to all persons in those workplaces with potential for exposure to excessive noise. The Code of Practice, which commenced May 1997, provides practical guidance on compliance with the Occupational Health and Safety (noise) Regulations 1996.

Since 1985, the Joint Coal Board has collected over 1 000 individual personal samples of noise levels and noise exposure in most NSW underground mines, selected open coal mines and coal preparation plants. The study showed that over 80% of the individual personal samples exceeded an average daily exposure level of 85 dB(A weighting).

5. 3 *Diesel Particulate*

The demand for increased power and increased mobility in recent years has seen a surge in the use of diesel engines in Australian coal mines. Presently, there are more than 3 000 diesel powered machines in Australian coal mines and İs increasing in a similar fashion as has been in the USA coal mines as reported (MSHA 1997).

While the diesel engine provides the workplace with an efficient and reliable source of power, İt İs normally noisy, smoky and can produce an unpleasant odour. More importantly though, is the concern over the possible health effects of using diesel equipment in confined space, such as in an underground mine.

Control of diesel exhaust levels in NSW and Queensland is partly determined by monitoring the gaseous components such as the NO, and CO in raw exhaust as per Coal Mines Regulation Act 1982 (CMRA 1982).

The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended 0.15 mg/m3 as a workplace standard threshold limit for DP exposure. In general, many non-mining workplaces in which diesel equipment is used, the level of DP falls well below the recommended ACGIH exposure standard. In contrast, studies show that the DP levels in the mining environment can be significantly higher than exposures in the ambient air or in other workplaces as shown in Figure 6 (Davies, 1997)

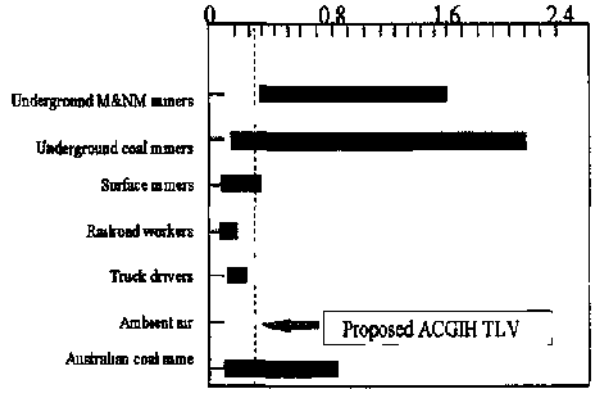

Figure 6 Personal DP exposure in mg/m^3 from USA mines and Australian coal mines (Davies, 1997)

Since 1990, there have been a significant increase in the concern of the effect of DP on the health of the mine employees, particularly in underground operations. Personal monitonng from the field survey conducted at nine underground mines in Australia by Pratt et al (1995) has mdicated that the exposure of the workforce ranges between 0.1 and 2.2 mg/m3 of DP, depending on job type and mining operation A detailed breakdown of the exposures from all nine underground mines are shown in Table 5. All samples collected were on a full-shift personal basis with a minimum of 4 hours sampling duration. A total of 134 personal samples were collected at the mines.

Currently mere is no engine emission standard for DP and no occupational exposure standards are available in Australian coal mining operations However, the ACGIH released notifications of a proposed diesel exhaust standard of 0.15 mg/m^3.

Table 5 DP exposure rates in nine mines (After Pratt et al, 1995)

Mine	Fuel type	Samples	DP exposure mg/m3
A	Standard	12	014-0 56
B	Standard	17	0 15-0 31
C	Low S	24	0 03-0 17
D	Standard	23	0 06-047*
E	Low S	22	0.04-165*
F	Standard	13	0 13-032
G	Standard	17	0 06-0 62
H	Low S	16	0 10-0 25

*(LW Move in progress requiring heavy equipment)

Table 6 shows a detailed breakdown of the exposures of various machine operators for each mine and the CMRA specified ventilation requirement per KW engine capacity, bearing in mind that the Act requires that, to ensure protection of the workforce, each piece of diesel equipment is required to operate with a minimum fresh air ventilation of 0 06 m3 /sec/kW of power to provide adequate dilution of exhaust gases.

Table 6 Diesel particulate exposure rates by different mine machine operators

Machine Operator	Engine Power (KW)	Vent Rqd/KW	DAP mg/m3
Shearer Transporter	84 00	50	I 7
Chock transporter	11200	67	0 3 - 0 70
Eimco	75.00	45	0 15-0 30
MPV	68 30	41	0 15-0 25
PJB Power tram	50 00	30	05 -02
Domino	42 00	25	0 05 - 0 1
Wagner	J12	67	0 2 - 0 6
Gardner	48 5	29	01-06
Myne Bus	65 0	39	03

The research work conducted by Pratt et al (1997) added significantly to the knowledge of the extent of employee exposure to DP and to me methods by which exposure can be controlled. The study has shown that the traditional control strategies such as engine and scrubber tank maintenance, regular gaseous emission testing, and the requirement of minimum ventilation rates provide considerable control of workforce exposure The study also showed that the use of correct fuel quality such as low sulphur fuel, regular engine tuning, and engine decoking provides further significant overall reductions in DP exposures and creates a more

under heavy load conditions, additional controls in the form of disposable filters fitted to the exhaust outlet appear to provide the most effective control at this stage. Figure 7 shows the effect of sulphur in diesel fuel on engine emissions respectively as reported by Pratt et al (1997).

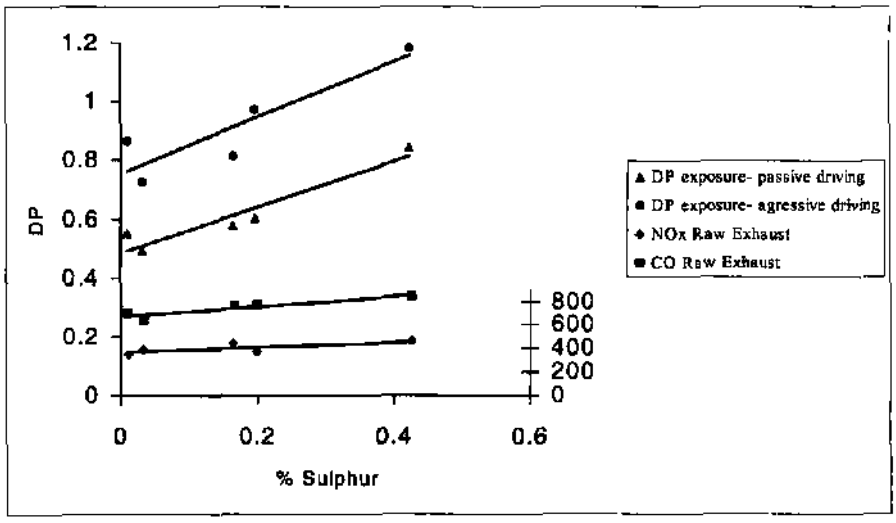

Figure 7. The effect of sulphur in diesel fuel on engine emissions.

6 CONCLUSIONS

The combined efforts of the industry, governments and miners union İn Australia has seen a dramatic improvement in the health and wellbeing of coal mine personnel. Longer shift hours and compressed working weeks have shown benefits both to the employer and employee. The various safety measures outlined in the paper have clearly yielded benefits. Initiatives in workplace environment improvements, such as dust, noise and diesel emission control, are all positive step in the right direction in improving the health of the mine employee because of the hostile environment of the workplace. As a result, there has been 40% improvement in production at 36% reduction in manpower between 1990 and 2000. At the same time there was a drop of 35% in worker compensation, and 76% drop in LTIFR. Clearly, the continuing decline in the workforce employments may, in the long run, prove not to be in the best interest of the Australian coal industry to maintain the skilled workforce. For the industry to move forward and confront successfully the difficult challenges of die technological advancement and market economy, greater attention must be paid on better training of its skilled workforce. Trained mine personnel is an invaluable asset which no mine manager can afford to ignore.

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