RESPIRABLE DUST RESULTS FROM NSW LONGWALL MINES

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ABSTRACT: An outline of airborne dust sampling methodology, instrumentation and exposure standards in the New South Wales coalmining industry are presented combined with the results of dust monitoring of the mining industry workforce with particular emphasis on longwalls. The overall improvements to workforce exposure levels and the systems and techniques which led to these improvements are dealt with, as are respirable quartz levels, together with sources and difficulties of compliance with the Coal Mines Regulation Act (CMRA) 1982 requirements. The non-punitive nature of the regulations combined with the mutual co-operation between management and unions in the interpretation and use of monitoring program results, to achieve overall improvements in airborne dust levels throughout the industry is examined. Results are presented covering long wall, continuous miner and open cut / surface operations. Periodic health screening and results of epidemiology studies of the workforce by Coal Services Health (formerly the Joint Coal Board) indicate adherence to current maximum exposure levels is sufficient to maintain a healthy industry workforce.

INTRODUCTION

The Joint Coal Board was originally constituted under an arrangement between the Governor-General of Australia and the Governor of New South Wales made pursuant to the provisions of the Coal Industry Act, 1946 (Commonwealth) and the Coal Industry Act 1946 (NSW). In 2001 the Commonwealth withdrew from the Joint Coal Board and those Acts were repealed. As a replacement for the Joint Coal Board under the Coal Industry Act (NSW Govt 2001) a corporation was formed, Coal Services Pty Limited to oversee occupational health and welfare in the NSW coal industry. Coal Services is owned equally by the New South Wales Mineral Council and the CFMEU (mine workers union). The powers and functions of the corporation are stated in the provisions of the Act and include the responsibility to monitor respirable dust in NSW coal mines.

Coal Services Health operates the dust sampling program, which is an occupational hygiene service and is complementary to the other health services provided which include mine workers biological monitoring from chest x-ray examination and lung function tests. Since July 1994 the dust sampling service has been on a fee-for-service basis.

HEALTH RISK

The health risk to mine workers has long been acknowledged as being related to prolonged exposure to high concentrations of respirable coal dust which can lead to pneumoconiosis, and when mining high quartz content material, silicosis. Coal mining has historically been associated with the occurrence of disabling chest diseases.

The International Labour Organization (ILO) Classification System, the international standard, is the system used by Coal Services Health to grade pneumoconiosis on chest radiographs of coal mineworkers. Under this system, there are four major categories used to grade the severity of pneumoconiosis. Essentially, category 0 is the normal state (no pneumoconiosis), category 1 is mild pneumoconiosis, category 2 is moderate pneumoconiosis, and category 3 is severe pneumoconiosis. It is generally agreed by clinicians, that symptoms of pneumoconiosis are not experienced until category 2 is reached. At category 1, most individuals would be unaware of the presence of early pneumoconiosis, and would not normally be restricted in work or leisure activities.

When the Joint Coal Board was established in 1948 pneumoconiosis was prevalent among coal miners (16% all categories, 4.5% category 2 or worse). Today, the prevalence is so low that no new cases of pneumoconiosis have been detected in the last 10 years. The incidence of pneumoconiosis in NSW is among the lowest in the world. For the last 5 years the rates of pneumoconiosis in NSW continues to be less than 0.5% (Joint Coal Board 2001)

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STANDING COMMITTEE ON DUST RESEARCH AND CONTROL

The Joint Coal Board since its inception actively pursued the eradication of dust related diseases among coal miners. In 1954 a Standing Committee on Dust Research and Control was established to provide expert advice to the NSW coal industry on respirable dust issues. The committee was constituted from representatives of the colliery proprietors, mining unions, government departments and the Coal Services Health division. The committee was instrumental in the introduction of the gravimetric sampling method and setting the current exposure standards. Coal Services Pty Limited is continuing those same objectives in 2002

The Committee meets bi-monthly to review results of Coal Services Health monitoring programs and evaluate and exchange information on technologies, innovations and problems in the industry related to respirable dust. The role of the committee in 2002 remains fundamental to the promotion of improved health standards for coal industry workers.

DUST MONITORING SERVICE

The Coal Services Health (formerly the Joint Coal Board and JCB Health) dust monitoring service is quality accredited and has been the sole organization involved with personal dust monitoring in the NSW coal industry since the current regulations (CMRA, 1982) were gazetted in March 1984. The service has the total support and acceptance of both management and unions.

The specified limit for respirable dust other than quartz-containing dust, is 3mg of respirable dust/m^3 of air sampled. The specified limit for quartz-containing dust is 0.15mg of respirable quartz/m^3 of air sampled (CMRA, 1982). The details are in the attachment (Appendix A)

The frequency of sampling, places and persons to be sampled in each part of a mine are specified in the table (Appendix B). In NSW sample collection commences at the time of leaving the crib room at the start of the shift and ceases on arrival at the crib room at the end of the shift. The sampling period, if practicable should be not less than five hours (CMRA, 1982).

While it is the responsibility of mine management to meet the frequency of sampling required by the CMRA the Coal Services Health monitoring programs are structured in such a manner that management's obligations are fulfilled where possible.

The integrity of results is guaranteed by a Coal Services Health employee present in the workplace during the sampling shift recording such information as ventilation quantities, blocked sprays, operator location, water pressures or anything which may affect results. Results are used solely to identify problem areas which may exist and are not used at any time for punitive measures. Where areas of high dust concentrations are found to exist efforts are directed to these areas in order to rectify the problems. These efforts in many cases involve Management, Union and Coal Services Health initiatives.

Results of the sampling are forwarded to the colliery manager, senior inspector of coal mines, united mineworkers district check inspector and included in the Coal Services Health dust database.

If the result of any sample exceeds the specified limit a re-sample must be taken within seven working days in similar circumstances to those existing when the sample was collected. If the resample still exceeds the specified limit the district inspector of coal mines may, in writing direct the colliery manager to carry out additional procedures to reduce the concentration of airborne dust (NSW Govt. 1999).

During the period 1984-2001 the number of underground mines in NSW reduced from 67 to 32, mainly with the closure of non-longwall mines. Open cut mines increased in that period from 18 to 24 mines. Total raw coal production in the period increased from 68.3 million tonnes in 1984 to 142.9 million tonnes in 2001. Underground production increased from 42.2 million tonnes to 54.6 million tonnes and open cut production substantially increased from 30.7 million tonnes to 88.4 million tonnes during the same period (Coal Services 2002)

COAL SERVICES HEALTH DUST DATA BASE RESULTS

By the end of 2001, after nearly 18 years of sampling, over 46,000 personal dust samples (including re-samples which is the worse case scenario) had been collected from over 9,000 mining locations. Sampling locations were 30% longwall faces, 62% underground other than longwall (mainly continuous miner panels) and 8% open cut/washeries. From 1984 to 1997 the sampling location mix was 65% underground other than longwall and 5% open cut/washeries, increased sampling at open cuts in the last 4 years has seen that % change. An average of over 2,500 personal dust samples at over 500 mining locations were collected per annum from 1984 to 2001.

Analysis of the data is based upon the results obtained during the standard frequency sampling and re-samples. The results of re-samples taken for the requirements of CMRA have been included in the data analysis in Table1

Table 1 Respirable Dust Results (Including Re-Samples) 1984 - 2001

Mining Method	Number of Personal Samples (Including Re-Samples)	Number > 3mg/m3	**Percentage** Exceeding Limit
Longwall Faces	14170	1002	7.1
Other Underground	29040	468	1.6
Open Cut/Washeries	2790	21	0.8

Examination of the dust results by mining method gives a clearer understanding of the situation shown in Table1

- Longwall operations - over 14,000 samples and 7.1% exceeded the limit.
- Other underground (mainly continuous miner panels) - 29,000 samples and 1.6% exceed the limit.
- Opencut/washeries - 2,790 samples and only 0.8% exceed the limit.

This clearly shows that the area of main concern has been the results from the longwall faces.

LONGWALL RESPIRABLE DUST RESULTS

In 1984 there were 12 longwall faces, which progressively rose to 25 faces by 1997 but had reduced to 21 by 2001. Longwall samples over the 18 year period resulted in over 7% of the samples exceeding the 3mg/m³ level. Details of the results are shown in Table 2 where significant improvement has been achieved in the results over the 18 year period. During the 1980s the percentage of results exceeding the limit peaked at over 18%. From 1990 substantial initiatives by coal companies achieved the present situation where only 6% of results exceed the limit but longwall mining results still remain the main area of concern. The overall trend during the period has been a reduction in the percentage of samples exceeding the limit. There had been a slight deterioration in the late1990's and this was attributed to a few particular longwalls where there were operational problems. These are being addressed and the trend in results exceeding the limit is expected to continue going down in the future.

It should be noted that two significant changes occurred in the 1984-2001 period. Firstly the number of longwall faces had doubled and the average shift longwall face output increased by more than 100%. During 2001- 02 NSW longwall production was from 22 mines with the coalfield details as follows:

Hunter Coalfield	-	10.8 million raw tonnes from 5 faces
Newcastle Coalfield	-	8.6 million raw tonnes from 6 faces
Western Coalfield	-	10.0 million raw tonnes from 4 faces
Southern Coalfield	-	10.9 million raw tonnes from 7 faces
Total NSW Coalfields	-	40.3 million raw tonnes from 22 faces

Respirable dust monitoring results for all NSW longwalls after 18 years monitoring has achieved 14,170 personal samples with just over 1,002 (7.1% failures) exceeding the prescribed limit. Which longwalls or coalfields are contributors to these failures?

Western coalfield mines are not a significant contributor 1,500 personal samples and only 52 failures (3.5%). In 1987 and 1994 a few dust problems affected results at Clarence and Ulan. In 2001 there were some high dust results on a Lithgow seam longwall mine which are being addressed.

In Southern coalfield mines, which were the forerunner for longwall mining, 5,930 personal samples produced 465 failures (7.8%). The NSW dust failure trend has traditionally followed the performance of the southern coalfield mines which had generally half the longwall samples and half the failures. There had been a concerted effort in the late 1980's to drive the high 30% of failures down to the present level of 3 – 5%. In the last 5 years the southern coalfield results have been better than all the NSW percentage failures, although the number of southern faces has reduced by 30%.

Northern coalfield (Newcastle) longwall mines had 4,770 personal samples and 276 failures (5.8%). During the 1980's results were better than the all NSW percentage failures, from the mid 1990's the results have not been as impressive and the situation up to year 2000 was worse than the combined results of the NSW longwall faces. The main contributor during those years had been the new faces in the West Borehole and Great northern seams. Combined efforts were concentrated to reduce the personal exposure on the longwall faces to the present level of 5 – 6 % of results failing. The number of northern faces has been reasonably static for the last 10 years.

Hunter coalfield (Singleton) longwall mines have had 1,960 personal samples and 209 failures (10.7%). The number of faces has doubled in the last 10 years and since the mid 1990's the results have seen the number of failures (8 – 10%) far in excess of the NSW number of failures, around 6%. Initially the main contributors were faces in the Whybrow and Pikes Gully seams. From the mid 1990's the Wynn seam at Dartbrook Colliery has been difficult to longwall mine and maintain dust levels below the prescribed limit. All the Hunter coalfield longwall operations have been continually trying to improve dust suppression measures and operating procedures to reduce the face operators dust exposure levels.

Longwall dust suppression has been very successful in the following areas:

- sealing the covers on the BSL and enclosing the BSL discharge on the belt to reduce intake contamination
- homotropol ventilation has been very successful in allowing clean uncontaminated air onto the longwall face
- water infusion in the Bulli seam utilising in-seam gas drainage holes has been reasonably successful in putting some moisture back into the seam
- operator location with emphasis on face operating procedures has been a major contributor to the improved longwall face dust results. The 'Hund' instrument has been an excellent tool to highlight areas of high dust levels and indicate the best location for face operators
- shearer initiation of chocks (shields) has also moved people from the return side of the shearer.

RESPIRABLE QUARTZ RESULTS

Analysis of the quartz data is based upon the results obtained during the standard frequency sampling and re-samples. The results of re-samples taken for the requirements of CMRA have been included in the data analysis.

Of the 46,000 personal samples taken around 4,500 were sent for quartz analysis. The samples sent for analysis were from those locations where the mining practice or material was expected to contain high quartz containing dust and where the sample failed the respirable dust limit. In the case of longwall samples 20% were sent for quartz analysis. Samples from longwalls sent for quartz analysis had a 1 in 3 chance of exceeding the specified limit of 0.15mg of respirable quartz/m³. Those samples exceeding the specified limit for different mining methods for the period 1984 - 2001 are detailed in Table 3.

TABLE 3
RESPIRABLE QUARTZ RESULTS (INCLUDING RE-SAMPLES) 1984 – 2001

Mining Method	Number Of Personal Samples (including re-samples)	Number > 0.15mg/m³
Opencut/Washeries	2790	38
Longwall Faces	14 170	536
Other Underground	29040	382

LONGWALL QUARTZ RESULTS

High quartz has resulted from longwall mining through stone rolls, faults and dykes or when cutting roof and floor. Some coal seams in the Hunter coalfield are high in quartz and are proving difficult to maintain below the CMRA maximum allowable limit of 0.15mg/m^3. Examining the quartz results in a worst case scenario including re-samples, 536 failures 3.8% of 14,170 personal samples.

The western coalfield had 21 failures and this is only 1.4% of the 1.510 samples. Overall there have been only a few problems over the last 10 years. In the last 2 years there have been high results at a Lithgow seam mine cutting roof stone in sections of the longwall block. The southern coalfield had only 31 failures, 0.5% from 5,930 samples. This coalfield and the western coalfield traditionally only have high quartz results when longwall faces are cutting roof, stone rolls or floor stone.

Quartz results in the northern coalfield (Newcastle) showed 302 failures, 6.3% from 4770 samples. This coalfield from 1985 – 95 was far above elsewhere in NSW and a main contributor to the high trend of failures in NSW. The Great Northern seam longwalls had high quartz results during this period, overall in the last 5 years the situation has improved. The Hunter coalfield had 182 failures from 1960 samples, which is over 9.3%. This coalfield has impacted greatly on the quartz results trend in NSW. The longwalls in the Whybrow seam have been the area of main concern, high quartz content in the seam and a need to operate at half the respirable dust levels to avoid quartz failures. The need to cut substantial amounts of roof on the longwall faces in the Pikes Gully and Liddell seams is going to be an area that needs to be addressed.

PERSONAL PROTECTION

Where dust exposure cannot be maintained below the specified limit, personal protection should be introduced but due to the protection factor of respirators being relative to facial fit and wear time (uncontrolled factors), they should only be used as a last line of defence and must not take the place of prevention or dust suppression techniques.

COAL SERVICES ORDER 40 - ABATEMENT OF DUST ON LONGWALLS

Another initiative of the Joint Coal Board and continued by Coal Services by its role in the area of airborne dust was the issue of Order 40 on 5 July 1990. This order requires the manager or owner of any mine operating by longwall or shortwall mining methods to obtain Coal Services approval prior to the commencement of production in any longwall or shortwall block. Results of dust samples from previous longwalls are examined prior to approval. Most approvals granted are subject to some form of imposed conditions.

The advent of Order 40 appears to have created a more positive and co-operative attitude towards dust control measures by both management and unions.

CONCLUSIONS

Results of the Coal Services Health Dust Monitoring programs combined with epidemiology studies indicate that adherence to the current maximum exposure standards outlined earlier is sufficient to maintain a healthy industry workforce.

Even though occupational lung diseases are currently well controlled in the New South Wales industry, it is essential that face management is vigilant to ensure that longwall machinemen adhere to face operating procedures, to limit dust exposure and that dust suppression equipment is maintained through engineering maintenance programs.

In mines operating in seams with high levels of inherent quartz and where there is a need to cut roof stone, it is necessary for operators to achieve lower than required dust levels in order to meet the specified levels of respirable quartz. Similarly additional dust suppression techniques may be required in development panels where conditions are such, that stone roof or floor must be continually mined.

Although recent annual reports from Coal Services former organization the Joint Coal Board have been indicating prevalence rates of pneumoconiosis in the NSW coal industry of less than 0.5%, respirable dust control management plans should still be a high priority.
Finally it is important that the industry does not become too complacent regarding the pneumoconiosis risk, particularly as memories of early miners disabled with chronic chest disease fade from the memories of the current workforce.

REFERENCES:

Joint Coal Board 2001, 54th Annual Report, 2000- 2001, page 10. Joint Coal Board: Sydney
NSW Govt. 1982 Coal Mines Regulation Act 1982 No 67. NSW Govt. Printer: Sydney
NSW Govt. 1999 Coal Mines (Underground) Regulation 1999. NSW Govt. Printer: Sydney
NSW Govt. 2001 Coal Industry Act 2001. NSW Govt. Printer: Sydney
Coal Services 2002, New South Wales Coal Statistics, 2001 - 02, page 15. Coal Services Pty Limited: Sydney

Table 2 All Respirable Dust Results (Including Re-Samples) New South Wales Coal Mi
19842 All Respirable Dust Results (Including Re-Samples) New South Wales Coal Mine 1984 2001

Years	UNDERGROUND LONGWALL FACE			OTHER UNDERGROUND			OPENCUT AND WASHERIES		
	Number of Personal Samples (including re-samples)	Number >3mg/m³	Percentage exceeding limit	Number of Personal Samples (including re-samples)	Number >3mg/m³	Percentage exceeding limit	Number of Personal Samples (including re-samples)	Number >3mg/m³	Percentage exceeding limit
1984	238	40	16.8	1820	61	3.4	47	1	2.1
1985	340	32	9.4	2322	50	2.2	72	0	0.0
1986	307	38	12.4	1862	31	1.7	99	1	1.0
1987	592	102	17.2	1915	32	1.7	127	3	2.4
1988	553	118	21.3	1604	27	1.7	32	0	0.0
1989	426	64	15.0	1323	18	1.4	75	0	0.0
1990	645	61	9.5	1306	18	1.4	129	0	0.0
1991	1112	61	5.5	1863	21	1.1	107	0	0.0
1992	1275	60	4.7	2064	19	0.9	195	0	0.0
1993	1198	37	3.1	1592	4	0.3	157	1	0.6
1994	1078	31	2.9	1591	21	1.3	214	0	0.0
1995	922	48	5.2	1627	21	1.3	213	2	0.9
1996	981	53	5.6	1572	26	1.7	308	5	1.6
1997	1010	39	3.9	1398	25	1.8	213	1	0.5
1998	1079	53	4.9	1536	22	1.4	193	0	0.0
1999	866	59	6.8	1353	30	2.2	225	2	0.9
2000	727	57	7.8	999	19	1.9	153	3	2.0
2001	817	49	6.0	1289	23	1.8	228	2	0.9

APPENDIX A

9154 OFFICIAL NOTICES 24 September 1999

COAL MINES REGULATION ACT 1982
COAL MINES (UNDERGROUND) REGULATION 1999
COAL MINES (OPEN CUT) REGULATION 1999

File No. C99/0691
Date: 1 September 1999

SPECIFIED LIMITS FOR AIRBORNE DUST

FOR the purposes of clause 161 of the Coal Mines (Underground) Regulation 1999 and clause 29 of the Coal Mines (Open Cut) Regulation 1999, (definition of 'specified limit'), it is hereby notified that the limit specified in respect of certain types of dust is as follows:

Specified Limit for Quartz-Containing Dust:

The specified limit for quartz-containing dust is 0.15 milligrams of respirable quartz per cubic metre of air sampled.

Specified Limit for Respirable Dust (other than quartz-containing dust):

The specified limit for respirable dust (other than quartz-containing dust) is 3 milligrams of respirable dust per cubic metre of air sampled.

Definitions:

In this notice:

- "quartz-containing dust" means dust which contains five per cent or more by mass of respirable quartz
- "respirable dust" has the same meaning as it has in Australian Standard 2985
- "respirable quartz" means the quartz present in respirable dust
- "breathing zone" has the same meaning as it has in Australian Standard 2985

PAUL THOMAS HEALEY,
CHIEF INSPECTOR OF COAL MINES.

NEW SOUTH WALES GOVERNMENT GAZETTE No. 111

APPENDIX B

TABLE OF LOCATIONS, FREQUENCIES AND PERSONS FOR SAMPLING

Column 1	Column 2	Column 3
Location	Frequency of Sampling	Persons to be Sampled
(a) in each part of the mine where longwall mining is carried out.	each producing shift at intervals not exceeding six months.	samples to be collected from the breathing zone of at least five persons including, where possible: - a shearer-loader operator, - two powered support operators, - a deputy, and - one other person to be selected by the manager.
(b) in each part of the mine where a continuous mining machine operates.	each producing shift at intervals not exceeding twelve months.	samples to be collected from the breathing zone of at least five persons in each unit including, where possible: - a continuous miner driver, - a sideman or cable handler, - a shuttle car driver, - a deputy, and - a boot end attendant or other person to be selected by the manager.
(c) in any place in or about an underground mine other than those referred to in (a) or (b) above, but including crusher stations and wateriest	at intervals not exceeding twelve months.	samples to be collected from the breathing zone of at least one person.
(d) in any place in or about an open-cut mine where dust may be present.	at intervals not exceeding twelve months.	samples to be collected from the breathing zone of at least one person.

NOTE:

(1) Any further samples required by regulation will be additional to these prescribed frequencies.
(2) In the case of (c) or (d) the manager shall select those activities where workmen are likely to be exposed to airborne dust. Such selection shall be notified on a yearly basis to the District Inspector who may require additional activities to be sampled.
(3) Samples and analyses conducted by or for the Joint Coal Board may be used by the manager as part or the whole of the required number of samples to be collected for a given period.
(4) Persons sampled shall, as far as possible, remain at the same job for the duration of the test.