LEGISLATION AFFECTING VENTILATION IN N.S.W. COAL MINES

by
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ABSTRACT

Legislation for control of ventilation in New South Wales coal mines is contained in the Coal Mines Regulation Act, 1912, as amended. The standards set down in that Act were based on the needs of the industry at the turn of the century. Changes and additions to the original standards have been made to cater for mechanization of the industry and the introduction of modern developments such as the use of diesel equipment. Technological progress has been recognized by the requirement for monitoring of machines and return airways.

The passing of the Coal Mines Regulation Act 1982 has ensured that there will be a revision and modernization of the regulations affecting day to day operations of the industry.

INTRODUCTION

The Coal Mines Regulation Act, 1912 as amended, incorporated standards for ventilation and gas control which were based on the need to ventilate places which were hand worked and involved the loading of coal into small skips hauled by horses. The development of modern mining techniques has resulted in additions to the legislation to cater for the extensive use of electricity, the concentration of mining by mechanical equipment and the widespread use of diesel equipment.

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The main standards for ventilation quantity and quality are contained in the General Rules of the Act particularly General Rules 1, 1A, 3, 4B, 5A and 7 while some quality control is also incorporated into the 5th and 7th Schedules. Further control has also been made in special circumstances by way of condition attaching to approvals granted under the provisions of the Act.

SPECIFIC STANDARDS

Apart from the constituents of normal air a mine atmosphere may contain a number of other gases. Some of these gases such as methane and carbon dioxide are expected and are related to the mining environment others such as carbon monoxide and nitrous fumes are usually related to the introduction of outside agencies such as engines or explosives and other gases such as sulphuretted hydrogen occur only rarely. The Joint Coal Board (1981) has issued a booklet which gives a comprehensive list with details and characteristics of most gases and a description of the various combination of gases which in mining parlance have become known as damps.

The Coal Mines Regulation Act does not set standards for all gases found in the mining environment but does contain some specific levels for quantity and quality of ventilation.

QUANTITY

The main provisions of General Rule 1 Sectior 54 Coal Mines Regulation Act can be summarized as follows:

In every mine an amount of ventilation air drawn from a pure source by means of a mechanical contrivance shall be continuously provided so that the roadways shall be in a fit state for working and the quantity shall be sufficient to provide 0.08 m^3/s for each man and 0.16 m^3/s for each horse on the intake side of a point 100 m from the first working place in each ventilating district with not less than 2.4 m^3/s passing the person operating a combined cutting and loading machine or a continuous miner.

These requirements are extended by General Rule 1A which stipulates that "so far as is reasonably practicable the minimum air movement to be maintained at a point at the face of every working place while any person is engaged therein shall be not less than 0.254 metres per second".

QUALITY

The quality of ventilation is influenced by the requirement of General Rule 1 which stipulates that every mine shall be divided into ventilating districts supplied with a separate current of fresh air. A place in such district shall not be deemed fit for working or passing therein if the air contains less than nineteen per cent of oxygen, more than one and a quarter per cent carbon dioxide or more than one part in ten thousand of carbon monoxide. The intake airways up to 100 m of the first working place shall not contain a percentage of inflammable gas that exceeds one quarter of one per cent. Kininmonth (1981) has described the influence of that requirement on the development of Appin Colliery prior to the explosion in July 1979. A workable exemption clause was subsequently inserted into the legislation in 1980. The general environmental conditions applying in Australian coal mines have been described by Muir and Clark (1976) and reference was made to working temperatures. Despite the use of bigger machinery and the mining of coal at greater depths the provisions in General Rule 1A relating to a reduction of working hours when the effective temperature exceeds 26.1°C is seldom invoked.

Two other levels of methane require immediate specific action. General Rule 7 requires withdrawal of workmen from any part of a mine which is found to be dangerous and prescribes danger from gas as occurring if the percentage of inflammable gas in the general body is two and a half or upwards. Regulation 69 of the 7th Schedule requires the disconnection of electric power from any cables or apparatus in any part of a mine where the percentage of inflammable gas in the air is one and a quarter or more.

Layering of gas imposes particular problems because a flame safety lamp does not ensure reliable detection. The problem of layering of gas and its relationship to area, velocity and general body percentage has been described by the S.M.R.E. (1964) who developed a nomogram for prediction of probable layering. In practical application detection is more important than prediction and the Coal Mines Regulation Act stipulates that most tests for gas by deputies shall be done using a locked oil flame safety lamp and some other approved device. The other device has been defined as a methanometer or a Garforth bulb for use in conjunction with the flame safety lamp.

SPECIAL CIRCUMSTANCES

Compliance with the specific standards mentioned above does not guarantee freedom from special risks such as accumulations of methane in the face areas of the workings so a number of special requirements have been incorporated in the Act or in conditional approvals granted under the provisions of the Act.

GASSY PLACES

There are four different circumstances which

could lead to a place being defined as a gassy place for the purposes of the Fifth Schedule which covers use of explosives. The most important of these relates to the finding at any time in a mine of one and a quarter per cent inflammable gas or more by means of a locked oil flame safety lamp. Thereafter the whole of the mine would be classed as a gassy place and be subject to the more stringent shotfiring conditions which apply to gassy places.

The definition of gassy pla in the 7th Schedule in relation to use of el rical equipment is quite specific for all mi s not influenced by standards of ventilation. The purpose of the restrictions imposed in a gassy place under the 7th Schedule are set out in Regulation 12B (c) of that schedule as follows:

"While a voltage is switched on to any conductor connected to an apparatus situated in a gassy place, all parts of the apparatus which are designed to carry electric current or to have a voltage applied (other than any such part which is a part of a circuit which has been approved as being intrinsically safe) shall be --

(i) completely enclosed in an approved flame-proof enclosure, or

(ii) protected by such measure or measures as may be approved so as to obviate the risk of fire or explosion".

AUXILIARY VENTILATION

Approval of the District Inspector is required under the provisions of General Rule 3 before an auxiliary or booster fan can be installed underground. The conditions applying to the use of auxiliary fans include that there shall be available thirty per cent more air than the fan can pass on open circuit and provision for cutting power to inbye electrical equipment if the fan stops. One of the major problems with auxiliary ventilation is the degassing of places ventilated by the fan after such a shutdown. The Report on ventilation of narrow drivages (1979) described suitable means of degassing in a review of auxiliary ventilation and Kininmonth (1981) referred to the problem in relation to the Appin explosion. The auxiliary fan approvals now incorporate the following condition.

"The auxiliary fan shall not be operated if flammable gas can be detected at 1¼% or more within 20 metres of the fan or associated cabling using a locked oil flame safety lamp and some other approved device. When an accumulation of flammable gas is to be removed by the fan the following procedure shall be adopted:-

(a) The adjustable valve in the T piece arm or similar arrangement shall be fully opened.

(b) The discharge of the fan shall be monitored using a methanometer.

(c) The adjustable valve shall be operated in such a manner as to ensure that the flammable gas discharged from the auxiliary fan is less than 1¼%."

Booster fans are not widely used and the conditions are more stringent in that monitoring of methane and fan operation is required under the conditions of any approval granted.

DIESEL EQUIPMENT

Approval of diesel equipment for use underground is required under General Rule 5A. The need to dilute the exhaust gases given off by the engine is covered in the conditional approval by stipulation of a minimum air quantity in the roadway in which the vehicle works. The range of quantities applied in conditions relates to the engine size as follows:

Up to 60 kW.	0.0632 $m^3/s/kW$
60 kW to 67 kW	0.0474 $m^3/s/kW$
Over 67 kW	0.0316 $m^3/s/kW$
Minimum requirement	3.6 m^3/s

Gas emission from the engine and its dilution into the environment is assessed by compliance with the following two conditions.

1. "Once in every four weeks the undiluted and unconditioned exhaust gases of each tractor shall be sampled and analysed and should the carbon monoxide content be found to exceed 1,500 parts per million or the oxides of nitrogen content be found to exeed 1,000 parts per million, the tractor shall not be used until the quality of the exhaust gases has been brought within the limits above specified."

2. "Where, in any working place or road in which a tractor is in use, there is found in the general air a concentration of carbon monoxide greater than 50 parts per million, or of oxides of nitrogen greater than five parts per million, or of methane of 1-1/4% or greater, immediate steps shall be taken to disperse the said concentration, and the engine shall not be operated until it is found that the concentrations of these gases are below the limits specified."

MACHINE MONITORING

The Chief Inspector of Coal Mines under the provisions of General Rule 4B may require the fitting to any continuous mining machine of an automatic monitoring device capable of

(a) giving a warning when one per centum of more of inflammable gas is present; and
(b) automatically cutting off the power to that machine when two per centum or more of inflammable gas is present.

A similar device is required to be installed on the return side of every longwall working and in any other place that the Chief Inspector may require.

The direction by the Chief Inspector requiring the fitting of monitors to continuous miners is normally related to the history of gas control at a particular mine which in turn is related to the rate of gas release from the seam and the ventilation control.

RETURN MONITORING

In the absence of a methane drainage system all the gas released from the workings and from goaf areas finds its way into the return roadways of a mine. The gas percentage at any time will depend on the rate of extraction and on variations of ventilation quantity, on gas release from adjacent strata and on barometric changes. General Rule 1 provides that

"Where the percentage of inflammable gas in any return airway of a mine exceeds one half of one per centum, a continuous monitoring system approved by the chief inspector shall be installed so that the percentage of inflammable gas in the general body of the air in that return airway shall be automatically recorded at the surface of the mine."

DUST LEVELS

Control of dust levels in the environment is dealt with in General Rule 12B and is important not only for medical reasons but also to reduce the risk of coal dust being involved in ignitions or explosions should these occur.

The Owens dust counter has been specified as the instrument for assessing airborne dust. The proclaimed standard of concentration of dust which if in suspension in the air is deemed to be dangerous to health and safety is an average of 175 particles per cubic centimetre of air in the range of 1 to 5 microns in size. That

standard applies wherever the free silica content of the parent rock or coal does not exceed ten percent. The average number of particles is reduced in steps until at a silica content over 50 percent the particle count must not exceed 50. The distribution and total quantity of ventilation air have a major influence on the concentration of dust at the working places where the measurements are made.

The assessment of deposited dust is also made under the provisions of General Rule 12B. An evaluation of combustible volatile matter is used to determine acceptable levels.

The standard for acceptance can be summarised as follows: the concentration of combustible volatile matter by mass in the dust which passes through a 250 micro metre sieve shall not exceed eleven point five per centum. Where inflammable gas is present that figure is reduced by nine tenths of one percent for each one half of one percent of inflammable gas.

PROBABLE LEGISLATIVE CHANGES

The preparation of regulations for inclusion in the Coal Mines Regulation Act 1982 has led to a general review of existing requirements. Apart from consolidating the existing regulations it is probable that a number of changes affecting ventilation will be made. These changes are only in draft form for discussion at the time of writing.

QUANTITY

Face ventilation conditions are affected by the type of machinery, the size of roadways and the method of mining. A range of ventilation is now proposed as set out below:

Place	Minimum Quantity
In any place in which a continuous mining machine is mining coal or stone	4 cubic metres per second
In all working faces in bord and pillar workings	1 cubic metre per second
In longwall and short-wall faces	10 cubic metres per second

QUALITY

Worldwide interest in the long term effects of exposure to carbon monoxide has resulted in recommendation for lower levels of this gas. The U.S. Department of Health Education and Welfare (1972) for instance has recommended an average level of 35 parts per million for an eight hour day exposure.

It has been proposed to reduce the level for this gas to a figure of 50 p.p.m.

The level of methane at which withdrawl of workmen is required is likely to be reduced to two percent.

MONITORING

Operator measurement of methane levels around mining machines at half hourly intervals does not prevent the development of accumulations and the need for continuous detection has been recognised. It is proposed that an automatic methane detector should be installed at:-

(a) each place where coal is mined,
(b) at a working face during the application of support,
(c) at the face of all drifts being driven and shafts being sunk, and
(d) at such other places as the Chief Inspector may specify in a notice served on the manager.

The need for control of ventilation which was recommended by Judge Goran (1980) following the Appin explosion has been recognised by the proposal for the appointment of a ventilation officer with particular duties in regard to

ventilation changeovers. An appointed person will be required to take air quantity measurements. In particular the appointed person will be required to take readings at specified points wherever alterations are made which might substantially alter the ventilation quantities.

DUST

To bring N.S.W. practice into line with most other authorities it is proposed to change the method of assessing deposited dust. Mines will probably be classified according to the rate of release of seam gas into the workings. A percentage of incombustibles will then be specified as the standard for each classification. Measurement of the actual percentages of incombustibles will be made independent of the flammable gas at the time of sampling.

Despite the effectiveness of dust control which is apparent in the low incidence of pneumoconcosis in N.S.W. mines future measurement of risks will be based on gravimetric analysis.

CONCLUSIONS

The ventilation of coal mines is influenced by requirements for quantity and quality of air supply to the working places. Those requirements have been altered from time to time to cater for the introduction of large scale machines, to cover the use of special equipment and to give adequate control as development of mines occurs in more difficult conditions.

There have been progressive changes to the Coal Mines Regulation Act in N.S.W. but the new Act of 1982 gives the opportunity to consolidate the existing legislation and incorporate changes which should see an up to date and effective set of regulations suited to the present mining methods operating in this State.

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DISCUSSION

D.R. CHALMERS (Dept. Technical and Further Education): With the proposed change to firedamp detectors rather than methane monitors, what provision will be provided for the detection of Illawarra Bottom Gas rather than methane layers on the roof, considering a lot of incidents in this area have been ignitions of Illawarra Bottom Gas rather than ignitions of firedamp layers?

R.J. KININMONTH (Dept. Industrial Relations): One point about that question is that it is not intended that the automatic firedamp detector will replace the methane monitor. It is a supplementary means of assessment which will overcome some of the short-comings of the methane monitor, these short-comings relate to its fixed position and to the need for protection of the monitor head. Secondly, no proposals are known for installing special means of detecting Illawarra Bottom Gas. The problem of detection is localised to some pits and some areas; the problem is recognised at those mines and detection methods are used to suit the detection needs at each particular mine. In such mines the firedamp detector should be placed to indicate the presence of Illawarra Bottom Gas rather than methane.

G. CROFT (Gunnedah Collieries): What is the basis for proposing to increase minimum air flow requirement over a continuous miner from 2.4 to 4 cubic metres per second?

R.J. KININMONTH: It has been accepted that 2.4 m^3/s doesn't allow a velocity of air that is satisfactory for particularly high places. While 2.4 was an arbitrary figure and 4 is an arbitrary figure there will be an improvement which is realistic in terms of the capability of getting air to the face and in reducing the risk of layering. In some cases 4 m^3/s will not be sufficient: that's why emphasis has been placed on the word minimum, these are minimum requirements in an attempt to make people aware of the problem and cater for it. In some cases 6 cubic metres per second may be needed but there is no one figure which could be selected which would be ideal for every mine, because of the differences in height of the workings. It is not considered that 4 m^3/s will be unduly difficult in regards to increased velocity in low height places.

F. KISSELL (U.S. Dept. of the Interior, Bureau of Mines, Pittsburgh): Why not specify a minimum mean entry velocity rather than 4 m^3/s, in other words the minimum quantity based on the entry area.

R.J. KININMONTH: That is an alternative suggestion, which has been partly catered for in the existing Act, where a 50 ft. per minute minimum velocity is prescribed. The difficulty with minimum velocities is that in a very large roadway an excessively high quantity results and in low roadways the total quantity is too low. It is not considered that the velocity figure in itself is sufficient as a single determinant to meet all height conditions.

F. KISSELL: One approach would be to specify a minimum air quantity and a minimum velocity and then this would accommodate that pretty well.

R.J. KININMONTH: There are provisions in the present legislation for a velocity and quantity figure; it is now considered that the single quantity figure will be sufficient. If such a single figure was found not to be sufficient to meet the varying circumstances then the regulations will be changed to incorporate some

new standard. It is not considered that such a step will be necessary.

F. KISSELL: Bureau of Mines research in the U.S.A. has observed very little methane layering in face areas of coal mines during cutting. Primarily this is because of the mixing action of mining machine water sprays at the face.

R.J. KININMONTH: There are two points in regard to this matter, one is that the gas is not necessarily all given off at the face, in fact quite frequently it is given off slightly back from the face from rib side emissions and there is no opportunity for water sprays to mix that gas until the gas moves up to the face. Secondly the problem of layering often occurs when the machine is not working. The layer forms while the machine is waiting for a shuttle car; on such occasions dilution of the layering is dependent on the operator turning on the water sprays before power is connected.

G.E. ARTHUR (AIS - Wongawilli Colliery): Is there provision for a ventilation officer for each pit and if so, what would their duties and qualifications be?

R.J. KININMONTH: Certainly for each pit, but not exclusively for one particular pit. The details have not been finally decided and they will be included in regulations which are being prepared. It is probable that the Ventilation Officer will be required to have at least an undermanagers' ticket.

P. MITCHELL (BHP Steel Division Collieries): The requirement for 10 cubic metres per second of air for longwall faces is 2½ times as much as a continuous miner face, and is no problem where seam heights are more than 2 m. Appin is closer to the 3 m and with 15 m^3/s along the face there are no problems. However there will be instances, especially up at some B.H.P. Collieries where there will be longwall faces with seam heights of 1.4 m. It is possible that with the open face area on a longwall face in low seam height that with 10 m^3/s there will be quite high air velocities, which may create dust problems especially along the face conveyor. Has this been considered in the proposed legislation with the 10 m^3/s air quantity?

R.J. KININMONTH: There is currently no problem with low height faces at the moment. If such faces become a real problem action can be taken to review the requirements.