METHANE DRAINAGE UNDER THE NO. 7 LONGWALL BLOCK APPIN COLLIERY

By

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ABSTRACT

Appin Colliery mines the Bulli Seam with a gas composition of 98.5% methane and 1.5% carbon dioxide. Relaxation of the strata generally occurs to below the base of the Wongawilli Seam, some 40 m below the Bulli Seam, and approximately 125 m above the Bulli Seam, for longwall face widths of 135 m or more. Previous experience showed that when longwall faces were mined for a distance approximately equal to the face width, the mine ventilation could not provide sufficient dilution due to methane emissions from the underlying measures.

Postdraining downholes were drilled to intersect the Wongawilli Seam below the operating longwall. These holes were connected to an underground to surface gas range and various suction levels were applied to improve gas drainage. The resulting gas flow rates and purity from all the downholes were regularly monitored and peak flows in some holes exceeded 160 l/sec. The surface plant drained almost 20 million m^3 of gas for the period July 1981 to January 1982 at an average methane purity of approximately 70%. Distinct patterns emerged for different downholes from curves illustrating their variations in flow rate with distance subsequent to passage of the longwall face. The difference between free flow characteristics and those obtained with the application of suction was ascertained. All in all, the success of the methane drainage program in No. 7 Longwall panel was best demonstrated by the benefits it achieved namely, a reduction in methane concentrations in the return airway, higher average daily production and the possible utilisation of a hitherto uncontrolled energy source.

INTRODUCTION

Appin Colliery is situated 70 km south west of Sydney and is one of the nine collieries operated by Australian Iron & Steel Pty. Ltd. (A.I. & S.) and owned by The Broken Hill Proprietary Company Limited (B.H.P.). High quality coking coal is mined from the Bulli Seam, approximately 3 m in thickness at a depth of 500 m. During 1981, 1,005,000 tonnes were mined, with a workforce of 388. Production rates averaged 4,600 tonne/day.

Colliery development started in 1962 and high methane emission from solid coal was immediately a feature. Methane is contained as a free gas in fissures and pores of coal and other rock and/or is adsorbed on the internal surface of the coal, with the latter comprising the bulk of gas contained in 'in situ' coal. During mining, methane is released from the coal due to relaxation and fracturing of both the coal and the surrounding strata. In development roadways, gas is emitted almost entirely from the seam mined. In longwall and pillar extraction operations however, where a substantial goaf area is formed, the fracturing and relaxation will incorporate an extensive volume of the

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super and subadjacent strata as well as the coal seam mined. The effect of extracting a longwall panel is depicted in Fig. 1.

At Appin Colliery, relaxation of the strata extends to below the base of the Wongawilli Seam and approximately 125 m above the Bulli Seam, for longwall faces 135 m wide. Methane, liberated from the lower seams, migrates upwards into the goaf area. When this gas enters the ventilation system of the mine the percentage of methane in the return airways markedly increases.

The methane emission rate is approximately 160 m^3/min or some 50 m^3/tonne of coal mined, which is high by world standards. It presents a considerable problem in the general ventilation of the mine airways, which must comply with the requirements of the Coal Mines Regulation Act. Furthermore, the methane quantities liberated are not always steady. On a number of occasions methane 'flushes', largely unpredictable in occurrence and duration, made it necessary to cease longwall coal production.

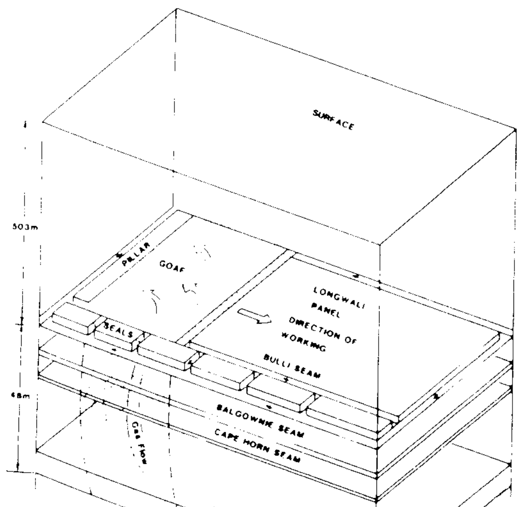

Fig. 1. Migration of methane from lower seams into workings

During 1979, a mine air monitoring system was installed to permit trends in methane emission to be determined. This facility provided some degree of warning before stopping longwall production due to increasing gas flow. The Department of Mineral Resources established that production should cease when there was 1.7 per cent methane in the tailgate return airway behind the longwall face.

In February 1979, approval was sought from the then Minister for Mineral Resources and Development to extract the No. 7 block by longwall retreat method of mining. The approval was given in October 1979 subject to all the normal conditions and that an adequate 'methane drainage system' be installed and maintained to the satisfaction of the Chief Inspector of Coal Mines

METHANE DRAINAGE PROJECT

It was decided that the National Coal Board (N.C.B.) conduct a major study of the Appin problem and a contract was placed with it for this purpose, bearing in mind the fact that the N.C.B. is well experienced in the field of methane drainage. As a result of direct personal contact with senior technical officers of the N.C.B. in Australia, initial recommendations were implemented as these offered the most immediate way of reducing the methane content in the roadways associated with the longwall panels. Furthermore, the N.C.B. was able to provide sufficient technical data to enable the Company to initiate enquiries for the supply of equipment for early delivery.

The proposed scheme provided for the installation of a surface mounted vacuum pump station, located adjacent to the No. 1 shaft, designed to remove methane gas from the mine by means of an underground-to-surface gas drainage main via the downcast shaft and then to discharge the methane into the main mine fan evasee air stream for ready dilution and dispersal.

The underground gas main was installed through the mine and connected to:

1. solid drainage holes drilled in advance of longwall face from the floor of the Bulli Seam to the underlying seams,
2. stand pipes installed in seal stoppings in longwall waste areas, and
3. the solid drainage holes bored in the seam in advance of the working faces.

The scheme was implemented in accordance with the recommendation of the N.C.B. final report received in August 1980. A staged development was proposed with Stage 1 providing all of the surface buildings and services facilities, four of the seven vacuum pumps ultimately required, a surface to underground pipe range, an in-seam pipe range with capacity to satisfy the final system needs, and the necessary stoppings, stand pipes and ancillaries to initially commission the system.

Following acceptance of the N.C.B. report, the methane drainage project began. All contractors were chosen from September 1980 onwards, Local and State Government bodies' consent obtained, and engineering details and project management finalised. This was accompanied by utilisation discussions and other experimental degasification work comprising:-

1. drilling four hydrofracture holes adjacent to the existing Colliery workings,
2. engaging Australian Gas Light Co., on behalf of Occidental Research Corporation to drill three in-seam holes 300 m - 400 m long, and
3. inviting Dr. J. Cervik from the U.S. Bureau of Mines to advise on the potential of in-seam drainage.

UNDERGROUND INSTALLATION

A schematic drawing of the system at Appin Colliery is shown in Fig. 2. The drainage route

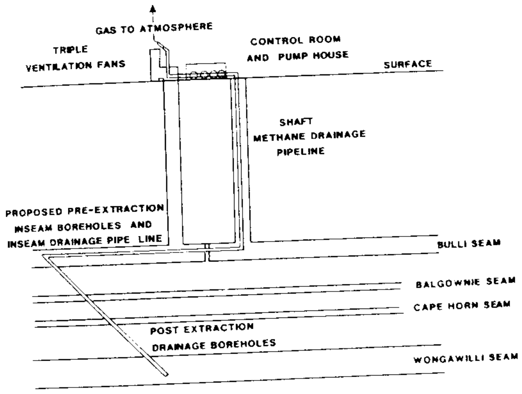

Fig. 2. Schematic of methane drainage at Appin Colliery

and location of Longwall 7 underground workings are shown in Fig. 3.

SEALING

The major goaf area, extending from Longwall 2 to Longwall 6 was entirely sealed with brick seals adjacent to all roadways and with pumped flyash cement for the separation of this area from the future Longwall 7 goaf.

A total of 67 seal stoppings had to be erected in the remote longwall waste areas.

Pump pack seals consisted of a plaster or brick back wall, wire tied to a proprietary formwork front wall and filled with a flyash cement mixture to form a stopping 1.0 to 1.5 m thick. The mixture was pumped for a distance up to 1200 m in 50 mm diameter Victaulic pipes. Due to the labour intensive nature of the required walling, trials were conducted using expanding jute bags which were filled with the mixture and retained in position by wooden props and small timber braces.

DRAINAGE PIPE

In total, some 4,000 m of pipe range was installed underground and a further 500 m suspended in the downcast shaft. Pipes varying in sizes from 503 mm to 150 mm diameter, were

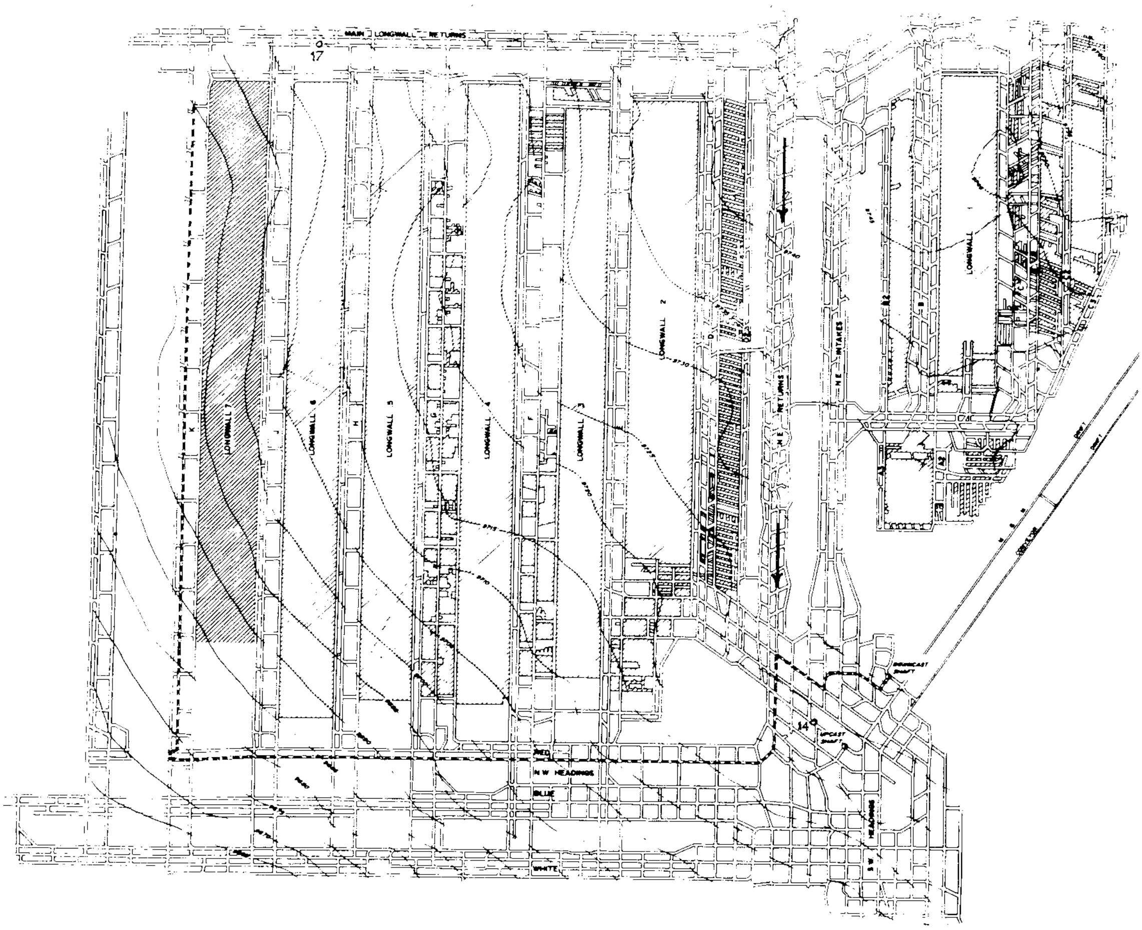

Fig. 3. Plan of Appin Colliery showing route of gas pipe range

installed using a four-wheel drive minesmobile fitted with a pipe handling jib, or directly from a rail trolley fitted with a lifting winch. Brackets were fitted to roof supports and the pipes suspended by chains. All pipes were adjusted to a surveyed line and grade, to minimise the number and severity of grade changes due to the seam.

Line leakage was tested by isolating sections of the range and pressurising with compressed air to 655 kPa. Audible leaks were detected and repaired with the result that 50 kPa suction at the surface allowed 45 kPa suction at the post drainage holes up to 4.5 km away and no problem was experienced with leakage into the range. Manual water drainage traps were installed at all low points.

DOWNHOLE AND UPHOLE DRILLING

Downholes were drilled using an Edeco Hydrack drill, Edeco flush jointed drill rods of 41 mm diameter and Stratapax (diamond impregnated tungsten carbide) tipped bits of 50 mm and 100 mm diameter. The drilling pattern as shown in Fig. 4 is on a 20-25 m separation with the holes angled down nominally at 1 in 2.4 to 1 in 3. The

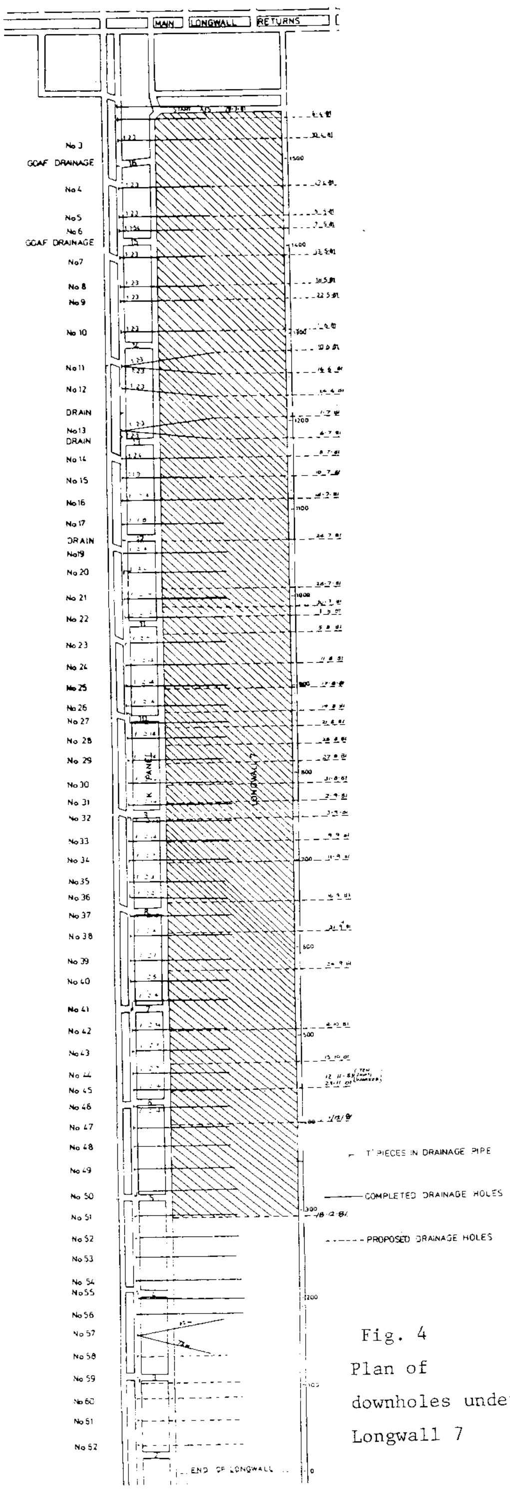

Fig. 4
Plan of
downholes under
Longwall 7

angle was determined so that the holes penetrate the Wongawilli Seam some 40 m below, at a point approximately in the centre of the Longwall 7 block, and necessitate a hole 120 m long.

Upholes were drilled at 1 in 1.5 for 80 m, to be in the relaxed roof strata of the longwall goaf as the face passes. One hole per pillar length was programmed.

STANDPIPES

Stand pipes were 6 m long of 50 mm diameter black pipe in two 3 m screwed lengths. Centralising bars on the outer diameter allowed concentric placement in the 100 mm diameter drilled hole. Two types of grout were used.

1. A 12 hour set non shrink grout which was fluid and pumpable.
2. A 45 min set non shrink grout which was sufficiently fluid to be poured into the hole.

UNDERGROUND MONITORING

FLOW

Equipment was selected on the basis of predicted flows of 28 litres/s per hole maximum. Orifice plates for each hole were designed to produce a differential pressure of 10 Pa at this maximum flow. Main range orifice plates were designed to produce 1,000 Pa at 3,000 and 4,000 litres/s depending on pipe diameter. Compatible instruments were Eagle Eye differential pressure devices reading 0 to 300 Pa and 0 to 1,000 Pa. However flows were much higher than predicted, some greater than 160 litres/s and many above 28 litres/s. For high flows a vertical water manometer reading to 180 litres/s was used. Suitably scaled Magnehelic differential pressure gauges were selected for the lower flows.

PURITY

Gas samples were extracted, under normal vacuum and flow conditions, with a hand operated vacuum pump and then analysed using an optical interferometer. High reading MSA 510B hand held methanometers were purchased to augment the analysis.

HOLES

For each hole as shown in Figure 4 the length, inclination from the horizontal, direction, date of initial purity and flow measurements, date of passing by the longwall face and full history of purity and flow were recorded.

EXHAUSTER SYSTEM

To bridge the gap between start of production from Longwall 7 and commissioning of the surface drainage plant, an underground system was installed. This consisted of two Nash Hytor L6 wet seal methane extractor pumps, in parallel connected to the downhole drainage range in Longwall 7 tailgate panel, having a combined capacity of 600 litres/s of standard gas.

Control at the pump room was by a Sieger BM2H 0-100 per cent methane monitor, set to give an alarm at 40 per cent methane purity and to trip power off at 30 per cent purity. Protection against positive leakage was provided by a Bacharach 0-5 per cent methane monitor set to trip power off at 1.25 per cent methane in the pump room. The exhausters were protected by thermistors, low sealant water flow and low sealant water level switches in each supply tank. Indication of methane purity and exhauster operation were relayed to the underground control cabin.

For non-vacuum operation a by-pass valve was incorporated. Discharge was into the adjacent return airway. A diffuser drum was fixed to the outlet, a cage erected around this, and the area fenced and signposted to prevent access, excepting statutory inspection.

SURFACE PLANT

The surface methane drainage plant commissioning began at the end of June 1981 and the changeover from underground to surface exhausters was set to coincide with the commissioning of a new triple ventilating fan system.

The surface component of the extraction plant to drain methane from the underground workings consisted of the connection to the pipe range from underground, four exhauster pumps, a separate control/switch room and the discharge, either via the vertical stack or the main mine fan evasee.

The process control and instrumentation system selects the appropriate discharge in accordance with operating parameters at any given time.

The plant was designed to aspirate naturally, completely bypassing the exhausters, in the event of a fault or major power loss. All drives are protected by overcurrent and earth leakage. Larger drives are also provided with thermistor protection.

The plant is extensively monitored. Once energised, the plant operates with a minimum of manual intervention. A comprehensive data logging system is used to record and report operational data and status, and a permanent record generated to document plant throughput and gas condition.

EXHAUSTER HOUSE

The methane drainage exhauster system is housed in a building with full block walls and concrete floor and ceiling. The system consists of Nash Hytor CL3002 exhausters, each driven by 185 kW 415 V Morley flameproof motor, and each capable of exhausting 700 litres/s of gas at standard temperature and pressure. Stage 1 consists of four exhausters, Stage 2 an additional three. Exhauster house lighting consists of Burnbrite flameproof lights switched by Wilco flameproof switches. Flameproof emergency stops were located to each exhauster motor. Flameproof Rotork valve actuators were also installed in the exhauster house.

CONTROL ROOM

The exhauster motor starters and process control cubicles were installed in the 6.6 kV switch room remote from the exhauster house. Process control information is collected from the exhauster house and pipe range via MTL intrinsically safe barriers. For data logging at pit top, an intrinsically safe data link was installed. The cable goes underground via the downcast shaft and back up to the pit top via the men and materials drift. At each end the cable was terminated in a Custom Scientific Electronics intrinsically safe barrier. In the event of mains power failure, a diesel alternator is automatically started. The flameproof Rotork valves are then driven to their bypass mode, isolating the exhauster house pipe range and directing aspiration to atmosphere via the stack.

THE MONITORING SYSTEM

The micropressor based computer system installed at Appin consists of three basic elements; firstly, local monitoring of the state of the various plant transducers employed, such as limit switches, relay contacts or variable analogue signals such as would be transmitted from a gas flow measuring system or inlet pressure detection and the conversion of these signals to electrical impulses or digital signals; secondly, a data link or transmission system to convey the digital signals or data from the point of origin, be it an underground gas measuring station or surface exhauster control room, to a central control room; and thirdly, the surface control centre for reception of all information, processing data, storage and displaying that data in a form that is practical and concise.

The pit top operator is capable of controlling plant via computer. Keyed messages are acted on by the computer to issue command instructions to relays on remote Data Gathering Panels (D.G.P.). The relays then operate the function mechanism required.

All data from D.G.P. is stored serially and converted suitably for display on either visual display units or line printers.

PROTECTION

The following list nominates the major protection features installed to safeguard the installation.

(a) A separate lightning arrestor system is installed for the pipe range and discharges to protect against lightning surges.
(b) A sieger BM2H will detect low methane purity in the pipe range and will trip the exhauster starters.
(c) Seal water for the exhausters: Low tank level, high tank water temperature, and loss of flow will trip the exhauster starters.
(d) Exhauster house high methane concentration (1.25%) will remove power from the exhauster house. Due to the ceiling height, the trip valve is set at 0.75% and the detector head is mounted in a collecting shade above each exhauster. This is measured by an MSA A510 low level (0-5%) methane monitor.
(e) Auxiliary drives are installed in fresh air and each has its normal electrical protection, earth leakage, overload, etc. This includes radiator fans and seal water pumps.
(f) Seal water tank methane concentration of 1.25% will cause the exhauster starters to trip. This is also measured by the MSA A510.
(g) Emergency stops located adjacent to individual drives will trip their respective starters.

RESULTS

The methane drainage system for the No. 7 Longwall block was monitored on an individual drainage hole basis and on an overall interactive drainage plant and mine performance basis, as shown in Fig. 5.

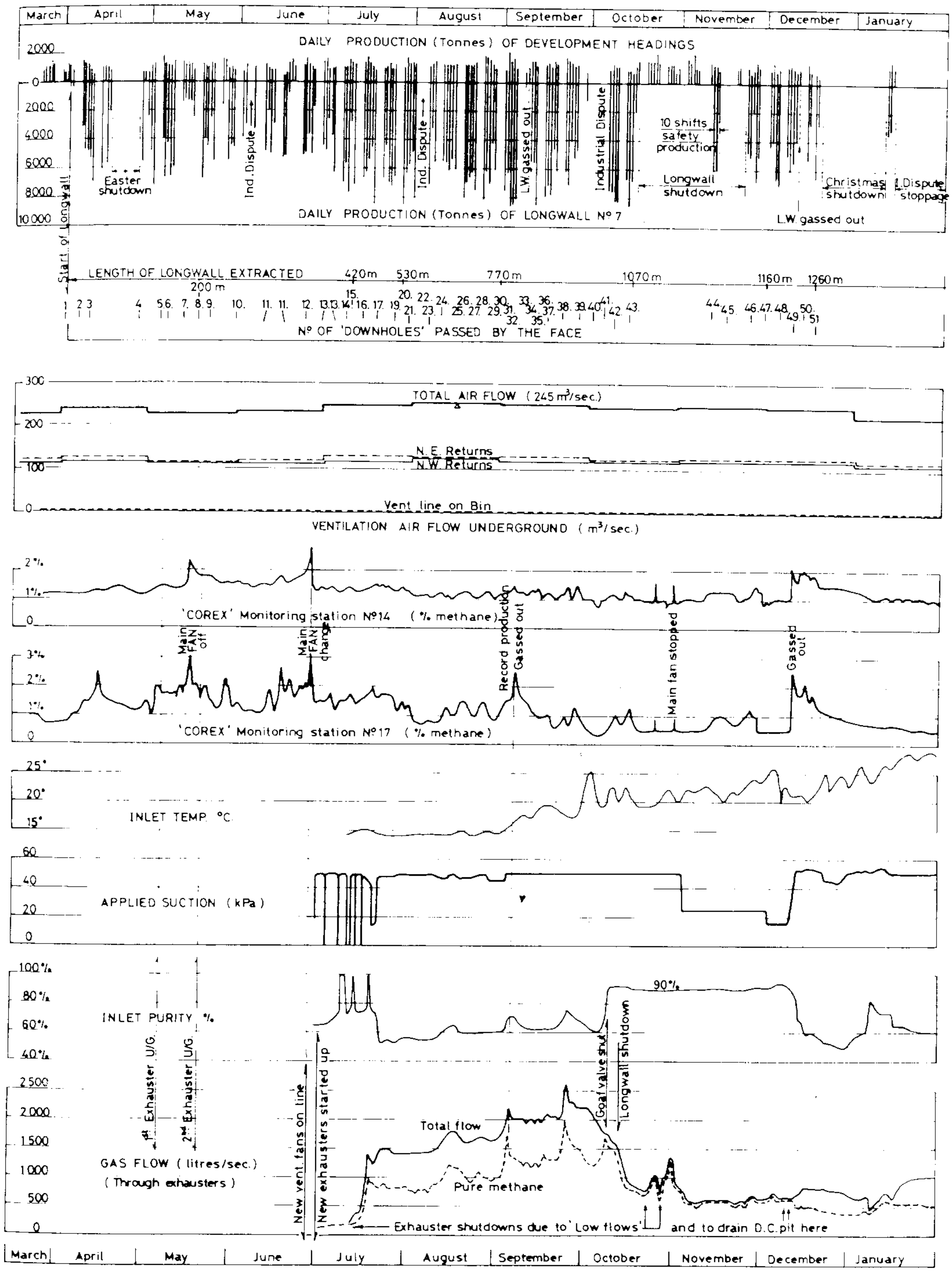

Fig. 5. Gas chart showing all parameters

LONGWALL PRODUCTION

Daily production rose from 6 m/day advance (3,000 tonne/day) to 10 m/day advance (5,000 tonne/day) from the No. 7 Longwall and maintained a high average production for the period from surface plant commissioning in July 1981 until reduced coal demand led to a shutdown in October 1981.

After the start of production on 2nd April 1981, high methane emission from the goaf halted production for a total of 33 shifts. Since the start of the surface extraction plant until the December shutdown, high methane emission halted production for only 12 shifts.

MINE VENTILATION

Three new single inlet Richardson centrifugal fans replaced the double inlet Davidson Sirocco fan and provided a ten per cent increase in ventilating capacity. Monitoring by the COREX tube bundle system showed that methane emissions rose as No. 7 longwall progressed from the face start position.

The significant decrease in the methane content of the longwall return station No. 17, and the north east main return, station No. 14, was due to the new fan installation and the start of the surface methane drainage plant. Continued monitoring showed a decreasing trend.

Peak emissions which halted production occurred in early September after two months of sustained high output, including the week's record production of 39,126 tonnes. A large emission occurred in mid December after the face had advanced 150 m in the three weeks of production following several weeks of stoppage.

DRAINAGE PLAN

Underground

The underground plant started draining gas from four holes giving off 177 litres/s at 58% purity and 15 kPa suction. Immediately before changeover to the surface plant, the exhausters were drawing gas from 12 holes, delivering 368 litres/s at 86% purity and 40 kPa suction. Flow at atmospheric pressure was 249 litres/s at 98% purity.

Surface

The surface plant drained a total of 19.6 million m^3 of gas mixture from 1st July 1981 to 17th January 1982, at an average purity of approximately 70% giving 13.6 million m^3 of pure methane.

Throughput varied from 26,000 m^3/day methane during the 17 days commissioning, to a mean maximum of 129,600 m^3/day for the 15 days after reaching record production during September 1981.

Gas Production

Methane drainage through the surface plant started with 12 holes giving 300 to 400 litres/s of 70 to 98% purity at 50 kPa suction. The flow was increased by drawing a regulated amount of less concentrated methane from behind the No. 16 cut through stopping. The flow rose to 1,400 litres/s of 52% purity at 50 kPa suction. The draw of gas from the goaf coincided with a high pressure flow of at least 180 litres/s from hole No. 15. The quantity and purity continued to climb as the longwall face and more drainage holes were placed on suction.

The peak flow of 2,500 litres/s and 77% purity occurred near the end of a three month period of high production.

At this time an industrial dispute stopped movement of the longwall face. The emission of methane reduced noticeably and the drainage gas flow began to fall. A further two weeks production after resumption failed to reverse this trend. The reasons for this were:

1. In order to readmit mining equipment into the drainage range roadway, goaf drainage from No. 15 and No. 16 cut throughs was stopped and the pipes sealed.

2. Longwall production was stopped and remained idle from 15th October until 23rd November except for two days safety production.
3. Honeywell technicians made adjustments to instrumentation which led to reduced flow readings over a short period of time.

The purity was only affected by shutting off the longwall goaf drainage, whereby it increased from 60% to 92%.

Holes No. 1 to No. 15 were disconnected and capped before the planned removal of 200 m of range to allow mining to recommence in the roadway. A slight drop in quantity and purity occurred.

The applied suction was decreased from 50 kPa to 20 kPa and although the purity was unaffected, the quantity reduced. Longwall production resumed and gas emissions began to increase. The methane concentration in return airways rose. Drainage quantity began to increase, but purity remained constant.

Plant suction was experimentally decreased to 15 kPa, resulting in a slight increase in purity and negligible effect on quantity or return concentration.

On the 10th December, the longwall face and return airways suffered gas emissions which could not be sufficiently diluted. The longwall return reached 2.4% and the main return 2.1%.

Drainage suction was then increased to 50 kPa, a 50 mm diameter line was installed for drainage from No. 6 cut through, just behind the face and the drainage ranges at No. 15 and No. 16 cut throughs were reopened. The total gas quantity increased but the purity fell to 60% reducing the amount of pure methane extracted. Both continued to fall during the December shutdown.

INDIVIDUAL HOLES

Flow Behaviour

Figure 6 shows the typical gas flow rate trends for groups of downholes in relation to their distance from the working longwall face. These trends are highly influenced by the period of time between flow measurements and rates of advance of the face. Four distinct patterns have emerged from the underground monitoring of the downhole flows (see curves A to D), from which the following observations may be made:

1. In all cases the peak gas flow rate occurred at distances between 50 m and 300 m after the longwall face had passed the holes.
2. The characteristic curves for grouped holes 1 to 9 (Curve A) and 10 to 14 (Curve B) represent typical patterns of flows for cases where the longwall goaf area is not completely formed and where the full length of caving to produce floor relaxation is not yet reached. For both curves, the downholes emitted relatively low early peak flow rates after passing of the face before tapering off to the lower level of drainage some 500 to 600 m later.
3. Curve C (for grouped holes 15 to 28) and Curve D (grouped holes 30-42) both depict patterns of gas flow rates for cases where floor and roof areas have relaxed and the profile of these curves follows closely the patterns established for strata pressure and stress curves as a longwall face retreats. Definite gas flow peaks occur at distances in the range 50 m to 100 m after the face has passed the downholes. The magnitude of these peaks is influenced significantly by the rate of advance of the longwall face and the intensity of paths and fissures created in the surrounding strata by its relaxation following the formation of the goaf.

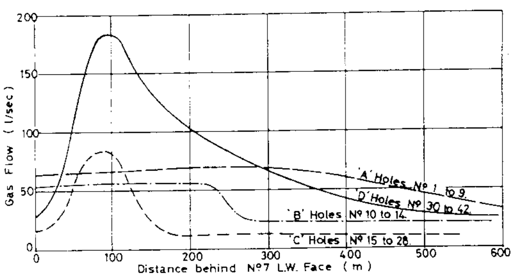

Fig. 6. Typical gas flow rates from methane drainage holes under Longwall 7, Appin Colliery

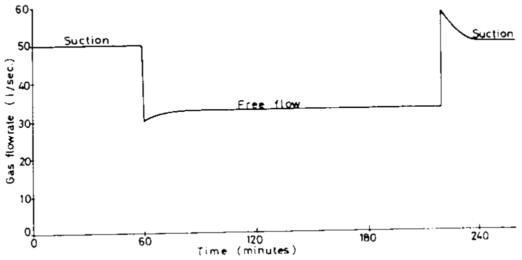

Fig. 7. Typical gas flow rate - time curve for suction/free flow conditions from downholes in 'K' Panel, Appin Colliery

4. Clearly, the peak flow rate established for curve D is at least twice as high as that obtained for curve C; moreover, curve D does not reach a minimum until the longwall face is a-proximately 500 m past the position of the downholes whereas curve C drops sharply at distances of 150 to 200 m. These differences may be explained by the fact that there is a continual breaking up of the surrounding strata and that the number of paths and fissures available to allow the gas to permeate is increasing on a cumulative basis.

FREE FLOW AND SUCTION CHARACTERISTICS

Investigations were conducted in a number of downholes to determine the difference in gas flow rates under suction and under free flow conditions. The procedure followed was to measure the gas flows from the chosen holes where a known constant level of suction had been applied for some time, then to withdraw suction and monitor the flow rate until a constant reading was obtained and finally to reapply the original level of suction. The typical results were graphed as shown in Fig. 7. In all cases studied, the free flow rate was on the average 60% of the flow measured with suction. Furthermore, a period of approximately 20 minutes was required to reach stable flow levels when changes from suction to free flow conditions and vice versa were made.

The difference in flow variation may best be explained by the fact that under free flow conditions the pressure in the seam is used both to desorb the gas and to transport it out of the boreholes. When suction is applied, it is mainly used for transporting the gas allowing the seam pressure to perform the function of gas desorption. As the quantity of gas drained depends on the difference between seam and atmospheric pressure and the application of suction will produce a greater differential, it follows that a higher amount of gas will be drained.

METHANE CAPTURE

The percentage capture of methane (see Fig. 8) was determined by ventilation survey of the No. 7 Longwall panel. All air quantities with respective methane concentrations were measured and compared to drained gas as follows,

Capture = Drained CH_4/(CH_4 make + drained CH_4),
where CH_4 make = Return CH_4 - Intake CH_4.

Capture rose as more drainage holes were completed and connected. Greatest capture of 72% occurred at the end of September with 38 holes on drainage. Production stoppages and alterations to drainage then caused the capture to decline.

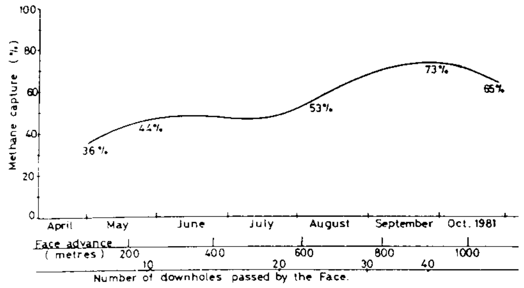

Fig. 8. Methane capture relative to length of longwall extracted, time (months) and number of holes drilled

CONCLUSIONS

BENEFITS

Methane drainage in the No. 7 Longwall panel was successful because of:

1. lower methane concentration in the return airway and consequent increased safety (1.2% vs 2.0%),
2. higher average production (10 m/day advance vs 6 m/day),
3. increased time availability for production (97% vx 85%), and
4. the possible utilisation of a hitherto uncontrolled and unharnessed energy source.

GAS EMISSIONS

The mechanism of producing gas flow in post drainage holes in longwall panels is related to strata relaxation. This relaxation is, in turn, affected by the parameters governing subsidence.

For the 150 m wide No. 7 Longwall, major methane emissions did not occur until at least the extraction length equalled the face length. For the five identifiable large methane emissions the face travelled 200 m, 220 m, 240 m, 260 m and 270 m between high flow holes and/or gas emissions unable to be diluted to safe levels.

SUBSIDENCE

Depth of cover was 506 m. A 35° angle of draw line from the surface above the longwall face start, intersected the Bulli Seam in the area of hole No. 15. To test the applicability of the subsidence relaxation association, holes were planned to be drilled up to the finish position of the panel. Flow measurements would provide information to further examine this conclusion.

It was hoped that drilling in the angle of draw area may not be necessary to achieve the desired drainage results. Further study of this is required as it represents a saving of up to 34 drainage holes per longwall block at this depth.

DRILLING PATTERN

High emission at regular intervals, and generally high pressures encountered indicated that a different hole pattern was required. Closer spacing and rearrangement of the drilling pattern to angle holes back beneath the approaching longwall face was suggested. The effect of this pattern would be to smooth out intermittent peak flows which a face parallel drilling pattern may encourage.

GOAF SEALS

The brick stopping seals enclosing the major goaf were sufficient to limit the emission of methane from this large area. These seals were unable to prevent leakage from or into the goaf. Due to the high mine ventilating pressure and large quantities of air flow the methane concentration at draw off points in the major goaf did not rise to a safe level (30%/min) for drainage.

The pump pack seals separating the major goaf from the No. 7 longwall goaf were efficient in that they restricted gas/air flow between the two goaves. At intake to return seal points however these were ineffective. Total sealing by full emplacement pump packing will be required at such points.

DEWATERING

Under 50 kPa suction individual hole dewatering was not a major problem. However, low flow holes did suffer from water retention. Main line dewatering required a few instances of short duration plant shutdown, for sections where automatic dewatering devices were not installed. Individual hole dewatering and solids removal devices are planned for the succeeding drainage programs. These should improve plant efficiency and reduce the problem of mine line dewatering,

INSTRUMENTATION

Complex instrumentation especially where telemetry and automatic recording is involved requires accurate adjustment. Regular separate physical checking is necessary to ensure that results obtained are correct and acceptable.

FUTURE

The amount of data gathered from the No. 7 Longwall methane drainage system was enormous. The interactive effects of the mine, drainage plant and geological strata further multiply the complexity involved in interpreting the results. The experience of one post drainage scheme is insufficient to make any firm conclusions and those made in this paper are offered as a direction to future investigations.

ACKNOWLEDGEMENTS

The results of the gas drainage investigations are published with the permission of The Broken Hill Proprietary Company Limited although the views expressed are those of the authors and not necessarily those of the Company. Recognition is made of the significant contribution by Mr. E. Anderson of the Collieries Research Office (B.H.P. Co. Ltd.) in the preparation of the diagrams and data and for the cooperations and assistance of the Appin Colliery personnel.

DISCUSSION

I. GRAY (A.C.I.R.L.): Regarding the use of Set 45 grout, this grout has lovely expanding properties and nice quick set, but people should be warned that it gets hot, very hot indeed. If at all insulated it will boil itself. This is seen as a potential problem for causing not spontaneous ignition, but a start of an ignition. If in a wet coal seam and in solids there would probably be sufficient conduction and less likelihood of it happening. But to use a stand pipe in a dry cracked ribside with a grout like this and if it gets sufficiently hot probably there is a potential problem which should at least be investigated further before these high temperature grouts continue to be used. A second point is that, the vacuums of 50 kPa, are very, very high, and how wise is that in terms of spontaneous combustion again. What is done about that and particularly carbon monoxide monitoring of the gas in the drainage lines?

R. REGAN (A.I. & S. Collieries, Wollongong): Firstly the use of that sort of grout will be further investigated. No problems were experienced with heating of that nature, mainly because the grouts were set quite soon after drilling had been done. It was a very wet area, most of the holes where it was used were set in nearly underwater conditions. Secondly, regarding the high suction, it was considered that allowing for back pressure in the plant and that caused by the line, line pressures and the pressure drop, it would be much better in trying to attract methane, remembering now this is not in-seam drilling, this is downhole drilling that has been released from lower seams and has found its way into cracks and relaxed strata around the actual seam itself, if a higher suction was applied. No regular monitoring of carbon monoxide was done in the gas drained.

S. BATTINO (B.H.P. Collieries Research): Regarding Set 45, following some tests carried out at Metropolitan Colliery which involve grouting stand pipes in in-seam holes there has been a switch back to the Embercom grout.

C. JEGER-MADIOT (CERCHAR, France): Regarding Figure 6, what is the thickness of the seam being degassed under the longwall and what was the content of gas in that seam?

R. REGAN: The seams that gas was being extracted from beneath the seam mined were approximately a 1 m thick seam which was 6 m below and a seam 8 m thick, which was 40 m below.

C. JEGER-MADIOT: 40 m below? Previously, in such a situation in France, with boreholes driven under the goaf the same flowrate per metre of penetrated seam would have been obtained as at Appin. But by vertical boreholes encountering the lateral fractures, it should be probably possible to get 5 times more. Recognising the good position and the good direction of the boreholes is a very important point to obtain an effective drainage from the floor. And what was the gas content of these seams?

S. BATTINO: 14 m^3/tonne.

C. JEGER-MADIOT: Regarding the goaf, in the paper it states that it is impossible to drain methane from the goaf. What kind of drainage from the goaf is meant?

R. REGAN: The type of seals used meant that in the areas where installations were made to drain from the goaf, it was impossible. This was only in those areas. But there are other areas which are on the rise side of the goaf area where it will be possible to drain from them as recent surveys have shown.

C. JEGER-MADIOT: By pipes in the goaf, not upwards boreholes?

R. REGAN: Just by draining directly from seals around the goaf.

C. JEGER-MADIOT: From seals? In France it could not be successful in this way; the sealing was not efficient enough; the drained gas contained too much air. But if one uses individual drainage boreholes let in the goaf, one can still drain gas from the goaf. This possibility is very important because, after the end of the mining, a big amount of gas can still come from the goaf, during several months.

R. REGAN: Certainly. This has been accounted for in the drainage system.

R. WILLIAMS (Collinsville Coal Co.): It is very interesting how this sophisticated methane drainage system has succeeded in lowering the gas emission levels in No. 7 Longwall.