Report from Michael Clarke concerning the accident which caused the deaths of Craig John Broughton, Robert Kelvin Coltman and Leigh Ronald Pearce at approximately 3.10 am, Wednesday 24th July, 1991 at South Bulli Coal Mine.

My full name is Michael Clarke, I reside at 6 Wedderburn Road, Wedderburn, 2560.
I am a Chartered Mining Engineer and hold a Mine Managers' Certificate of Competency.

I am an Inspector of Coal Mines, based in Wollongong with the Coalfields Division, Department of Mineral Resources. I have held that position for just over eight (8) years and was appointed District Inspector of South Bulli in October 1990.

Part of my duties as an Inspector of Coal Mines is to investigate reportable serious bodily injury and death in accordance with the Coal Mines Regulation Act 1982.

The following report is compiled and submitted for the coroners' inquest into the above deaths.

1. INTRODUCTION

South Bulli Coal Mine is situated in the Southern Coalfield of New South Wales, some ten kilometres north of Wollongong. The mine has been in operation for over 100 years, where coal has been produced from both the Balgownie and Bulli seams which outcrop on the Illawarra escarpment at Bellambi. Current mining operations are in the Bulli seam, some 17 kilometres from the escarpment, in a westerly direction.

Located about 11 kilometres west of the escarpment is the No 4 shaft complex which provides bath/change house accommodation, mine access for man riding and an office complex. Longwall mining is practiced to the west of the No 4 shaft.

Two sets of four main headings are being driven to the west, the 200 series and 300 series longwall blocks are developed and extracted from the main headings. See the attached plan No 9628C.

T Main headings consist of two intake and two return roadways. The 'T' side panels are driven to form longwall blocks to the north which are the 300 series.

W Main headings consist of two intake and two return roadways. The 'W' side panels are driven to form longwall blocks to the south which are the 200 series.

At the time of the incident the producing areas of the mine were longwall 308, longwall 211 and development panels T Main, T10, T11 and W12.

As shown on the attached plan No 9628C, the longwall development panels consist of two headings with 100m x 35m pillars.

MR McKENZIES

COPY OF INSP. M CLARKES STATEMENT TO THE CORONER FOR YOUR INFO.

6/12/91

The conveyor belts are located in the intake heading and the man/materials access is via the return heading. Ventilation of the panels up to the last open cutthrough is provided by the main ventilation system, thereafter an auxiliary fan with steel vent ducting provides ventilation for the face areas.

The introduction of new technology into the mine during the past few years, ie, single pass wide head continuous miners, high tensile "AX" roof bolts and total rib bolting techniques, has seen an improvement in both roadway stability and development rates.

1 (i) INSEAM GAS

The insitu coal seam gas content and composition has been determined from surface boreholes, inseam drilling of the coal ribs and general ventilation type determinations.

Historically, the insitu gas content has been in the order of $7m^3/t$ to $8m^3/t$, however, less than $10m^3/t$. The composition was predominantly methane (CH_4) in the order of 80%.

Carbon dioxide (CO_2) had not appeared in the mine in any great quantity for at least 17 years. CO_2 was detected in the form of Illawarra bottom gas in what appeared to be isolated cases in W Main Panel and in close proximity to a dyke structure in W11 Panel. The gas was dealt with purely as a ventilation problem.

A mine gas monitoring system is installed at the mine with all panel returns and main returns monitored for CH_4 and CO.

Not CO_2?

Due to CH_4 rib emission and intake contamination in the development panels, short holes are drilled into the virgin side rib. Gas is piped direct from the panel intake and released in the main return where the gas is diluted in the natural ventilation.

Generally, the gas produced during the normal day to day mining operations is dealt with by the mine ventilation.

1 (ii) OUTBURST HISTORY

Five outbursts had occurred at the mine - their dates and locations are shown on the attached plan No 9628C.

Four outbursts occurred in close proximity in T5 Panel; all were associated with a shear zone. They were of low intensity with CH_4 being the predominant gas released.

The fifth outburst occurred on a small dyke structure in W8 Panel. It was of low intensity with CH_4 being the predominant gas released. The particular dyke structure had been mined through on at least six previous occasions without incident.

Following each outburst the company geologist carried out a detailed inspection of the outburst site and the information was documented.

After the first outburst in T5 Panel, a code of "outburst procedures" was developed for mining through potential outburst zones. These procedures were in use during the further three outbursts which occurred in T5 Panel.

Subsequent panels on the 'T' side of the mine did not mine up to the shear zone, therefore no further outbursts were encountered. Notwithstanding the above, an exploratory drilling program was drawn up to prove the shear zone for any further development into the area but was not used because of reasons mentioned above.

Following the small outburst in the first heading of W8 Panel, the second heading and both headings of W9 Panel mined through the dyke structure under outburst procedures without further incident. Therefore, a decision was made to mine through the dyke in T10 and T11 Panels under normal mining operations.

1 (iii) GEOTECHNICAL DATA

The mine has a technical services division with one of its functions being to collect and assess geotechnical information for the overall planning of the mine.

There had been a considerable amount of surface topographical mapping carried out plus aerial surveys and surface magnetic surveys. Other information was supplied from borehole data. A reasonably detailed surface geotechnical plan was drawn up from the information gathered.

Several inseam seismic surveys had been carried out to determine possible structures which were questionable from the surface plan.

The company geologist carried out visual inspections underground on a routine basis, generally after each pillar was formed as a panel developed.

2. THE W12 PANEL

Plan No 9628C shows the location of the W12 Panel developed to the south of W Main Panel. The face was 5600 metres from the No 4 Shaft pit bottom.

The first two 50 metre pillars were developed towards the end of 1990 as part of W Main development. This was to allow for the installation of the conveyor drivehead, overcast and ventilation doors, while W Main developed 100 metres further inbye.

Subsequent pillars were developed at 100 metre cutthrough centres commencing in March 1991, the development being worked on four shifts per day using a Joy wide head continuous miner and two Joy shuttle cars.

The sequence of mining was to first mine 'B' heading (return) to a distance of approximately 115 metres. 'C' heading (intake) then mined to about the same distance before the cutthrough is mined holing into 'B' heading.

The panel services are then extended one pillar length before the sequence is repeated.

The immediate roof varies from sandstone, to mudstone to shale as the panel developed. The principle stress direction is normally in a north east - south west direction which tends to create roof guttering (mainly in the shales) on the left hand side of the

heading looking inbye. Roof jointing, following the stress direction, is present. Generally the roof in 'C' heading appears to be more competent, possibly explained by stress relief being given from 'B' heading.

Roof support is provided by 4.4 metres 'W' straps with 5 x 2.1 metres long "AX" roof bolts per strap.

The seam height is approximately 2.01 metres. A further 0.7 metres of roof and floor is mined to given an overall extraction thickness of 2.71 metres.

Ventilation of the face area is provided by a 13m^3/sec auxiliary fan via 610mm ventilation ducting hung to the roof on the left hand side of the heading.

3. NOTIFICATION

On Wednesday, 24 July 1991, I received a telephone call at about 4.20am from Ron Halsey, Mine Safety Officer, advising that an outburst had occurred in W12 Panel at the mine and two men were unaccounted for.

I phoned the mine at 4.30am and spoke with Bruce Roebuck, Undermanager in Charge. He advised that the outburst had occurred in W12 Panel, approximately 20 metres inbye of No 7 cutthrough in 'B' heading and two men were unaccounted for. He further advised that the gas liberated during the outburst was predominantly carbon dioxide (CO_2).

I contacted Acting Senior Inspector, Michael Carr, advising him of the information I had received and arranged to meet him at the mine.

At approximately 4.40am I received a further telephone call from B Roebuck. He stated that two bodies had been recovered and a third person was still missing. He told me that the mine manager, Michael Ogilvie, was at the incident site as he had gone into the mine at the commencement of night shift.

I arrived at the mine at approximately 5.15am where I was briefed on the incident by B Roebuck. I then received a telephone call from the Manager who asked for permission to remove the body of the continuous miner driver.

I was told that the crew of workmen who had been working in W12 Panel were assembled in the conference room. I had a short conversation with the workmen who were satisfied to stay at the mine for interview. Inspector of Coal Mines, Michael Carr, remained on the surface to conduct preliminary interviews with principal witnesses.

4. SITE INSPECTION

At approximately 7.20am I went underground with an investigation party which included Police Senior Constables Paul Hennessy, Steve Hodder and Paul Beudeker.

I proceeded in a diesel man car to the bottom of 'S' Main where the party waited for a diesel man car to pass, which was travelling outbye. The man car was carrying the body of the continuous miner driver, Craig Broughton.

I spoke briefly with undermanager Robert Hill, who was travelling in that man car, I asked him to accompany me to W12 Panel.

We proceeded inbye arriving at W12 Panel entry. The man car passed through two sets of ventilation doors into W12 return heading (B heading). About 55 metres inbye the doors was an explosion stonedust isolation barrier. The barrier was found to be intact and undamaged.

At this point I took gas determinations and found 0.5% methane [CH_4] and 0.5% carbon dioxide [CO_2]. The ventilation appeared fresh and brisk.

Travelling inbye I observed that the roof conditions were variable. There were many cavities evident, some quite high in places. The roof changed from a sandstone, to a mudstone, to a shale as the panel had developed. The coal ribs showed signs of crush, especially on the chain pillar side [left hand side - looking inbye]. Both roof and ribs were adequately supported.

I observed that stoppings between the return and intake roadways were of substantial construction up to and including No 6 cutthrough. Steel access doors with handle type fastening arrangements had been built into each stopping.

The heading was adequately stonedusted and standards appeared satisfactory.

Arriving at No 6 cutthrough, the vehicle stopped and all personnel passed through the stopping access door and assembled in the cribroom on the intake side.

I proceeded inbye along 'C' heading towards No 7 cutthrough. I observed ground water at No 6 cutthrough which was 20 metres long and about 0.1 metre deep.

Forty metres inbye I observed further ground water which was up to 0.35 metres deep over a distance of 60 metres. The water had a stagnant goaf type smell associated with it.

Some 30 metres outbye of No 7 cutthrough I passed an air pump, telephone, an air winch, conveyor boot end and a ratio feeder.

The roof in that area appeared to be much more competent than 'B' heading, however, there was evidence of roof guttering on the left hand side of the heading consistent with the normal stress direction.

At the corner of No 7 cutthrough I observed parts from self rescuer containers. I was told that they had been discarded by crew members who had donned their self rescuers immediately after the outburst. Further self rescuer tops and bases were found outbye near the air pump and on inbye shuttle car No 30.

An empty shuttle car No 30 was parked half way along No 7 cutthrough. There were no signs of physical damage or anything untoward with the shuttle car nor any signs of violence along the cutthrough.

At this point the ventilation was measured at 15.2m^3/sec with 0.3% CH_4 and 0.1% CO_2 detected.

Inbye of the shuttle car about 4 metres from 'B' heading I was shown the position where the bodies of two of the deceased workmen were found. Their positions had been outlined with stonedust. I was told the names of the workmen were Leigh Pearce and Robert Coltman.

At the intersection of 'B' heading I could see brattice erected across the intersection going inbye, which provided an airflow up towards the face area. This had been erected after the outburst to effect the recovery of the continuous miner driver.

On the left hand side of 'B' heading (looking inbye) about 4 metres from the intersection I observed a shuttle car No 33 which was filled with coal. The car was diagonally across the heading with the cable reel outrigger jammed hard against the left hand rib.

The wheels were in a straight-ahead position. I observed that the electrical power isolator was in the 'ON' position, the pump motor lever was in the 'ON' position and the light switch was in the 'OFF' position.

The shuttle car cable was partially under the front end of the shuttle car body. I observed that the shuttle car drivers' seats were both covered with piles of coal, there being more coal piled on the outbye seat.

Immediately in front of and under the shuttle car were a number of ventilation ducts. A further duct was in the shuttle car. It appeared that the ventilation ducts had been dislodged from the ventilation system.

I passed under the brattice onto the return side where I could see inbye as far as the canopy of the continuous miner.

I observed that coal had been ejected as far back as the shuttle car. The coal tapered from full seam thickness inbye of the continuous miner to a few millimetres at the outbye end of shuttle car No 33. It was obvious that the continuous miner driver's canopy had been completely engulfed with coal.

I had been told that the continuous miner driver, Mr Craig Broughton, was buried within the canopy of the continuous miner by the ejected outburst material. Rescue personnel had to clear away material from the rear of the continuous miner canopy to enable the recovery of Mr Broughton's body, which was finally recovered at 7.00am that morning.

After putting on breathing apparatus I made my way to the canopy of the continuous miner. Looking inbye I could see there was approximately 300mm of clearance from the ejected material to the roof, however, it was impossible to see the face area. I detected +6% CO_2 at this point with 1.8% CH_4.

The material which had been ejected was extremely small and powdered, consistent with an outburst.

I observed that the shale roof was extensively deformed; many cavities were evident with roof guttering visible along the right hand side of the heading.

Returning to the intersection I could see that there were no signs of violence outbye of that point. The ventilation ducting was intact over the 16 metres distance from No 7 cutthrough to the auxiliary fan. Fine coal dust had been deposited virtually everywhere in 'B' heading as far outbye as No 6 cutthrough.

I arranged for photographs to be taken at various locations by Police Officers, from the Police Scientific Department.
I arranged with the mine surveyor Mr R. Siddell, to commence collecting detailed information and measurements in order that relevant accident plans could be produced in due course.

Arriving back on the surface, a meeting was held with management where a plan of action was developed to recover the continuous miner and face area.

It came to my attention that, due to cable damage somewhere outbye, the return telemetric monitor for gas levels was not operating in W12 Panel at the time of the outburst.

I was made aware of the fact that the ventilation doors at the commencement of W12 Panel were found wide open by workmen shortly after the accident.

4. (i) FURTHER SITE INSPECTIONS

On Friday, 26 July 1991, I made a further site inspection, the shuttle car No 33 had been moved and parked in 'C' heading stub. There was no evidence of damage to the shuttle car from the effects of the outburst.

I left the face area and walked from No 6 cutthrough via 'C' heading to the ventilation doors at the panel entry. This journey took me eight (8) minutes to complete at a steady pace.

The ventilation doors were of the steel "FAL" type adequately constructed with brick walls and piers. I needed very little force to push open the ventilation doors. The doors remained open without self closing.

I was told that on Thursday, 25 July 1991, a ventilation assistant, H Wood, had found a sheet down on the W Main/W12 Regulator. The regulator was a plaster stopping with a sheet taken out. Wood measured 17.6m^3/sec in W12 Panel return before repairing the regulator and 21.56m^3/sec afterwards.

On Monday, 29 July 1991, on a further site inspection, I observed that the heading had been cleaned up as far as the side of the continuous miner. I was present as the continuous miner cabin was cleared of coal. The following points were observed:

1. The deceased driver's boots were buried by coal in the cabin.
2. The main control switch was in the 'ON' position.
3. The pump switch was in the 'ON' position.
4. The cutting head switch was in the 'RUN' position.
5. The light switch was in the 'ON' position.
6. The conveyor switch was in the 'STOP' position.
7. The gathering arm apron lever was in its lowest position.
8. It was found that the methane monitor had tripped the electrical power to the continuous miner.
9. The water spray valve was in the 'ON' position.

Basically, the information shows that at the time of the accident, electrical power was on to the machine; the pump motor was running; the lights were on; the gathering arm apron was on the floor; the cutting heads were turning and the water sprays were on.

Following the outburst, it appears that the automatic methane monitor sensed high methane levels and automatically removed the electrical power from the continuous miner.

During the clean up of the outburst material I was told that high levels of gas (mainly CO_2) was being encountered. The gas appeared to be from two sources - one being the outburst cavity, the other from the outburst material.

On Wednesday, 31 July 1991, I observed that the continuous miner had been recovered and parked outbye of No 7 cutthrough.

All of the outburst material had been cleaned up to the face line. It was estimated that some 130 tonnes of material had been removed. It was estimated that some 6000m^3 of gas had been liberated during the outburst. Bag samples of the gas taken on 24 July 1991, analysed by the Coal Mines Technical Services, showed the gas composition favouring carbon dioxide (CO_2) in the ratio of 9:1.

At this stage the whole of 'B' heading up to the face line was accessible and visible.

I could see quite clearly that there had been a significant change in roof conditions from No 7 cutthrough inbye. Roof jointing had swung through 90° to a north west - south east direction. Roof guttering was evident on the right hand side of the heading (looking inbye) consistent with a change in stress direction. The roof was extensively fractured and deformed. I considered these changes were consistent with a high localised stress regime and a change in stress direction.

The roof conditions had improved over the last five metre distance up to the face line. The face had been cut reasonably square, pick marks were evident near the roof on the left hand rib line. There was a penetration of outburst material into the left rib line.

The outburst had initiated from the right hand side of the face area where a cavity was visible. The length of the cavity was in excess of 5 metres, the depth of the cavity could not be clearly determined. The coal within the cavity was extensively pulverised.

A thrust fault intersected the roof in the rib side running approximately 28° from the horizontal, associated with the fault was a white ''breccia '' material. That material appeared to be the white ''clayey'' material that Mr Woods had observed prior to the accident. Mylonitic material was also evident in that area.

5. EVENTS LEADING UP TO THE OUTBURST

During the investigation I became aware of factors which appeared to be of significance to the outburst and were made apparent from witnesses and from reports. I feel it prudent therefore, to commence the events leading up to the outburst at a time when W12 Panel was developing inbye from No 3 cutthrough.

5 (i) ILLAWARRA BOTTOM GAS

The development continued mining inbye of No 3 cutthrough in early May 1991. The first reported finding of Illawarra bottom gas (IBG) was on 24 May 1991, by the district deputy on afternoon shift. Further reported findings of IBG were made on an increasing basis up to the 17 July 1991. The gas was being found on all four (4) shifts by the district deputies and predominantly in 'B' heading. The gas was detected on at least 48 occasions. There was a general increase in the finding and reporting of IBG inbye of No 6 cutthrough between 21 June 1991 and 17 July 1991. The gas was noted on the deputies' statutory inspection reports, apparently as a methane percentage. There were no specific recordings of carbon dioxide (CO_2) percentages.

Senior officials and management were aware of the IBG being detected and instructed that the gas be dealt with as a ventilation problem.

It appears that there were no instructions given by senior officials and management to have the IBG analysed for gas composition or for the use of Drager tubes to detect the amount of CO_2 present in the gas.

Comments recorded during interviews with the Manager, M Ogilvie and Undermanager in Charge, B Roebuck were that the IBG presented a ventilation problem and was dealt with in that manner.

5 (ii) GEOLOGICAL CONDITIONS

The mining conditions, particularly the roof conditions encountered in the early development of W12 Panel were poor, and according to witnesses, were similar to the conditions encountered in the early development of previous 'W' side panels.

Unlike the previous 'W' side panels, however, where the conditions improved, the conditions in the W12 Panel did not improve but continued to be poor as the panel progressed.

On 26 May 1991 a seismic transmission survey was carried out at the mine by BHP Engineering. Originally it was intended to carry out an inseam seismic "reflection" survey using shotholes at 10 metre intervals to geophones placed at strategic localities. The manager, however, determined that, for various reasons, the reflection survey would not be carried out, therefore the inseam transmission survey was conducted instead. The transmission survey was undertaken in W11 Panel using 100 metre spaced shotholes between No 3 and No 17 cutthroughs to a geophone placed in a borehole to the west of W12 Panel. The results of the survey had not been forwarded to South Bulli Mine Management prior to the outburst on 24 July 1991. Both the manager, M Ogilvie and geologist, B Agrali stated words to the effect that the seismic survey was carried out to prove the geology to the west of W11 Panel for the next two (2) longwall blocks.

The company geologist, B Agrali had inspected W12 Panel on several occasions during its development. The last inspection was carried out on 15 July 1991 in B heading. The heading had been driven inbye of No 7 cutthrough some 17 metres. The continuous miner was driving C heading towards No 7 cutthrough at the time. On that inspection and the previous inspection Agrali had observed significant changes in the roof conditions. According to his statement he observed jointings which were new to him at South Bulli and felt or suspected there was a local feature to the right hand side of B heading which required further investigation before W13 Panel was driven. He did not pass this information onto the Mine Manager, however, did verbally inform his immediate supervisor, the Technical Services Manager, M O'Brien.

The undermanager in charge, B Roebuck was aware that the roof conditions in W12 Panel did not improve as the panel advanced beyond No 2 cutthrough. He states he was reasonably happy with the operational aspects of dealing with the poor roof conditions.

5 (iii) ACCUMULATIONS OF WATER

During the first week of July 1991, No 6 cutthrough holed into B heading from C heading. At that point water broke through from the floor at the holing point which was of sufficient quantity to halt production for at least two (2) shifts until a pump could be installed.

A similar problem occurred at No 7 cutthrough where a large accumulation of water was found in C heading just outbye of No 7 cutthrough.

The undermanager in charge appreciated that the amount of water was the most encountered so far in W12 Panel.

The manager had not seen the water until the night of the outburst, 24 July 1991, however, he appreciated that the water make was unusual.

5 (iv) EVENING SHIFT - 23 JULY 1991

The W12 Panel deputy, S Shaw spoke with his undermanager, R Clough and the afternoon shift deputy in W12 Panel, P Ross before going underground. He was told that the roof was being lost and bolting of the roof straps was being carried out in front of the continuous miner.

Shaw had worked in W12 Panel as the deputy on only two (2) previous production shifts. He had received outburst training, being familiar with the outburst theory, outburst rules and outburst conditions.

At the start of his shift, Shaw made his way to the face of B heading and found 0.2% CH_4 near the floor and 0.3% CH_4 general body concentrations. The roof conditions were poor, such that minimal roof was being exposed and roof straps were being set closely spaced. Approximately 400mm of immediate roof was being lost.

During the shift Shaw made frequent inspections for gas, finding about 0.4% CH_4 in the general body. He states that he did not make any further inspections for gas near the floor.

The crew were cutting out for one (1) strap at a time, where one (1) car of coal was cut followed by the setting of a roof strap with five bolts. By the end of evening shift a total of eight (8) straps had been set, which gave an advance of about five metres. The roof had apparently improved as had the general mining conditions.

Shaw stated that during his shift he had found nothing untoward and everything appeared normal when he handed the district over to the nightshift deputy, R Corbett.

5 (v) NIGHTSHIFT - 24 JULY 1991

A crew of nine (9) workmen were deployed to W12 Panel to continue production in B heading inbye of No 7 cutthrough - one of which was a deputy, Robert Alexander Corbett.

Prior to going underground, Corbett spoke with nightshift undermanager, Robert Hill about the conditions in W12 Panel and the work to be performed on that shift. Corbett read the undermanager's end-of-shift report and obtained written work instructions from R Hill.

Arriving in the panel cribroom at No 6 cutthrough, the deputy, R Corbett spoke with the eveningshift deputy, S Shaw. Shaw told Corbett that the roof had improved at the face but to watch it. Corbett read several deputies' statutory reports, observing that there had been a fairly consistent 0.3% CH_4 at the face with no reports of Illawarra bottom gas.

Corbett walked up to the face in B heading which was some 24 metres in from No 7 cutthrough. He detected 0.3% CH_4 in the general body with no bottom gas present. He observed that the roof was guttering on the right hand side to an even parting and the ribs were secure. The immediate roof was flaking to a height of about 200 millimetres, the roof had been supported to within 150 millimetres of the face. Everything else appeared satisfactory. The time was approximately 1.55am.

During the time Corbett was at the face the panel fitter, G Partis, carried out a visual 103 Scheme examination of the continuous miner, before proceeding outbye to carry out visual 103 Scheme examinations of the two (2) shuttle cars which were parked midway along No 7 cutthrough and were both empty. Partis then returned to the face area.

At this point the continuous miner driver, C Broughton, and cable hand, A Wood had arrived at the face. Corbett instructed Broughton to cut out for one (1) roof strap at a time, to check the CH_4 monitor and to test for gas in the corner and on the floor. Broughton and Woods had a discussion about the face conditions before Broughton carried out gas tests with a D6 methanometer. Woods had observed that the roof was very weak with white clayey material causing the immediate 150mm of roof to fall out as it was exposed.

Another two (2) crew members, H Prychocki and M Croman obtained supplies from track end outbye of No 7 cutthrough in B heading and carried them up the heading, placing them in the side of the roadway behind the continuous miner.

R Coltman was deployed to drive shuttle car No 33 between the face and half-way along No 7 cutthrough.

R Bowden was deployed as a spare man to carry out a shuttle car training module. He operated shuttle car No 30 which was the surge car between No 7 cutthrough and the conveyor ratio feeder.

Broughton commenced production whereby the continuous miner sumped in at the roof and sheared down towards the floor. One car of coal was filled, Coltman driving the shuttle car, where he discharged the coal into the shuttle car operated by Bowden.

Bowden drove shuttle car No 30 to the conveyor boot end but could not discharge the coal into the ratio feeder because the conveyor belt was not running. Therefore, Bowden remained at the boot end awaiting the belt to start up - someone had told him that conveyor rollers were being replaced on the 'W' Main trunk conveyor belt.

After unloading his shuttle car Coltman returned to the face where Broughton, operating the continuous miner, half filled car No 33. Coltman drove car No 33 to the surge point half-way along No 7 cutthrough where he parked the car.

Corbett carried out an inspection at the face. He detected 0.3% CH_4 with no apparent bottom gas.
A 'W' strap was then set to the roof where M Croman and L Pearce commenced bolting the strap to the roof, using a hand-held Wombat roof bolting machine. Broughton remained in the continuous miner cabin during this operation. He then assisted with chemicals.

After the first bolt pinned the 'W' strap to the roof, the continuous miner was trammed back from the face 4 to 5 metres to allow the two man bolting crew access to the face area. Corbett instructed the bolting crew to place an extra bolt on the right hand side because of the roof guttering. Corbett then left the face area. Woods remained at the driver's side of the continuous miner to observe the roof and support cycle.

Corbett walked outbye to the auxiliary fan where he placed stonedust into the trickle duster hopper. He then walked along No 7 cutthrough into C heading where he learnt that the belt was not running. Apparently Corbett rang control on the surface to enquire about the conveyor belt status. Corbett then spent some time talking to the shuttle car driver, Bowden, who was sitting on the car at the boot end.

Woods had observed that the roof bolter had been operating slowly during the drilling but had not skipped as when breaks in the roof are present. He also observed white "clayey" material in the roof.

Croman had observed a black, shiny, slickenside in the roof during the bolting operations.

Corbett returned to the face to find the roof bolting and support completed. He instructed the crew to stonedust the face area while the conveyor belt was off. Leaving the face area, Corbett walked outbye to the conveyor boot end where he spoke with the fitter, Partis about the air pump located in that area.

At this time the conveyor belt re-started. Bowden discharged the car of coal into the ratio feeder and then drove the car back to the surge point. Corbett, observing the conveyor belt running, walked back towards the face. He surged coal from No 33 shuttle car into No 30 shuttle car and drove No 33 car to the intersection of B Heading. He walked up B heading to the face where he saw that the crew had just finished stonedusting. Corbett spoke with Broughton, advising that the conveyor belt was running and was right to proceed mining again.

Coltman drove shuttle car No 33 to the face area in readiness for filling.

It appears that neither Corbett or Broughton made an inspection for gas prior to commencing mining on this final occasion.

The nightshift undermanager, R Hill had deployed the shift and arrived underground at approximately 1.20am.

He had received a report that W12 Panel was still experiencing poor roof conditions and support was being carried out with hand-held roof bolters. The conditions were consistent with those experienced for at least the last week.

On the surface, Hill had spoken with the mine manager, Michael Ogilvie who was carrying out an inspection on nightshift. Ogilvie had indicated he was going into LW211 panel and from there would walk to other places.

At pit bottom Hill organised the locomotive work with mining assistant, Peter Shepherd. Hill organised the high tension cable work and gas drainage pipe work for W12 Panel which involved his transporting three (3) workmen, Dennis Narbeth, Bill Wonson and George Blackwell into W12 Panel.

Hill left pit bottom at approximately 2.35am, driving a diesel man car with the above three men sitting in the rear of the man car and three others, P Shepherd, Tony Fisher and Ron McFarlane sitting in the front of the man car. Hill dropped the later three men off en route to W12 Panel.

Arriving at the ventilation doors at the entrance to W12 Panel return heading, Hill opened the outbye set of doors and drove the man car into the air lock. Narbeth closed the outbye set of doors before opening the inbye set of doors. Hill drove through into the return and observed Narbeth close the inbye set of doors. The time was approximately 3.00am.

Hill proceeded inbye observing stonedust in the air. He drove the man car to the track end inbye of No 6 cutthrough intending to pick up some chain for pipe hanging. Due to the stonedust from the auxiliary fan exhaust and the fact he had men in the man car, Hill decided to drive back to the cribroom at No 6 cutthrough and return later for the chain.

Arriving at No 6 cutthrough, Hill left the man car engine running as he intended to be but a short while, first instructing the three men as to their job of work. The four (4) men passed through the stopping trap door into C heading where Hill spoke to the men about the work to be carried out.

After speaking with Broughton, Corbett saw the headlight of a diesel man car arrive in the panel. Corbett walked outbye along No 7 cutthrough to ascertain who had come into the panel in the man car.

The continuous miner proceeded to cut the face and load car No 33. Woods advised Broughton that he was going outbye to watch the hoses through a cable hanger at the intersection. Croman and

Pearce were sitting in B heading just outbye of No 7 cutthrough on the left-hand side of the heading.
Bowden was sitting on shuttle car No 30 awaiting car No 33 coming from the face.

Partis was in the vicinity of the conveyor boot end.

Prychocki was standing nearby A Woods at the intersection waiting for Coltman to drive car No 33 outbye so that he could take some supplies forward.

Shuttle car No 33 was filled with coal. Coltman then proceeded to drive the car outbye from the face.

The continuous miner was in the cutting mode with the cutting heads still turning, the water sprays and lights on and the gathering arm apron on the floor. The cutting heads were also close to the floor.

The position of each W12 crew member just before the time of the outburst is shown on plan No 9628A.

6. THE OUTBURST

At approximately 3.10am the outburst occurred, described by witnesses as an explosion, a rumbling bumping noise, a loud bang, like a goaf fall. Several witnesses felt a small percussion wave.

A Woods, M Croman and H Prychocki ran along No 7 cutthrough towards C heading. Woods, Croman and Bowden donned their self rescuers and attempted to go back inbye but were overwhelmed and driven back by the dust and gas which was pushing against the ventilation into No 7 cutthrough.

At the time of the outburst, Prychocki had seen Leigh Pearce moving in a different direction to that taken by Croman.

Partis, who was near the telephone at the conveyor boot end, switched the conveyor belt off when he heard the outburst. He saw Prychocki running outbye, waving his light, yelling there "had been an outburst". Partis operated the telephone emergency button and notified surface control of the situation. He then handed the telephone to Corbett, who confirmed the situation and that men were trapped at the face. Partis donned his self rescuer.

Corbett met Woods and Bowden at the corner of No 7 cutthrough. Corbett donned his self rescuer and attempted to go inbye but was driven back by the gas. Corbett detected 4% CH_4 at the conveyor boot end.

During the initial minutes following the outburst, there appeared to be quite a lot of confusion and disorientation amongst the workmen.

R Hill, who was talking to Narbeth, Wonson and Blackwell, heard the outburst occur. He walked inbye to No 6 cutthrough, up to the stopping and opened the trap door. He observed a brownish dust cloud envelop the diesel man car in the return and the engine suddenly stop running. At the same time, Hill felt the effects of CO_2 coming through the trap door towards the intake.

Hill closed the trap door and retreated to C heading, where someone yelled out to "knock the electrical power off" which Hill quickly did by operating the emergency stop on the transformer just outbye of No 6 cutthrough.

He then proceeded inbye towards the conveyor boot end, picking up an Entonox bottle, handed to him by A Woods. Having not travelled very far inbye No 6 cutthrough, Hill felt the effects of the CO_2, therefore retreated to the cribroom.

By this time everyone who had survived the outburst had assembled at the cribroom where a head count was made. It was realised that at least two (2) men were unaccounted for.

It appeared that in the early confusion, some of the workmen had started to walk outbye, however, they returned to the cribroom after walking only a short distance.

7. EVENTS FOLLOWING THE OUTBURST

At approximately 3.21am the manager, M Ogilvie, who was in LW211 Panel, was advised of the outburst by the surface control officer. Ogilvie then spoke to R Hill at the W12 cribroom. Hill advised Ogilvie that an outburst had occurred, three men were missing and to expect the worst as the atmosphere was irrespirable inbye of the conveyor boot end. He then asked Hill if compressed air was available in the panel. Hill was advised by Corbett that compressed air was coupled via a hose to the air pump further inbye in C heading. Hill informed Ogilvie that compressed air was available and he would attempt to use the air hose to get inbye.

Ogilvie then contacted the surface control officer, requesting transport to be provided to take him to W12 Panel, rescue suits to be sent into W12 Panel and the Mines Rescue Station be advised of the situation.
Ogilvie contacted the surface control again and told them to activate the emergency procedure and request a rescue team be sent from the Mines Rescue Station. The time was approximately 3.28am.

Hill walked inbye to the boot end where the air diaphragm pump was located and disconnected the air hose from the pump, tied the hose to the winch frame and cracked the operating valve. This operation took a couple of minutes and Hill was again affected by the gas concentration which was present. He was assisted to the cribroom by D Narbeth and R Bowden.

Corbett, who went to the air pump with Hill, was also affected by the gas, however, made his own way back to the cribroom. Narbeth had sensed the effects of CO_2 on his legs as far back as the cribroom.

Corbett took a CH_4 reading at the cribroom where he detected at least 2% CH_4 on his D6 methanometer. He took a further reading at the transformer, detecting 0.5% CH_4.

The realisation was that a major incident had occurred and Craig Broughton, Robert Coltman and Leigh Pearce were missing.

R Hill then made the decision to send all of the survivors outbye to the drivehead, except himself and Corbett. Hill told the men to make their way outbye along C heading, assemble at the W12 drivehead area, notify surface control of the number and names of the men and to contact Hill at the cribroom to advise of their arrival.

The men complied with Hill's instruction and, still wearing their self rescuers, commenced walking outbye along C heading. As they progressed outbye, several noticed a sluggishness in the ventilation which gradually improved as they advanced further outbye. They observed the improvement in ventilation, therefore removed their self rescuers.

During the journey outbye someone suggested that the ventilation doors at the entrance to W12 return could have blown open by the effect of the outburst.

Arriving at the main track road, M Croman, G Partis, H Prychocki and D Narbeth walked to the double set of doors which were found to be fully open. Croman and Partis ensured the doors were closed before proceeding back to the point where the rest of the men had assembled.

A Woods had phoned the surface control officer advising the number of men and their names.

A short time after this, Woods attempted to contact R Hill by telephone, however, Hill did not answer the telephone.

By this time the manager, Ogilvie arrived and, following a brief conversation with the men, walked inbye along C heading. As he passed No 4 cutthrough he noticed that the ventilation appeared quite normal.

At approximately 4.13am a South Bulli Mine rescue team arrived at the W12 drivehead area, consisting of four (4) men with rescue suits.
The W12 Panel crew then left the area and were transported to pit bottom in a diesel mancar - the crew arriving on pit top at about 4.50am.

A rescue team from the Southern Mines Rescue Station arrived at the mine at approximately 4.20am, along with ambulance paramedics. They remained on standby.

From the time the W12 crew members commenced walking outbye from No 6 cutthrough, Hill and Corbett started to make their way inbye along C heading using the air hose as a means of attempting to disperse the gas. The dust cleared and the CH_4 concentration was down to 1.5% in No 7 cutthrough.

Hill walked to the inbye side of the cutthrough where he saw R Coltman and L Pearce lying side by side.
Hill beckoned Corbett to him and between them they dragged both men to the rear of the shuttle car. By this time the ventilation had improved.

Finding no vital signs of life, attempts were made to revive them. After about 10 minutes Hill and Corbett realised their attempts to revive Coltman and Pearce were futile - no vital signs returned to either of the men. A further rumble and a cloud of dust from the face area of B heading prompted Hill and Corbett to retreat outbye.

Ogilvie arrived at W12 Panel cribroom where he sensed the presence of CO_2 in the atmosphere. He rang surface control to gain an update on the rescue personnel, rescue equipment etc.

Proceeding inbye, Ogilvie met Hill and Corbett near the conveyor boot end. Corbett went to the cribroom and was assisted by Peter Shepherd who arrived in the Panel. Ogilvie and Hill went inbye and commenced bratticing their way into B heading by erecting brattice across the intersection to the rear of shuttle car No 33. Ogilvie observed that the ventilation was clear up to the intersection and outbye, however, was irrespirable inbye of the intersection in B heading.

Blankets were brought from the cribroom by Shepherd and the bodies of Coltman and Pearce were covered.

The manager made the decision to withdraw all men from the mine. Hill phoned surface control advising of that request - following which the mine was evacuated, apart from key personnel.

Arriving at the W12 Panel cribroom, the South Bulli rescue team set up the base before proceeding inbye.

Shortly afterwards, the rescue team extended the brattice along B heading to the rear of the continuous miner.

B heading return was inspected and cleared for travelling by transport. The bodies of Coltman and Pearce were placed onto stretchers and loaded into mancars, then transported out of the mine.

The rescue team had to dig away the outburst material to gain access to the continuous miner canopy, where Craig Broughton was found buried to his neck in outburst material. Four men, R Budd, R Clough, J Swane and G Clarke were wearing BG174 rescue suits, whilst four others, including Hill and Ogilvie, shovelled coal from the rear of the continuous miner canopy. They were not wearing rescue suits. According to witnesses, the task was arduous, with CO_2 being given off the outburst material as the recovery continued.

Craig Broughton's body was eventually removed from the continuous miner canopy at approximately 7.00am, placed on a stretcher and transported out of the mine in a diesel mancar.

Apart from Ogilvie, all other personnel left W12 Panel to travel to the surface. Hill met the investigation party at the bottom of S Main and returned to W12 Panel with them.

8. INFORMATION GATHERED AFTER THE OUTBURST

8 (1) INSEAM SEISMIC SURVEYS

The preliminary results of the inseam seismic "transmission" survey carried out on 26 May 1991 were relayed verbally to the mine on 1 August 1991. It appears that the seismic trace did indicate a possible structure to the west of B heading W12 Panel. However, the results were questionable, unclear and far from conclusive.

Further inseam seismic "reflection" surveys were carried out by BHP Engineering in W12 Panel on 11 and 14 August and in W11 Panel on 20 and 21 August 1991.

The results of the two (2) surveys indicated that the data quality recorded was very good to excellent. The conclusions made as a result of the surveys are as follows:

1. The two surveys have successfully imaged a number of small scale geological features interpreted as jointing.

2. The W12 outburst area is a very poor seismic reflector.

3. One reflector imaged which is to the west of W12 Panel has the potential for seam displacement.

4. The large number of seismic reflectors imaged is due to the excellent data obtained in the field collection, probably the best ever collected in the Bulli seam.

Attached are copies of two plans, Fig 4 and Fig 5, which show the interpreted geological features.

8 (2) INSEAM GAS CHARACTERISTICS

Between 8 and 10 August 1991 a series of eight (8) gas samples were collected from the mouths of drill holes in W Main and B heading W12 Panels. The gas samples were taken at approximately 100 metre spacings from No 6 cutthrough of B heading outbye to W Main Panel.

The gas samples were analysed by Coal Mines Technical Services on 12 August 1991 using Infrared/Electrochemical analysis. (See attached sheet 158).

Although the gas samples were not an exact representation of the insitu gas composition, the results did show that from W Main Panel the carbon dioxide (CO_2) increased in quantity going inbye to No 6 cutthrough W12 Panel.

Gas samples taken in T11 Panel were analysed and showed a bias of +80% methane (CH_4) to 4.4% carbon dioxide (CO_2). (See attached sheet 159). Whereas the samples that were taken behind the continuous miner in W12 Panel on the day of the outburst showed a

bias of +90% carbon dioxide (CO_2) to 9.2% methane (CH_4). (See attached sheet 160).

8 (3) INSEAM DRILLING

The mine procured drilling machines and drilling expertise to assist in carrying out exploratory drilling in the mine particularly in W12 Panel.

Drilling was carried out in W12 Panel primarily to determine the geological structures in and around the outburst area, secondary, to afford some gas drainage inbye of both B and C headings. (See attached plan W12, 161).

Four (4) drill holes were drilled in the western rib at right angles to B heading between No 6 and No 7 cutthroughs. The holes achieved a maximum distance of 35 metres before penetrating a zone which prevented the drill rods gaining any further distance.

At No 7 cutthrough three (3) drill holes drilled in the western rib at approximately 45° from B heading achieved a distance of only 15 metres before penetrating the same zone.

Two (2) drill holes were drilled in front and to the left in the face area of B heading which achieved a distance of approximately 10 metres.

The drill rig was set up in C heading stub where seven (7) drill holes were drilled in a fan pattern, four (4) of the holes angled across to intersect the area in front of B heading. The hole lengths ranged from 45 metres to 105 metres. A further one (1) drill hole was drilled parallel to No 7 cutthrough across towards W11 Panel.

Gas samples taken from several of the holes showed that the predominant gas was carbon dioxide (CO_2).

The holes drilled to the west of the panel from both B and C headings penetrated a zone whereby the drill rods bogged down and thus prevented any further drilling distance beyond that zone.

It would appear that the zone was the structure from which the outburst initiated on 24 July 1991.

9. FINDINGS, DISCUSSION AND COMMENTS

Much of the evidence and information collected during the investigation into the accident concerned factors which indicated that significant changes occurred during the development of W12 Panel up to the time of the accident. Those factors were mentioned earlier in the report in Section 5.

Illawarra bottom gas (IBG) was found on an increasing basis and reported by deputies on their statutory reports. It appears that, the gas was treated purely as a ventilation problem, there were

no instructions or work carried out by management to identify the change in gas composition particularly carbon dioxide (CO_2) by using drilling, bag sample analysis or Drager tube detection.

Geological conditions were assessed by the company geologist. He stated that he felt there was a geological anomaly to the west of W12 Panel, however, did not consider it to be a problem in W12 Panel but felt it would possibly impact on the W13 Panel development. The undermanager in charge showed some concern at the continuing poor roof conditions, however, was happy that the operational aspects of roof support were dealing with the poor roof conditions.

The seismic survey carried out on 26 May 1991 was undertaken to determine the geology to the west of W12 Panel. It is reasonably clear from witness' statements that the scope of the seismic survey was centred around future longwall layout and development, not for outburst prediction or outburst identification. Mine management did not receive any results from that seismic survey until 1 August 1991. Development of W12 Panel continued, regardless of the seismic results. It can be clearly argued that there appeared to be no urgency or importance placed on obtaining the results of the seismic survey, as would possibly be the case if used for outburst prediction.

Accumulations of water in the areas of No 6 and No 7 cutthroughs were considered by some witnesses and on deputies' statutory reports to be of an unusual amount and of an unusual nature. It is debatable whether or not the water was significant to the outburst, however, the water did appear as an unusual factor at the time.

> All of the above-mentioned significant factors were known prior to the accident, however, each factor appeared to be treated on an individual basis, not collectively. Had these factors been assessed collectively then it may well have triggered further investigation. I saw this as a lost opportunity by management to have further investigatory work carried out which may have identified the potential risk of an outburst.

Pre-drilling for geological evaluation or gas drainage was not practised at the mine. The company geologist stated that if a structure is identified then further work may take place. In order that pre-drilling can be practised the mine has to bring in skilled personnel and drilling equipment. Past history at the mine of mining through geological faults and dykes in the absence of drilling makes the likelihood of pre-drilling in W12 Panel highly unlikely.

> In light of the above-mentioned facts, the outburst history at the mine and the lack of accurate or collated data, it makes it understandable that pre-drilling was not done.

Following the first outburst which occurred at the mine in T5 Panel, an "outburst procedure" document was drawn up to be used when mining through outburst potential areas. The document has Stage 1 and Stage 2 procedures which are initiated when either mining in close proximity to or within an outburst potential area. Failure to recognise a potential outburst area before mining takes place means that visual observations are used to recognise potential outburst areas.

Basically the document refers to outburst prediction by crew members whereby they must recognise typical outburst indicators, such as, changes in roof jointing, gas fluctuations, change in coal characteristics, greasy back, slickensides, brown/red staining, etc. It relies upon persons being adequately trained to observe the above indications. If such indicators are observed then the senior official on shift makes an inspection and the outburst procedures are put into place. Several of the above-mentioned outburst indicators were present before the accident, however, the nightshift crew was not trained in outburst procedures, neither were several of the senior management. The evening shift crew, who had been trained in outburst procedures, failed to recognise any indication of a pending outburst. That can be extended to many other persons at the mine.

The outburst protection equipment is not stored in the panel but had to be transported into the panel if required.

In reviewing and analysing the "outburst procedure" document it appears to rely upon known or suspected potential outburst areas.

The "outburst procedure" document is seen as being somewhat ambiguous and lacking clarity. It was considered to be less than adequate in dealing with an outburst of major proportions as in the accident situation. Had the "outburst procedures" been in place at the time of the accident it is unclear as to whether or not the same outcome would have occurred.

It appears that training of personnel in "outburst procedures" was done when either mining was to be carried out within a known outburst area or following an outburst. Clearly there appeared to be a lack of training in the staff area - many of whom would be responsible for initiating the outburst procedures.

The lack of personnel training in outburst procedures, the history of outbursts at the mine (especially the frequency) and the perceived level of outburst severity, based on that already encounted, makes it understandable that the outburst area was not identified.

Carbon dioxide (CO_2) was the predominant gas liberated in the outburst, with concentrations in excess of 70%.
There has been a considerable amount of research work carried out into the effects of CO_2 in concentrations greater than 30%. The research work indicates that at this percentage or greater the CO_2 has a profound effect upon the central nervous system; it also has a toxic effect upon the body. That means that a person subjected to a high concentration of CO_2 would be immobilised almost instantaneously, thus prevented from taking any evasive action and it would also mean that death would be almost instantaneous. (See attached abstract from the I.S.R.P. Journal).

In the accident situation the continuous miner driver was subjected to an irrespirable atmosphere with plus 70% CO_2 present. Within a few seconds the CO_2 would have engulfed the whole heading outbye to No 7 cutthrough. Anyone caught in that area at the time, not already wearing some form of breathing apparatus, would undoubtedly be asphyxiated within a few seconds. The shuttle car driver and timberman managed only a couple of metres' retreat before being overcome by the effects of the CO_2.

> Assessing the effects of CO_2 at high concentrations, especially in the outburst situation, it is obvious that persons immediately affected by the CO_2 would not have sufficient mobility nor sufficient time to don any form of breathing apparatus.

Following the outburst several attempts at rescue were made by crew members, the deputy, the undermanager, and finally rescue personnel, which may have put further lives at risk.

At least four (4) crew members and the deputy made attempts to go back inbye to effect a rescue. They had donned their self rescuers before doing so, which appeared to be an act of using the only rescue equipment available. Their attempts at the rescue were futile due to the effects of the CO_2, each person was affected and could have been overcome by the gas. The carbon monoxide self rescuers are, as the name implies, self explanatory - their use is in the event of carbon monoxide liberation and as a "self rescuer", not to attempt rescue of other persons.

A second attempt at rescue was made by the deputy and undermanager who wanted to use a compressed air hose to direct compressed air into the roadway to disperse the gas. This attempt resulted in both being affected by CO_2, more so the undermanager who had to be assisted back to the cribroom.

The third rescue attempt using the compressed air hose was made by the deputy and undermanager. This time they were able to make it to the inbye end of No 7 cutthrough, locate two bodies and administer revival techniques.

It is difficult not to accept the strong, emotional desire of workmen to attempt a rescue of workmates. However, such rescue attempts described above were made without a full understanding of the event which had occurred, the full nature of the gas liberated and the extent to which the event had impacted upon the ventilation.

The deputy and undermanager had evacuated the district, therefore, having no back-up support, they were not aware that the ventilation had been short circuited when the ventilation doors blew open. They were not to know that the air hose they were using may have failed for some reason such as burst hose, air failure, blocked hose, etc.

First response rescue attempts, which are spontaneous, without full thought and without a full understanding of all the factors, are at the least, extremely risky, if not foolhardy - especially when the persons attempting such a rescue are not equipped with suitable rescue breathing apparatus.

It is reasonable to assume that the crew, the deputy and the undermanager, who had been affected by the CO_2, would be distressed, confused and perhaps disoriented, which may have clouded their judgement and decisions.

The recovery of the continuous miner driver's body involved eight (8) personnel, of which four (4) were wearing BG174 rescue breathing suits. Those four erected brattice up to the rear of the continuous miner to direct fresh air to that point and provide a means of diluting the gas. They then commenced removing the outburst debris from around the canopy of the continuous miner.

The four other persons not wearing rescue suits or any form of breathing apparatus were employed in shovelling and moving the coal away from the rear of the continuous miner. The manager, in his statement, recalled the fact that CO_2 was predominant and stinging the eyes of the rescuers and providing that persons did not bend down they were okay.

Undermanager Hill recalled that the shovelling was slow and laborious with CO_2 being given off the coal as it was disturbed.

Those latter four persons, who were not wearing any breathing apparatus, were placed in a compromising situation and in grave risk from the CO_2, being some 15 metres inbye of No 7 cutthrough. Had there been a failure of the ventilation or of the brattice or had there been a further liberation of gas, those persons would more than likely have been seriously affected.

Had "outburst procedures" been in place at the time of the accident, then SG10 and SG15 self contained breathing apparatus would have been at hand. Such breathing apparatus is for evacuation purposes, not for rescue. This apparatus has a life of 10 minutes and 15 minutes respectively, under normal breathing; when a person is working hard and breathing heavy the life is reduced by almost 50%. Therefore, it is considered a misunderstanding to treat such breathing apparatus as rescue apparatus and it should be used for personal self rescue only.

The mine emergency procedure was put into place following the accident and appeared to be both adequate and satisfactory. The appropriate persons were notified, emergency personnel were summoned and the evacuation of mine employees (apart from key personnel) was carried out in a satisfactory manner.

Accepting the fact that there is a strong, emotional desire for workmen to attempt a first response rescue of workmates, it is appropriate nevertheless for workmen to have an understanding of rescue procedures and rescue equipment.

In the accident situation workmen donned their self rescuers which were totally useless in a CO_2 environment.

Had SC15 escape breathing apparatus been at hand at the time of the accident, their use in a rescue attempt may well have resulted in the wearers being exposed to a high level of risk.

The "outburst procedure" document refers to what persons should do following an outburst. It appears to cater for a low intensity, less significant outburst not an outburst of the magnitude experienced during the accident.

The ventilation provided in the W12 Panel appeared to be satisfactory prior to the accident. The two (2) sets of steel ventilation doors at the commencement of the panel were of sound construction, however, were not self closing and had very little pressure against them.

A regulator which was in use near the start of the panel consisted of a plaster board stopping, where a sheet had been removed as the regulating medium. In every stopping in each cutthrough a steel trap door had been erected to allow man access between intake and return headings. The trap doors were of sound construction and were equipped with fastening handles to keep the doors closed. The stoppings were satisfactory and installed up to No 6 cutthrough. The auxiliary fan was sited approximately 6 metres outbye of No 7 cutthrough in B heading. The fan pulled air from the face through steel ventilation tubes.

At the time of the accident the outburst had sufficient intensity to cause a compression wave and push open the ventilation doors. The doors did not "self close" thereby creating a loss in panel ventilation. The volume and density of the gas liberated was responsible for pushing back the restricted ventilation that was available, therefore little dilution of the gas was achieved in the inbye working area. A further plaster sheet fell off the outbye regulator at some stage which would affect or reduce the ventilation into W12 Panel. It most certainly had some effect on the quantity of air available to W12 Panel.

Trap doors located in the stoppings were fastened, which maintained a seal between the intake and return airways.

The plaster board stoppings were of a satisfactory construction and maintained up to No 6 cutthrough. They also provided a seal between the intake and return airways. Had the No 6 cutthrough been stopped off with brattice rather than plaster board, there could have been more lives lost.

Electrical power was removed from inbye equipment following the accident. The auxiliary fan may have had some impact upon dilution of the dust and gas, however, was rendered ineffective when the electrical power was removed. Also, the fan ventilation tubes were dislodged by the outburst as far back as No 7 cutthrough.

> The maintenance of ventilation before, during and after an outburst is of paramount importance. In the accident situation the design, construction and maintenance of part of the ventilation system did not reduce the likelihood of damage and did not remain intact.

A few minutes before the accident four (4) persons travelled via the return heading up to No 6 cutthrough in a diesel man car. Under the circumstances that a potential outburst was not known, it is understandable that such vehicle access occurred. However, had those four (4) men travelled inbye at the time of the accident then their lives would undoubtedly have been at risk.

Although the "outburst procedures" document does not specifically mention persons entering or travelling in the return airway during outburst mining, the "outburst warning signs" which are posted at the panel entries do restrict panel access other than under the direction of the panel deputy.

Evidence would suggest that restricted access into panel returns is practised during outburst mining. It is not clear however, that persons may enter the return or in fact, work in the return, during outburst mining at the discretion of the panel deputy. The "outburst procedure" document makes no mention of those latter facts.

Under the Coal Mines Regulation (Notification and Investigation of Accidents and Dangerous Occurrences - Underground Mines) Regulation 1984, an abnormal outburst of gas with coal or other solid matter into the mine workings, is considered to be a reportable dangerous occurrence.

No other part of the Coal Mines Legislation makes any reference to an outburst, whereby any form of prescriptive Legislation is documented to address the outburst risk.

Outbursts have been experienced within the Bulli seam over a number of years at various mine locations. The outbursts have been of varying intensity - some being responsible for fatalities. Dealing with the outburst risk has been in the form of a concerted approach involving Mine Management, the Inspectorate and Mine Unions. The concerted approach has varied from location to location, dependent upon the frequency and intensity of outbursts. It is evident that where fatalities have occurred, ie, Metropolitan, Tahmoor, and the latest accident at South Bulli, the predominant gas has been carbon dioxide which is quite significant when some 600 reported outbursts have occurred - the bulk of those being predominantly methane.

Much of the current Legislation appears to cater for methane with very little reference to carbon dioxide. The risk associated with carbon dioxide (CO_2) may well be dealt with inappropriately in current Legislation, especially when considering the outburst situation and the physiological effects CO_2 can have on a person.

In the accident situation the CO_2 contained within the IBG was dealt with purely as a ventilation problem. Legislation does not provide a clear direction for mine management and mine officials to follow in dealing with CO_2 in an appropriate manner as it apparently does with methane (CH_4).

Continual reference is made to methane in the Coal Mines Regulation Act, 1982 - very little to carbon dioxide. In the accident situation it appears that the CO_2 was dealt with in an appropriate manner as a ventilation problem in accordance with the Legislation. Legislation is not specific in giving the same priority to CO_2 as with methane.

In concluding this section of the report I feel it necessary to review the outburst, which occurred in the accident.

The outburst was one of extreme intensity unprecedented in the history of South Bulli, and possibly the Bulli seam. Of great significance was the fact that carbon dioxide (CO_2) was the predominant gas liberated, which appears to provide a greater violence and propensity for damage to people and equipment.

Past outbursts at South Bulli have been of low intensity and extremely low frequency with methane (CH_4) the predominant gas. Due to those factors, an outburst procedures document was drawn up which appeared to cater for the outburst risk perceived at the time.

In terms of reality a comparison should be made between South Bulli Mine, having had 5 small outbursts and mines such as West Cliff, Tahmoor and, to a lesser extent, Tower, which are considered to be high frequency, medium to high intensity outburst prone mines.

West Cliff Mine, for example, a high risk outburst prone mine having had in excess of 200 outbursts of varying magnitude, understandably places a high priority on outburst planning and prediction.

There are several parameters and methods used in outburst prediction - one method being the assessment of the geology, however the main method which can identify numerous parameters is that of pre-drilling. Pre-drilling can identify structures, shear zones, mylonite, high gas pressures, gas content, gas composition, etc, all considered to be pre-cursors in attempting to identifying potential outburst areas.

West Cliff practises the gathering and assessment of geological information for both future longwall development and equally for outburst risk. Their fundamental prediction tool however, is that of pre-drilling which is readily available at the mine. As a mine which practises gas drainage and has a gas drainage/ utilisation plant established at the mine, West Cliff can easily use pre-drilling techniques for outburst prediction which is only a minor variation from the normal day-to-day de-gassification operations. Having the drilling personnel, drilling equipment and drilling expertise on site, it makes it that much easier and reasonable to apply pre-drilling at the mine for outburst prediction.

The number and frequency of outbursts at West Cliff Mine has resulted in outbursts being given a high profile and priority in terms of outburst identification, planning, assessment, training, mining procedures, etc, which form part of West Cliff's outburst management system.

Using such an example as West Cliff makes it understandable that South Bulli Mine would not place the same emphasis, nor apply the same priority to the outburst risk as would a mine like West Cliff.

10. CONCLUSION

From the results of my investigation, which included, site inspections, interviews of witnesses, the photographs, reviewing the accident plans, statutory reports, mine plans, goetechnical reports, etc, I concluded that :-

At approximately 3.10am on the night shift, Wednesday 24 July 1991, an abnormal and intensive outburst occurred in B heading of W12 Panel inbye of No 7 cutthrough.

The outburst was associated with a geological structure and occurred when the continuous miner mined through the containment into the outburst zone. This was based upon the facts that the continuous miner was in the cutting mode at the time of the accident.It was estimated that some 260 tonnes to 300 tonnes of material was involved with up to 6000m^3 of gas liberated, predominantly carbon dioxide (CO_2).

Thirteen (13) workmen were employed in W12 Panel when the outburst occurred, three (3) of the workmen were asphyxiated by the high levels of gas and irrespirable atmosphere produced as a result of the outburst.

The continuous miner driver, Craig John Broughton, died almost instantaneously when he was buried to his neck in outburst material and overcome by the gas as he sat in the operator's cabin of the continuous miner.

A second workman, Robert Kelvin Coltman, was driving his shuttle car away from the rear of the continuous miner at the time of the accident. From the injuries sustained to his elbows and knees it would appear that he was thrown out of the driver's compartment by the force of the outburst as it slewed the shuttle car sideways across the heading. He managed to move only a couple of metres in his attempt to escape before being asphyxiated by the gas.

A third workman, Leigh Ronald Pearce, a timberman, found alongside the body of the shuttle car driver, had also been asphyxiated by the gas. The position in which his body was found would suggest that he had aided the shuttle car driver during their attempted escape.

The intensity of the outburst was sufficient to blow open the ventilation doors at the panel entry which caused a short circuit of ventilation. The impact on the inbye working area was dramatic, whereby the lack of normal ventilation prevented any dilution of the liberated gas, therefore the density and quantity of gas present moved very quickly into both headings, placing many, if not all, of the survivors at risk.

Several of the survivors donned self-rescuers and made first response rescue attempts. Although it is understandable that there would be a strong emotional desire to rescue workmates, such rescue attempts were thwart with danger and risked further loss of life, especially when wearing inadequate and inappropriate rescue equipment for the accident situation. From the time of the accident to the recovery of the continuous miner driver's body, various rescue attempts were made without having a full knowledge and an understanding of the effects carbon dioxide can have on a person when the gas is present in high concentrations.

The investigation revealed that there were significant changes in such factors as ingress of water, stress direction, roof jointing, roof guttering, roof conditions, gas fluctuations and gas composition during the driving of W12 Panel up to the time of the accident. On shifts preceding the accident and on the accident shift, the above-mentioned factors were evident. On the accident shift further factors were observed, ie: a greasyback/slickenside, white breccia in the roof and coal softening.

All of those factors are indicative signs associated with outburst activity,in my opinion, probably more prominent in this accident than normally encountered in outburst occurrences at other locations, at other mines.

I discussed earlier in the report, particularly in Section 9, the understanding of why South Bulli failed to detect the potential outburst zone. However, failing that prediction, the factors mentioned above should, at the very least, have prompted further investigation by management which may have led to the detection of the potential outburst zone.

The level at which South Bulli managed the outburst risk appeared to be too low for the intensity of outburst experienced in tbe accident.
The outburst which occurred in the accident was in my opinion, definable and could have been predicted.
An appropriate management outburst risk system, such as that used at WestCliff Mine, would have detected the zone, and through drilling and gas drainage dramatically reduced the intensity of the outburst, which may then have prevented loss of life.

11. SYSTEM SAFETY ACCIDENT INVESTIGATION (SSAI)

In addition to my investigation, the Chief Inspector of Coal Mines ordered a SSAI be carried out to review the accident so critical elements and factors could be established which could then be applied to the Bulli Seam, following which a risk assessment on outbursts within the Bulli Seam could be undertaken.

The SSAI was carried out at the Department of Mineral Resources' Wollongong Office..

The investigation was conducted by a select team comprising:

R Smith	Senior Inspector of Coal Mines
M Clarke	Inspector of Coal Mines
A Reczek	Senior Inspector of Electrical Engineering
R Lama	Kembla Coal & Coke
C Ellicott	Training and Development Officer
J Joy	Facilitator - MineRisk Pty Ltd

Analytical tools used to review the accident and identify the critical elements and factors were:

Events and Conditions Charting
Change Analysis
Codes, Standards and Regulations
Energy/Barrier Charting

Relevant critical elements and factors from the above analytical process were identified and compiled into a "Judgement of Needs". A copy of the SSAI was forwarded to the Chief Inspector of Coal Mines.

12. DEPARTMENTAL REPORT.

An investigation report was compiled and forwarded to the Head Office for information as part of my normal investigatory duties.

13. ATTACHMENTS.

1. Accident Plans.

   a) Site Plan (Face to Bootend) 9628 A.

   b) Panel Plan (Face to Panel Entry) 9628 B.

   c) Whole Mine Plan (No 4 Shaft - Inbye) 9628 C.

   d) Support and Geology Plan (Face to No 7 Cutthrough) 9628 D

2. Inseam Seismic Survey Plans. (Fig.4 & Fig.5).

3. Coal Mines Technical Services, (Gas Analysis Certificates).

   Reference 158. 12 August, 1991
   Reference 159 25 July, 1991
   Reference 160 24 July, 1991

4. Drilling Plan. W12 Panel. Reference 161 W12.

5. Abstract from the Journal of the I.S.R.P.
   Carbon Dioxide (Physiological Effects).

6. "Outburst Procedures" document.

7. A set of 23 Photographs lettered A through to W.
   A caption at the bottom of each photograph indicates what is shown.

M Clarke
22 November, 1991