

# **COAL AND GAS OUTBURST COMMITTEE**

## **HALF DAY SEMINAR – Wollongong 29th June, 2016**

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## **Metropolitan Colliery MG26 Grunching Induced Outburst**

**Alaster Wylie, Development Superintendent, Metropolitan Colliery**

### **Questions and Discussion**

**(Ed. Notes not edited by Alaster)**

**Brad Elvy, Appin** – How much powder did you use in the pattern?

**Alaster** – Our shot pattern was a 19 hole pattern using 22.6 kg of Senotel 1000. We basically use a wedge cut in a 3 m round. In our original pattern, we used 19.4 kg, but a lot of areas were hanging up and we had suspected misfires. Our powder factors were too low. When we increased the powder factors we had less hang-ups and more certainty about the shots having fired.

**Les Lunazewski, Lunagas** – What was the coal harness or strength in MPa?

**? Geologist** – We have not measured the strength but I estimate 10 to 12 MPa.

**Anon** – What is the in-situ gas content?

**Alaster** – 13 m<sup>3</sup>/t. One reading was 15 another 9. There seems to be considerable variation in a short distance.

**Mitchell Hudson, Metropolitan** – When you are shotfiring, for around 20 kg of powder, there would be an extra 16 m<sup>3</sup> of initial gas produced by the shotfiring and around 1-2 m<sup>3</sup> can be pure CO<sub>2</sub>.

**Alan Phillips, Outburst Seminar Committee** – Grunching helps reduce risk but it can induce an outburst.

## **In-seam Boreholes to and Beyond 2000 m With a Combination of Slide and Rotary Drilling**

**Frank Hungerford, VLI and UoW PhD Candidate**

### **Questions and Discussion**

**Anon** – Where you had the scatter with the rotatory drilling, could you associate it with geology, structure or other drilling comments?

**Frank** – It varies. If deflecting from roof or floor, the drill will deviate substantially. If we hit stone and do not know if it is roof or floor, we can use the deviation to work out whether it is as expected. If you are drilling to the left and you hit floor, the next survey will show you have deviated to the right. That is why there is a scatter on the graph. But there will always be some scatter when the bit deflects off bands in the seam. Coal is not homogeneous in drilling. So the driller has to deal with natural variations in the seam.

**Anon** – What was the orientation of the holes with respect to north? Drilling in an EW direction can be worse than in the NS direction.

**Frank** – We have shown them on the plan as drilled and surveyed. Azimuth of 17.75 degrees. When mining intersects the first hole, it might be say, 2 m out from where predicted, so, knowing the actual angle of projection from the collar, the rest of the borehole trajectory can be adjusted. This way the miners have more confidence in where the hole will be.

**Mark MacCabe, GE Tech** – When the drillers do the survey, do they use the most accurate tool orientation as determined by the calibration?

**Frank** - No the survey is as taken in the hole. The drillers are reporting the orientation of the motor for my sake, not doubling up on surveys.

**Les Lunarzewski, Lunagas** – What was the hardness of the seam?

**Frank** – Better than was quoted in the previous presentation. It was unstructured. There were fluctuations in drilling but each hole stayed stable while being drilled.

**Les** – What drilling and flushing media did you use?

**Frank** – Mostly water, but we did clean out the hole with foam. There were substantial gas flows from the hole while drilling so the addition of detergents increased the flushing of the hole. The rotary drilling reduces the size of the cuttings, making them easier to remove.

**Les** – What size bit did you use?

**Frank** – The first hole was drilled with 96 mm but the rest were with 99 mm. The standpipe was 6 inch diameter.

**Mitchell Hudson, Metropolitan** –Initial flows were 300 litres/sec plus. We intersected the first bore this week, without any problems. It was the hole with the lowest flows so we were wary. The hole was where predicted.

**Anon** – Did you use any special procedures for intersecting?

**Mitchell** - We ran a second gas drainage line so we could connect the hole straight into the range. We are currently mining TG301. The 8 holes should give us sufficient drainage to cover the maingate for the next panel.

## **Gas Drainage at Metropolitan**

**Matthew Potter and Mitchell Hudson**

### **Questions and Discussion**

(Ed. Notes not edited)

**Brad Elvy, Appin** – What spacing do you drill the downholes?

**Mitchell** – 20m spacings at seam intersection.

**Peter Jandzio, Metropolitan** – It is generally a fan pattern so not parallel holes. We target the tailgate corner of the wall, which takes the holes to about 25m apart.

**Matthew** – We are drilling from the maingate side under the wall.

**Anon ?** – What is your drilling rate?

**Mitchell** - About 66 m per hour depending.

**Matthew** – The longer the hole gets the slower the drilling.

**Anon** – What sort of gas are you getting from the seam?

**Matthew** – It is all CO<sub>2</sub>.

**Mitchell** – The incident that occurred produced a lot of CH<sub>4</sub> also, up to around 3%. That was the reason there was a full withdrawal from the pit. We generally don't have any CH<sub>4</sub> in this area. So it was pretty certain that the CH<sub>4</sub> came from a floor break to the Wongawilli seam. Hence the downhole drilling now.

**Chris Harvey, Outburst Seminar Committee** – Is the set-up of the drill rig and the mechanism for taking cores documented as a part of your operating procedures?

**Matthew** – We have procedures for site set-ups, installing standpipes and gas drainage lines. We do have procedures drawn up for around 90% of our operations but there are changing circumstances every day for which we do not have set procedures. But in the last 2 years, the number of defined procedures have increased dramatically.

**Chris** – How does your Gas Drainage Superintendent ensure there is compliance from one shift to the next?

**Pete** – We continually audit our supervisors, undermanagers and deputies so they can inspect the sites and ensure that the standards are being met.

**Matthew** – Different from most operators we have to do a full shift report which is given to Pete each shift. We give this to Pete to help him keep on top of management of the drilling. We have a spread of operator experience, but knowledge is shared amongst them.

**Anon** – Do you have a flight plan for every hole drilled?

**Matthew** – Yes. We have targets but are not issued with seam profiles. We have access on the computer to previous holes drilled and where they went, where they hit roof or floor. For the downholes, we are given information on where to expect the Wongawilli seam.

**Mitchell** – We rely a lot on the data log for the hole with the operator recording all that happens in the hole. If they don't record what happens, the next shift won't know. We rely a lot on what the operator on the previous shift experienced.

## **Gas Drainage Drilling at Appin Colliery**

### **Russell Thomas, Appin Colliery**

A lot of the Appin story is similar to the Metropolitan experience. Everything at Appin is focussed around structures. 20% of the pit that is heavily structured causes 80% of the heartaches. Where we have had difficulty draining and where we have had to resort to remote mining have been around a couple of structures that are difficult to drain. Getting holes into these areas can be an issue. But if we can drill holes into the areas, they do drain but slowly. But getting holes into these areas can fail. If the coal does not drain the gas is close to virgin conditions, so normal mining cannot be conducted due to outburst risk.

Regarding site set-up, we try not to run a spa bath. With some holes we get a build-up of drilling fines, blocking the standpipe and suction hoses, so we try to keep the system as open as we can. Hoses running from the hole to the spa bath can get blocked and create near misses that could hurt someone. So we prefer to keep systems open with as few potential blockages as we can.

Regarding equipment, we have quite a museum with 5 Kempe K200's, including DR5 which was used on Australia's first 1000 m hole, one Boart-Longyear LM75 and a couple of ADS rigs we got recently. The ADS rigs are big bits of gear which can be difficult to get into place, but once they are set up, they are good for drilling with a lot of thrust. They are well set up for the things we have to do including over-coring to recover gear. Our coring is focussed mainly around structures similar to what the blokes from metropolitan described earlier. If we have enough mining experience through a structure that we can convince ourselves the structure is not outburst prone we only core inbye and outbye the structure, otherwise we take two cores on either side of the road, both inbye and outbye the structure (4x cores for each location a roadway intersects a structure). Our standard pattern for coring is 100 m spacing and for a single gateroad panel, just one across (in the worst location) for a normal gateroad, but we can do some extra cores to cover the whole area in wider panels. So normally we core around the structures with perhaps some infill cores between them.

Gas composition - over 75% of the pit is mainly CH<sub>4</sub>, but with variations of CO<sub>2</sub> between 12% to 18%. One part of the pit around North Mains and the western side of Area 7, has higher CO<sub>2</sub> but similar gas content. Have not had many issues draining it except the need to drill more holes and allow more time to drain. We don't have a standard drill pattern for the higher CO<sub>2</sub> areas. Our drill patterns are heavily influenced by structures with concentration of draining around structures but not through structures as by trial and error we found that did not work. So we drill all around the structures and hole spacing is determined by the leadtime we have for drainage. We have a reference table built from experience (including the times where we did not drain sufficiently due to insufficient time available) that tells us the spacings required for the lead-time required.

For cross-measure drilling we have a standard program for targeting the Wongawilli seam which started long before I started at Appin. When it is working well we capture up to 75% of the longwall gas into the drainage system. We basically run two drainage plants in parallel,



the old Appin plant and the old Tower plant. Both can run up to -50 kPa running 6000 to 7000 lps out of the pit (pure CH<sub>4</sub> flow). Every 4 pipes along the main gas drainage range we insert a manifold and drill a spray of holes along the Wongawilli seam, the exact number of holes depending on mainly Longwall retreat rate – we basically try and drill as many holes as possible while keeping ahead of the retreating longwall face. Ideally we drill 8 holes every site but this is a moving target depending on our learning cycle.

### **Questions and Discussion**

**Ken Cram, Outburst Seminar Committee** – The gas-outs on the longwall, are they frequent?

**Russell** – They are not at present, but over the last 2 years we have had between 55% and 75% of the gas from the Wongawilli seam captured. In the last 2 months the capture has dropped to between 30 and 45% and this affects coal production. Production is stopped if the gas in the returns hits 1.6%.

**Chris Harvey, Outburst Seminar Committee** – What is the composition of the gas from the cross-measure holes?

**Russell** – The gas from the cross-measure holes is strongly CH<sub>4</sub> even in areas where the Bulli seam gas is high in CO<sub>2</sub>. The Wongawilli seam is over 85% CH<sub>4</sub>.

**Chris** – Could you run through indicators while drilling that help identify a structure? What would the driller document?

**Russell** – The indicators that the drillers notice include the presence of stone, the drilling conditions. 75% of our structures are picked up because they cannot drill through them and they get bogged, or drilling gets really slow, the fines size changes either big or small. We see a fair bit of mylonite which sits like talcum powder on top of the water in the dam. 75% of our structures can be projected from one panel to the next along straight lines. Information from surface exploration is not authoritative but is indicative. We cannot absolutely rely on seismic or aeromagnetic data to rely on where structures will be but they do give warning there can be something suspicious ahead which needs further definition. Much of our seismic information is from 3D surveys.

**Chris** – What I was focussing on is that the surveyor can supply a plan which shows where a structure is predicted, but how does the driller know he has actually hit the structure?

**Russell** – It is based mainly on how drilling of the hole goes. Sometimes, if a predicted structure locality is drilled through with no indications we will have more of a think about it. If a structure is suspected, we would not rely on a single hole but would drill more holes to test for it.

**Graham Pryor** – When the downholes put pressure in the drainage line, does that cause issues for your department?

**Russell** – Sometimes it does. Occasionally there is a lot of gas released into the range and this can be a problem. When a hole starts to flow suddenly it can add 300 lps in a short time. The solution is to turn up the suction. We have had issues when there is a sudden flow and we have had to wait for the flow to die off. It mainly impacts the other drill rigs as we don't have enough suction to keep the rigs drilling. This can lead to some of the cross panel holes leaking a bit of gas into the ventilation, but the ventilation at Appin is pretty efficient. The last time this happened we shut down the rigs for a while. The gas did not exceed 0.25% so it was not a problem. Although there might be positive pressure in the range, the gas is still moving.

**Brad Elvy, Appin** – It is probably more just a need to keep the water traps clean and the drainage system is working optimally. You will know the system is working well as there will be good suction everywhere else except that one localised area.

**Chris Harvey, Outburst Seminar Committee** – What is the rule of thumb for lead time on drainage to reduce gas content to below the threshold?

**Russell** – There is no rule of thumb. Through previous mistakes, we now have a table showing lead-times and hole spacings for various parts of the pit. The reservoir is quite variable, so it is horses for courses.

**Brad Elvy** – It comes down to the mine planning department not changing the locations of the from what the drilling is based on.

**Alan Phillips, Outburst Seminar Committee** – A problem for mines such as Appin and Tahmoor with higher CH<sub>4</sub> composition is gas exceedance. Now the Department has a policy of zero tolerance for gas exceedance, if the airway content exceeds 2% CH<sub>4</sub> it is reportable and there have to be actions taken. There is a huge amount of scrutiny at present. Different mines have their own different strategies to avoid exceedances of 2%.



## **Gas Drainage Drilling Experience at Tahmoor Colliery**

### **Wayne Walker, Driller, Tahmoor Colliery**

(Ed. Due to Wayne being on leave, these notes were kindly checked by Paul Maddocks)

At Tahmoor, we have 3 VLD rigs (Derick 100's) and a Clark rig. Our drill patterns are similar to those described for Appin and Metrop. We use a 15 m hole spacing along the drive. For each hole site, we drill two holes by branching the second hole of the first giving us a 30 m span. In every drill stub, we drill 9 holes producing 18 holes with the branching. Tahmoor is mainly CO<sub>2</sub> up to 85%.

For drilling we use a 6 m copper standpipe fully encapsulated so when the longwall goes through we only have to remove the valves and the longwall can mine through the copper. We also use a Clark rig for downhole drilling in the maingates under the longwall to pick up the first 3 or 4 chocks to help degas as the Balgownie and Wongawilli seams break. We also now do drilling in the Balgownie seam where we drill up to 500 to 600 m in front of the longwall to try to help degas so when floor bumps and breaks do not have too big a gas effect. They work sometimes. We are now going back into old holes, branching and taking a core sample to test for efficiency of drainage. But we still drill a cross hole to test for drainage. We try to take most of the cores from the virgin side to test for highest content. We aim for 180 days drainage time. We can core at up to 500 m. We use a 90 minute window. All the holes are sampled for gas. All samples are sent to GeoGas for analysis.

**Chris Harvey, Outburst Seminar Committee** – After the holes are drilled, are there any subsequent tests of content and flow rate?

**Wayne** – Every hole gets tested for flow rate and composition weekly. Drilling patterns depend on the gas content and flows from holes to assure drainage is occurring. By continuously monitoring we reduce the risk of problems when the panel reaches the area tested.

**Brad Elvy, Appin** – What is the purpose of taking bag samples?

**Wayne** – That is so we can read the gas composition in them. As a hole gets older, the gas content drops. If we get 19% oxygen we know the hole is finished as it is sucking air. This can then trip the gas plant which we do not want. So we close off these holes.

Like everyone, we have water problems. From the 3 different types of holes we can get a lot of water of varying quality in our gas range. With most of our drilling, we can be pumping 250 lpm into the coal. If we get good drilling we can do a set each 3 to 6 minutes depending where we are in the hole. Every 80 m we do a roof touch, so we have control of where we are in the seam. We try to drill in the middle of the seam. We do a survey each 6 m and this is plotted three ways. We write everything, we plot distance and up/down. We also record down-track? Which is the give and take depending on how much swing there is in the turn. If you are swinging 100 m out your down-track will be 20 m. This helps to calculate correct location versus drilling distance.

**Brad** – So all this is written down as well as recorded on the computer?

**Wayne** – All is written on paper as well as on grid. Driller's impressions and problems are recorded. If there is a change in water pressure, it is recorded as a problem because it will be something wrong at the motor, right at the front of the hole. If you are 200 m out or 800 m out, you will get the signal 20 minutes before you have to tilt. On distance your motor has told you that you have hit a problem.

**Brad** – You mentioned a 90 minute window with coring. What did you mean?

**Wayne** – From cutting the core we have 90 minutes to retrieve it. Our core spacings are normally 140 m for cutthroughs 120 m apart.

**Mark MacCabe, GE Mining Tech** – Do you do floor touches on the way back out of the hole?

**Wayne** – No, we only do roof touches. We occasionally will do a floor touch if information on seam thickness is required. Where we are drilling at present the coal is very soft and we can be running on a -7 pitch which means the bit is dropping 1 m each 6 m of hole drilled. If we are not on -7, we will be scraping the roof. If we are scraping the roof the motor will flick the azimuth to the left. If the motor is scraping the floor, it will flick to the right. The seam is around 2 m thick so there is not much room for error. Divergence is difficult to stop when drilling soft coal.

**Ting Ren, UoW** – You produce a lot of data. How do you manage the data?

**Wayne** – I read every hole once a week. From a normal stub with 9 holes I take two gas samples per week. I normally work them from left to right. We are restricted to which way

we drill because of the motor etc. Because the motor is on the right hand side we drill from left to right. Because of where our miner is, we come around from the left side, so we drill from the left hand side going towards the right hand side. So the left hand side is always more in advance but we don't have a 4" hose hanging over the operator. Presently, everyone is fighting water, so we have a fish tank plus a plant to manage fines. We run the 4" hose into the filtration tank which then sucks straight into another filtration so we are sucking gas from there and from the super management plant. We used to shovel out the fines onto the roadway or stow it elsewhere, but now we have a big bucket and the supermanagement system has an auger which augers the coal up into the bucket which when full is taken away by an Eimco. 17 holes in one stubb produces a lot of coal fines. Every rig has a management plan to cover situations such as bogging, crossing another hole, etc. If we have a hole with high gas pressure, the DGS can now be drawn through the front jaw of the rig so we make sure our rotation unit is back 3 m from the end of the standpipe so we don't need to disengage the stuffing box. So we can pull back straight through the stuffing box then isolate the hole. Our drillers are highly trained but we have to keep on top of the gas problems. We have air curtains and venturis. We will sometimes drill through brattice with a venturi to maintain power to the rig. If we trip the rig it is notifiable.

**Chris Harvey, Outburst Seminar Committee** – Part of the reason behind today's seminar was taking a core sample and getting below threshold value is something we all use to determine if it is safe to mine. But a key component of the sample is the mechanism used to take the sample. Everyone will have different adaptation of how they do it, but a certain level of consistency of doing it in each mine is just as important as the sample itself. That is why we thought it valuable to share thoughts on the exercise and how the different mines go about it. We would like to encourage cross fertilisation in how drillers do what they do and how to standardise processes and procedures and to make the operations more consistent and therefore, safer.

**Brad Elvy, Appin** – I would like to ask Mark Blanch a question. The 90 minute window came out of Tahmoor practice. Was that a recommendation by GeoGas?

**Mark Blanch** – Yes. It was based on a study conducted in 2012 by Geoff Williams specifically for Tahmoor. Other similar studies have been undertaken by Geoff for other mines based on their specific coal desorption characteristics (referred to Geoff).

**Anon** – At Appin we looked at taking core from a kilometre but could not retrieve the core in time.

**AS3980:201X Determination of Gas Content of Coal and Carbonaceous Material -  
Direct Desorption Method**

**Murry Bull, Appin**

**Mark Blanch** – Are you or other labs reporting  $Q_t$  rather than  $Q_m$ ? Also what about DRI?

**Murray** – We don't record  $Q_t$  because we are reporting for outburst management. It would be difficult for us to report DRI at Cordeaux because of our different methodology from GeoGas.



## **Defining the Hard-to-Drain Coal Seam**

**A/Prof. Ting Ren and Dr. Gonda Wang, UoW**

### **Questions and Discussion**

**Chris Harvey, Outburst Seminar Committee** – have you considered any correlation between strength of the coal and permeability?

**Ting** – We have not done much work in that area yet. We need to get more coal from different locations to establish such relationships.

**Dennis Black, Consultant** – As you know I have found the degree of saturation to be most significant. Have you tried to study this in lab?

**Ting** – Gas movement in a coal is controlled by diffusion in the coal matrix and by Darcy flow in the fracture or cleat system. Saturation and permeability are the two most important factors impacting gas drainage. When mining activity comes to the low permeability area, gas drainage will be poor which can be easily understood, but besides that, the low degree of saturation will also reduce the efficiency of gas drainage, and the ‘hard-to-drain’ problem of CO<sub>2</sub> rich seam is quite a good example. At UOW, we have conducted extensive lab tests to establish the isotherms of different coals, including these samples collected from typical hard-to-drain areas in Metro and Appin, and most these results demonstrated a feature of under-saturation, confirming the impact of the degree of saturation on gas drainage.

## **ACARP Projects Update**

### **Brad Elvy, Appin Colliery**

**Coalbursts** – Stage 1 of a scoping study into research needed for coal bursts was completed by University NSW and a heap of consultants. The report is nearly ready for publication.

A stage 2 project is underway by the same people. There have been interesting presentations from people from Wollongong Uni and Uni NSW and also a presentation to the Coal Mine Managers Association by a couple of consultants. The Uni NSW team has come up with 9 parameters by which to rate your mine's risk of coal bursts. These include:

1. Depth of cover
2. Changes in topography
3. Structures in immediate roof
4. Geological and geotechnical structures in the mine
5. Past seismic activity in the mine (e.g. bumps during mining through to bursts)
6. Joints and cleats
7. Abutment stresses from adjacent longwalls, multi seam operations
8. Gas content of seam

They looked at 20 to 30 mechanisms then refined them to the 9 criteria. They are now plotting the various mines in Australia against the above criteria with some interesting findings of mines which are in the medium risk level.

They are trying to put some process around risk management for a guideline. They are also looking at methods for monitoring such as seismic and looked at data from Geoscience Australia which might be relevant. But it looks like there will be very little that is relevant.

There will be an international workshop. It will be by invitation only, but to people in the industry. If you want to go and don't receive an invitation, see me. There is a limit of 70 seats. This will be held at UNSW. UOW will also be organising a workshop.

**Ting Ren** – Will the ACARP work help to better understand the mechanism of outbursts?

**Brad** – There was a session 3 to 6 months ago where we looked at all the mechanisms and all the different areas and rated each mechanism in relation to our industry in Australia. The US have significant issues with channels and pillar design which contribute to bumps but we

don't really have those issues in Australia. We have higher rated issues around development panels, so we rated which issues were most important for targeted research over the next 12 months. We are encouraging consultants to get together to work co-operatively. Winton Gale has some role with SCT looking at the gas side. CSIRO has someone looking at microseismic. Every researcher has their own field of expertise.

**Anon** – Does the rating of coal mines you mentioned take into account gas outbursts?

**Brad** – Gas content was one of the parameters. But it was not rated as heavily as depth of cover. The question was how does your mine rate against the list of parameters. The outcome of the stage 2 is to get a draft into the management guidelines of coal bursts with a list of what needs to be considered and what monitoring systems can help.