

COAL AND GAS OUTBURST COMMITTEE
HALF DAY SEMINAR – Wollongong 4th August, 2010

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**Outburst Threshold Limits Current Research Outcomes - Dennis Black,
University of Wollongong**

and

Application of Outburst Thresholds to Non-Bulli Seam Mines – Mark Blanch, GeoGAS

Questions and Discussion

Mark Fisher, Inspector of Coal Mines, Dept. of Industry and Investment- Question to Dennis. A criticism I direct at most of the ACARP and other research projects is that most of them conclude that more research is needed. One of the difficulties we had with raising the thresholds at West Cliff and Tahmoor was the nature of Ripu's results and the viability of carrying through the application of 15 year old thinking to today. Can you conclude a new direction is possible with safe limits, or is more research required?

Dennis Black– The primary aim of my research was not related to outburst thresholds however through analysis of gas testing data I have identified some quite significant relationships one of which relates to, and impacts, the validity of the DRI900 methodology to determine threshold levels for non-Bulli seam mines. I do make the point that the threshold limits, as introduced in 1994, while very effective in ending outburst events in the Bulli seam, were less than the TLVs proposed by Ripu. Several of the Bulli seam mines have been through the review process and gained approval to raise the TLVs and these mines have continued to operate without outburst incident. Several points to note are the increased TLVs are not any higher than the levels initially proposed by Ripu and these mines, as is pretty much common practice now, undertake substantial directional drilling and core sample analysis which was never allowed for in the original TLVs.

Ray Williams, NuninunaCSG – It would be nice to raise thresholds but history must be taken into account. Mark raised the point about safety factors with Ripu's work and that they are not high. It depends on what the threshold is designed to achieve. Mark referred to “zero dynamic incidents” as our preference whereas in the old days small outbursts occurred and nobody was worried. Our thresholds were designed on the basis that you can mine as fast as you like and no matter what structure you might intersect, you won't have an outburst. Regarding raising thresholds, some scary incidents have happened in the past. I don't think you need gas content much above the thresholds to have a gigantic outburst. The first outburst at Collinsville in 1954 produced 500 tonnes of coal and 500 tonnes of rock and 7 fatalities. It occurred in an environment we can link because of the Hargraves EV meter and gas content tests Hargraves did at the time, to a gas content of 7 - 8 m³/tonne CO₂. It occurred on a 3.5 m thrust fault. Are such structures encountered in the Illawarra? Yes. The South Bulli outburst surprised everybody. It was hard to drill. Up until then I believed that drilling ahead would find these structures. The gas content was mainly CO₂ between 9 -10 m³/tonne. The big outburst at Leichhardt occurred with high gas content (12 – 15 m³/tonne – Ed.) on a nasty (reverse fault – Ed.) structure. Experience at the mines that have raised their thresholds is fine, but you have to be sure there is not a big structure lurking ahead. I have always been concerned that the DRI thresholds we applied to the Greta seam, to North Goonyella and some other mines were too high, not too low. At Central Colliery, the compliance check test was lower than the threshold. In the Greta seam, the test samples were taken from the back of the miner and were low. At North Goonyella, the test samples were low at 5.5 to 6.5 m³/tonne CH₄.

Also a comment on Dennis' research: showing all the DRI's on a graph, drawing a line of best fit and getting a good r² does not cut the ice with me. I do not believe that is the right way to look at the data.

Mark Blanch, GeoGas— Regarding structure, I agree with Dennis that a lot of the advances in outburst management have come about because of the high density of drilling at Illawarra mines with the additional gas content cores. I also know the mines are still hitting unexpected structures with the continuous miners. So the current systems are not infallible. That is why we stick to our approach.

Dennis Black – The development of the DRI900 was originally based on drawing a line of best fit and getting a good r^2 , so Ray appears to be contradicting himself. Attempting to measure the gas content of a coal sample post-mining or post-outburst is going to deliver questionable results and although I have no experience with the Hargraves EV Meter I'd expect measurement accuracy may have also been an issue. Using Bulli seam experience, in some areas gas drainage boreholes drilled at 10 to 20 m spacing can be left for years and achieve minimal gas content reduction. The Queensland outburst examples presented by Mark show known gas content from core samples taken some 20 m from the known outburst structure. Over that distance the gas content could have increased significantly and have been greater than the threshold limit. As for my analysis of the gas content/DRI relationship, I have used GeoGAS data provided from the mines. The strong correlation and high r^2 value is what the data show. Although not presented today, I produced the same graphs using individual mine data and they each show the same relationship. What you see on this graph is effectively each mine's data overlain. I interpreted the data according to my understanding of the method.

Alison Booth, Rock Solid Systems Management - Question to Dennis. I am happy to see there have been good control measures applied to the increases in TLV's. I worked in the development of the original thresholds applied in BHP mines. Considering the proximity of structures, is there any scope to test your derived relationships between DRI and content to the proximity of structures and testing under stressed conditions with regards to mining rates?

Dennis Black – It is probably an opportunity for the future. The DRI / gas content data that I have used was determined from laboratory gas content testing and I don't have the coordinates to be able to relate the results back to proximity to geological structure. Also, the cores were in most cases taken some distance from active development faces so the results are not impacted by mining rate.

Xavier Choi, CSIRO – We will always have a problem when we base outburst thresholds on a single parameter. From our field experience, we know we can safely mine through some areas with gas contents as high as 14 m³/tonne CH₄. As Dennis has mentioned, there have been no fatalities with more intense gas drainage. But we do know that outbursts have occurred when the gas content has been low and around or under the threshold limits, and, as Ray explained, some of these outbursts have been very large. Our modelling has been able to explain these types of occurrences based on our understanding of outburst mechanisms. A question to Mark regarding DRI; This is mainly to do with the amount of free gas that would actually be available to drive a gas outburst. DRI will give us some indication of the rate of gas release when we crush the coal. Prior to an outburst, much of the coal might already be failing, especially if highly sheared, and can be in a very fine particle size state such as mylonitic, and gas can perhaps be released very quickly under such conditions. However, prior to the outburst, depending on the properties of the coal, the coal can still consist of “intact” fragments even though it can be highly fractured. When we consider the isotherms for CO₂ and CH₄, we know that CH₄ will desorb at higher pressure than CO₂. Then, if there is not enough time for the reservoir pressure to dissipate, the pressure corresponding to say, 9 m³/tonne CH₄ compared with 6 m³/tonne CO₂, the pressure can be much higher for the case of CH₄, and this can have an impact on the pressure gradient and the amount of free gas that would actually be available to drive the outburst, and an outburst can occur. Around many structures, the permeability can be very low and it is only when the structure is intersected that gas can flow from the coal. What is the impact of desorption pressure and reservoir pressure on DRI?

Mark – It is important to understand the difference between desorption pressure and desorption rate. Desorption pressure is what we see when we mine a roadway or drain the gas. We typically see CH₄ desorbed first as it has a higher desorption pressure than CO₂ for the same gas content. In an outburst setting where we rapidly drop the pore pressure well below the desorption pressure of either CH₄ or CO₂, the desorption pressure is irrelevant to a large extent in that the pressure drops close to atmospheric and hence it is the gas that desorbs at the fastest rate that drives the outburst mechanism. For that reason CO₂ has a lower threshold and is a potentially more dangerous gas for outbursts.

Xavier – How far behind the face would you consider the pressure would drop to atmospheric pressure?

Mark – I don't know, it varies with conditions at each outburst site. I mentioned previously that development rate has nothing to do with outburst initiation based on explanations of mechanisms which show a flat gas pressure gradient up to near a structure then a steepening of the pressure to very high at and just in front of the outburst structure. Around a lot of structures, the stress is there prior to mining and the permeability is near zero. Around these structures, because the permeability is so low, you cannot drain the gas. So you cannot just mine slowly up to them hoping to drain more of the gas. It is not until the structure is mined into that the desorption pressure is dropped and the gas is released.

Ray Williams - Xavier's modelling shows the differences in gas desorption pressures are a driving mechanism in outbursts, therefore, for the same gas content, CH₄ outbursts should be more severe or more prone than CO₂ outbursts. From his modelling, I doubt you would see a CO₂ outburst as the desorption pressure is so low with CO₂ that nothing pops out. Desorption pressure is important for breaking barriers. For gas contents, it is important to know the desorption pressure. Also, if you are mining up to a mylonite zone, if you have high desorption pressure, the gas is going to blow the barrier out sooner for CH₄ than for CO₂. The difference is you are mining the coal and cutting the barrier, so the outburst occurs. One of Xavier's questions was how do we view desorption pressure. The difference between desorption pressures for the two gasses is huge. For example, methane at 9 m³/t might have a desorption pressure of 2.5 MPa and CO₂ at 9 m³/t might have a desorption pressure of 0.5 MPa. So how do we get outbursts with CO₂ at all if desorption rates don't play a role?

Xavier – Some of the laboratory outburst experiments show that it is possible to induce an outburst at very low pressure such as 0.5 MPa if the material is very weak and already in a state such as highly sheared or like mylonite. But this is in association with a structure and the material state associated with the structure is important.

John Hanes, post script – At Leichhardt Colliery, mined in the Bowen Basin in the 1970's, the majority of the more than 200 outbursts were **not** associated with structures or mylonite. The coal was more heavily cleated than the Bulli seam and the cleats were mainly uni-directional, thus imparting anisotropic strength to the coal. Outbursts mainly occurred perpendicular to the cleat when the gas pressure exceeded the tensile strength of the cleated coal mass. As the permeability perpendicular to the cleat was practically nil, the gas pressure gradient near the face was very steep and over 2 MPa gas pressure was measured at 2 m into the face after an outburst. The fatal outburst in 1978 occurred from sheared coal on a reverse fault. It was an abnormal outburst, but the large areal extent of the sheared coal helped produce the 500 tonnes of coal involved. As shown at Leichhardt, outbursts can occur in the absence of structures.

John Weissmann, Queensland – Dennis, when you showed your data, I got the impression that you interpreted there was no difference in DRI to gas content line slope for both CH₄ and CO₂. Was that correct?

Dennis Black – That is correct. This is a very important point and separate to any changes to Bulli seam TLV differences in the slope of the CH₄ and CO₂ lines has a significant impact on the method used to determine OBTLV's for non-Bulli seam mines.

John – Then I would like to see your data in more detail as your interpretation is very different

from Ray's and my interpretation of our early data in 1995.

Dennis - That is my point. Instead of having the different gradients for the different gases, the recent data, regardless of location and composition, align consistently with the line presented.

John – My second point is when someone asks “is it safe to mine” and you have to sign it is safe, you need a clear set of simple guidelines and we have that now with just gas content. Even though Ripu's suggestions were empirical, they have been shown to work. To go forward and test the thresholds is difficult. I was asked 10 years ago whether I could design real time monitoring using piezometers etc for outburst prediction. In practice, the important factors are the pressure of the gas and how fast the gas gets out. How could you realistically change thresholds other than slowly as is being done at Tahmoor? When I worked at Tahmoor, they mined through some outbursts using remote mining, but no data were gathered. I accept that if you do not have data around an outburst how can you back-analyse it?

Dennis – The experience at West Cliff and Tahmoor are good examples. Although increased from the original, prescribed thresholds they aren't greater than the levels originally proposed by Ripu. The difference is that where a gas content falls between the L1 and L2 threshold, intensive directional drilling, coring and even mining rate controls have replaced the outburst mining procedures (bomb squad). There is a real opportunity to use available technology such as measurement while drilling (MWD) to collect a lot more information about coal seam conditions ahead of mining. Piezometers aren't likely to offer any practical benefit in terms of outburst prediction. I have recently analysed piezometer response to mining and gas drainage which showed the slow rate of pressure reduction, particularly from deeply under-saturated areas where in certain areas the pressure remained above the critical desorption point up to the time of mining. These areas also experienced poor drainage performance.

Brad Elvy, Appin Colliery – As Appin gets deeper, as the seam starts to see 8 to 10 MPa gas pressure, will that change the threshold values?

Mark Blanch– I suppose the increased depth, gas pressure, stress etc will increase the propensity for outbursts. The structured threshold will remain relevant until we see reasons to change them. There is no real correlation between depth of cover and outbursts. At Moura they occurred at around 90 m depth and at Collinsville around 200 m. Gas content increases with depth (due to fluid pressures) and it is the increased gas pressure that increases the proneness, not simply depth of cover.

Ray Williams– The deeper the coal, the higher the stress, the lower the permeability, the more difficult it is to drain the gas. But if you get the gas down to the levels we have discussed there should be no problems.

Threshold Limit Value History and Regulator Perspective

Bill Barraclough, Area Manager, South East Region, Department of Industry & Investment

(Editor's Note: The following record of presentation has not been checked by the presenter for accuracy).

Prior to the thresholds being introduced, we had a history of fatalities and very-near misses and this should not be forgotten. Since the thresholds were imposed there have been no subsequent fatalities. The record of the threshold's performance speaks for itself.

Any application to the Department to vary the thresholds has to go to the Chief Inspector. I put it to you that if you were he, on what basis would you change those thresholds? You would have the same concerns the Chief Inspector would have. Is an extra metre of coal worth putting people in danger? Because we have not had a fatal outburst since the thresholds were introduced, does that mean there is a factor of safety built in? The previous speakers have said there is a factor of safety built in, but how big is it? Should we change the thresholds by 5%, 10% or what? On what basis do you make any change? I suggest to you that the basis should be plenty of serious research so there is some science behind it. I would recommend the research continue, if not escalate so we understand outbursts even more. From my point of view, there may have been missed opportunities for monitoring outbursts under remote mining conditions. Are we learning enough from those incidents by gathering enough data to add to our understanding of what an outburst is?

With some of the local mines targeting seams other than the Bulli seam, it is timely that the subject of potential outbursts in them is being addressed. Questions about whether these seams can be outburst prone, what the thresholds should be and how seam banding affects these parameters need to be asked. If you drill in-seam in the Wongawilli seam and take a check core, do you know which layer of the seam the sample comes from? Is the sample representative of the contents above and below that band?

I also want to recognise the importance of the commitment to their outburst management plans, of the companies, mine management and workforce since the West Cliff fatalities and I believe everyone here should be proud of that.

The Inspectorate, while we take a conservative approach, are open to applications to vary the threshold limits. But there must be serious science behind any applications. We do not want to allow the thresholds to creep up sufficiently high that we have a fatal accident. I don't think anyone would disagree with that.

Open Forum

Questions and Discussion

Bob Gordon, BHPB – What sort of information should we be investigating in the future and how can we obtain that information. Currently we do mine remotely at Appin and experience outbursts during that mining. What information should we be capturing? (Ed. See post script at end of discussion for some suggestions).

Bill Barraclough – In hindsight, if we had in-seam sensors we could have collected a lot of information.

Chris Harvey – In 1991 after the South Bulli outburst, there was a rush of research undertaken across the industry, even to the point of considering putting a radar on the front of a continuous miner, to identify changes in coal properties, structure, etc. Most of that research was taken to a certain point then dropped. In my mind this was because gas content thresholds were so successful at preventing outbursts. Now everyone focusses on the most efficient ways of draining gas to reduce the content below the threshold.

Overseas there has been work on trying to correlate coal strengths to outburst potential, monitoring changes in permeability during mining and using a number of parameters trying to include in a permit to mine, rather than relying on a single parameter.

Mark Blanch – I agree there is a good opportunity to gather data during remote mining, but it is an onerous task. Someone would be needed at the site all the time. You would need to collect gas content data, geological mapping, mining conditions and changes. This would produce a lot of data that would then need to be analysed and as we have seen today, different people can analyse data differently. But I agree, there is a great opportunity to improve our knowledge.

Mark Johnson, Queensland – A question to Garry. In Queensland we have Principal Hazard Management Plans, one of which is Outburst Management plans. We review them regularly. Within them we have trigger action response plans. In these we have physical indicators. The issue I have in Queensland is that we have had incidents at Central, North Goonyella and Collinsville (also more than 200 at Leichhardt, about 6 at Cook and a few at Moura back in the 1970's -Ed.). There is no real outburst experience amongst the miners in Queensland. Of the signs and indicators listed in the NSW outburst mining plans, have any of them been recognised by the miner crews and has production been stopped to investigate any of these signs? Is there any evidence to show that stopping mining on recognition of such indicators has prevented an outburst? Or is the gas drainage relied on totally?

Garry Horne – There have been numerous occasions when the crew have identified signs and stopped mining. Generally, the areas where they have stopped have been thoroughly investigated and re-drilled where necessary. Many times there have been unpredicted structures and on coring the gas contents have been above the thresholds. The men take outbursts very seriously and have a very good grasp of outburst indicators. They expect the information in an authority to mine to be accurate and they respect it. .

Mark Blanch – The diligence in the management systems in the Bulli seam mines is comprehensive, especially in those mines that have raised the thresholds, especially with regards to extra drilling and coring. In Queensland, there are a lot of people moving between mines and the experience base is just not there. So we need to be cautious that in transferring information between mines, we must remember that a lot of the measures are people dependent. For example at Appin, when they get into an area that won't drain and they revert to remote mining, the decisions made are based on the skills and experience of the various people involved rather than relying totally on there being systems in place. We must be cautious transferring information from Bulli seam mines to other mines.

Gary Parker, Integra underground Operations, Hunter Valley – Garry, what were the thoughts of the miners when West Cliff and Tahmoor raised their thresholds? Did management approach it well re the education process?

Garry Horne – I had a lot of involvement with the West Cliff application. I thought the mine's approach was good and they involved the workforce in consultations. I was comfortable with the work they did.

Ray Williams – Regarding remote mining, I would have thought BHP had a good system of geological mapping and data collection in place, not only for crossing the remotely mined zone but in other places also. There should be a wealth of information available. I would also think there should be a wealth of return gas monitoring available also. In areas where coring is not possible, if there is return gas monitoring, at least there is some data available. Also, regarding raising thresholds, I suggest the seminar committee invite West Cliff and/or Tahmoor to give presentations on what specific details of their outburst management plans they rely on to create no reduction of safety while increasing the threshold.

Bob Kininmonth, Outburst Seminar Committee – Please let us know to any member of the committee any other suggestions for seminar topics and speakers.

Naj Aziz, University of Wollongong – Question to Scott Langley, regarding your slide showing the use of N₂ injection for degassing coal, where has the injection been done? In West Cliff Colliery, has N₂ been used to reduce CO₂?

Scott Langley, BHPB – The slide refers to upcoming work not work done. We are looking to host two sites for ACARP trials, one at West Cliff and one at Dendrobium.

Naj – Our lab results show you can use nitrogen to remove CO₂ from the coal, double the amount for CH₄. If you don't use N₂ to remove CO₂ from the seam in Area 5 West Cliff, what will you do with that coal?

Scott – If the panels went full length we would get into subsidence problems around the river. Now we only have 3 panels left in that area, so would only have time for a trial rather than to make a difference. In Dendrobium, the CO₂ area is not due for mining until 2023, so we have sufficient lead time there for a good effort.

Bob Newman, retired ventilation engineer – I was at Tahmoor when the submission was made. That was a very minor change only and was well handled with a lot of co-operation from the inspectorate. It mainly relied on Ripu's work and his levels. Whatever is done now to change thresholds and whatever research is done to back the change, you get to the point where you have to tell a miner to mine the coal under the changed conditions. I think the typical miner driver would say “here are the controls. I will see you later”. If you work to a higher threshold limit, the gas will still be in the coal and it still has to come out. You might solve your drainage problems but you might worsen your ventilation problems. I feel from both those aspects we are better off putting effort into improving drainage than trying to raise threshold limits.

Mark Blanch – I agree Bob. Especially in thick seams, if you cannot get the gas below the thresholds, you will suffer on longwall extraction. So you need to focus on getting the gas down.

Chris Harvey – Regardless of the levels of your thresholds, the decision on whether to mine depends on drilling data. The accuracy of the drilling data must be fundamental to the decision - making process. In the market are a number of mechanisms by which you can link your drilling rig to a computer to get a complete log for each hole with respect to drilling parameters such as thrust, drilling rate, rotation, feed rate, water and gas return etc. We know our drillers are competent and well trained. But they are human and might occasionally miss important information. If you have the driller's log to cross check with automated data, you have a much more reliable information set. I am surprised nobody is using this technology.

Mark Fisher – I would like to ask the whole audience a question. I applaud the speakers as an

essential for the industry progress is ongoing debate. Firstly a comment to Garry Parker, although it is onerous, the nature of consultation on a sensitive issue when we are delivering a message to the workforce, is to get every workforce member's comments and input. Each workforce member's comment is our protection. If I redraw the typical outburst threshold diagram, I can show three horizontal zones (based on gas contents). In the lowest we have shown that nobody has been killed to date and we have certainty based on history and proof that we have drained below the threshold limit. The top zone is also one of certainty because all people have been removed from the area and there is no mining or there is remote mining. In the middle is a zone of uncertainty. It contains all sorts of conditions including boggy conditions, poor drainage, patchy drainage, cannot quite get authority to mine. Some local mines have raised their thresholds in these zones by improving their procedures, scrutinising their management plans etc. But there is a degree of uncertainty here as you can still encounter an unsuspected structure.

What I want to ask the audience is based on working for 30 years for BHP at the face as a mining engineer. I am not asking the question as a member of the Inspectorate. If you were the managing director of a company who wants to assure his workforce is safe or the parent of people working underground, would you prefer to see the threshold limit raised or lowered? The upper area is an area of uncertainty and unknowns. I believe that with regards to progressing the threshold limit research, the industry is lacking an Industry co-ordinated approach to research. The question is do we fund raising the threshold limits or do we fund removing people from the danger. I applaud Scott and BHP for their work in this area.

Alan Phillips, Metropolitan – Regarding permits to mine, I feel there is a need to challenge the men to check the details of the permits. They all need to question them in detail and to know them back to front. Not just the deputy. They need to be tested on their knowledge regularly. We rely on each member of the crew and all people involved with mining to know the details and to recognise any signs of danger. They are the last line of defence.

Brad Elvy, Appin - From Appin's perspective, our thresholds are slightly less than the industry standard. Over a 2 year period we have been looking at addressing this and trying to match our thresholds to West Cliff. It has not been an easy exercise as there have been 25 outbursts at Appin including the recent 2 under remote mining conditions. This means there are a lot of experienced people at Appin and consultation with them is very important. We are trying to refine the threshold lines through remote the mining process. We have a learning opportunity while we are mining above the thresholds. We have mined remotely in excess of 14 m³/tonne without an outburst occurring. What it comes to is a better understanding of the drilling process as most outbursts in the Bulli seam occur on structures and we have to better identify those structures ahead of mining. The position of the top line on the threshold diagram is controlled by better drilling and identification of structures.

As part of the Underground 21st Century Communications for Illawarra Coal, I have been working on getting computerised PLC programs on our drilling rigs so we can have a drilling co-ordinator watching where drills are going and what they are saying. There is more to be learned around drilling processes and structural mapping to help define the upper line. At the moment, Appin has only the lower zone for safe mining. Paul Maddocks (Tahmoor) suggested a need to involve more drillers in the seminars and to have some presentations on drilling matters, similar to the workshops that used to be run by John Hanes for ACARP. At Appin, our surveyors survey each hole to better understand accuracy issues of the survey tool. They recognise the need to make sure the tools are fully calibrated and match their boxes.

Bob Kininmonth – We would appreciate presentations on these topics at future seminars. Please communicate your suggestions and nominations.

John Hanes, post script – In 2003, I completed a report for ACARP titled “SCOPING STUDY - OUTBURST MANAGEMENT IN AUSTRALIA”. It summarised the status of outburst knowledge and research at the time and suggested avenues for further research and development and for what information could be gathered from mining in outburst prone conditions. Some of these suggestions have been furthered (e.g. Dennis Black's research reported at this Outburst Seminar and the University of Wollongong's Outburst website as developed by Naj Aziz, both with ACARP sponsorship). The report on the scoping study is available from ACARP.

Throughout my many years of association with ACARP, I found a dominant problem with regards to outburst understanding and research was with regards to efficient communication of information. Today's seminar and all the Outburst Seminars organised by this committee since 1995 have had communication of information as the prime priority.

These Seminar notes are sent to participants of the seminar, to interested researchers and to each gassy mine and Inspectorates in NSW and Queensland. The latter two groups get unbound copies to facilitate copying and distribution to their employees and other locally interested people.

If you have read this far in the notes, could I please trouble you to send me an email message with the words “Read OB notes” in the title so the Committee can get an idea of how well we are succeeding in getting the Outburst information out or whether apathy reigns. If you include your workplace name, it will give a better idea of where information is flowing. Your privacy will be honoured, but I will add your email address to our (blind copy) list for information about future seminars, unless you request not to be added.

Emails to : hanesj@optusnet.com.au

Next Seminar

The next Outburst Seminar will be held at the usual time of 1:30 pm on Wednesday 1st December. It will be preceded by a half day workshop run by Coal Services for which a nominal fee will be charged to cover costs. Details of both events will be circulated in November.