Appendix M – MSHA Technical Support Memoranda on UBB Floor Bursts

Rick / Jon B.

U.S. Department of Labor

Mine Safety and Health Administration
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Roof Control Division 04AA34

3/8 Bill: Thought you may find this interesting

Signature John Pyles

March 4, 2004

MEMORANDUM FOR JOHN M. PYLES Initials JMP
Acting District Manager, CMS&H District 4

Signature

THROUGH: EDWARD J. MILLER
Chief, Pittsburgh Safety and Health Technology Center

Signature - Joseph A. Cybulski

for M. TERRY HOCH
Chief, Roof Control Division

Signature

FROM: JOHN R. COOK
Mining Engineer, Roof Control Division

Signature

SANDIN E. PHILLIPSON
Geologist, Roof Control Division

SUBJECT: Evaluation of Controls on Floor Bursts at Performance Coal Company, Upper Big Branch Mine - South, MSHA I. D. No. 46-08436

Summary

As requested by CMS&H District 4, an evaluation of the controls on a floor burst that occurred on February 18, 2004, was conducted on February 24, 2004. Observation of maps prepared by the mine, combined with underground observations of subtle geologic features and information supplied by mine management, suggest that several factors may have contributed to the formation of the floor fracture from which natural gas was released: (1) critical overburden value of 1100 feet; (2) critical Eagle/Lower Eagle interburden thickness of 12 feet; (3) location of barrier pillar in the overlying Powellton seam; and (4) projected zone of geologic weakness. Although these factors may have influenced the formation of the floor fracture, the source of gas is more likely

to be a pressurized geological reservoir, rather than bleed-off from a coal seam. Thus, the Lower Eagle coal seam may have trapped gas beneath structurally high areas, but it is less likely that the Lower Eagle coal seam is the actual source of the gas.

The mine has prepared a variety of maps to portray overburden, interburden, overmining, and structural contour relationships and appears to have devoted considerable effort to understanding the controls on the floor bursts. Mine personnel reported that, in the subsequent longwall panel, degasification wells will be developed into the Lower Eagle seam in an attempt to decrease the potential for future outbursts. This appears to be a reasonable plan. Additionally, the construction of a hazard map, identifying overlapping zones of overburden in excess of 1100 feet, Eagle/Lower Eagle interburden of less than 13 feet, structural domes and arches in the Lower Eagle seam, position of barrier pillars in the overlying Powellton seam, projections of lineaments and the identified slickenside zone are suggested.

In addition to the authors, the following persons were present during the underground evaluation or related discussions:

George Levo, Senior Mining Engineer, Performance Coal Company
Bill Downey, Longwall Coordinator, Upper Big Branch Mine
Don Winston, Mining Engineer, CMS&H District 4

Background

As requested by CMS&H District 4, an evaluation of the controls of a floor burst that occurred on February 18, 2004, was conducted at Performance Coal Company's Upper Big Branch Mine on February 24, 2004. The floor burst occurred at approximately 40-41 Crosscut in the Headgate 17 Longwall Panel, and gasses issued from a fracture in the floor behind the shields that was reportedly up to 240 feet long (Drawing 1). Reportedly, the crack was most prominent at shields 106-107, just to the tailgate side of mid-face. The fracture was aligned parallel to the face, and occurred within approximately three crosscuts of where the longwall face was planned to cease extraction in this panel. Bottom heave was reported at the face, tilting the longwall shearer away from the face toward the shields. At the time of the outburst, the employees were said to have heard a "big thump" that they associated with the sound that the overlying sandstone usually emits upon failure. Both before and after the outburst, it was noticed that the shields were taking weight and yielding. Employees working in the Headgate 18 section, on the opposite side of the subsequent longwall panel from the outburst area, reported that they heard a thump. The shearer had been down for about 20 minutes preceding the event, thus the face was idle. The outburst occurred at 11:40 Wednesday morning and the longwall face resumed production on Friday evening.

A similar, but apparently higher pressure floor burst occurred in the previously mined adjacent panel in July 2003 at approximately 49 Crosscut. Mine personnel reported that this outburst event was also associated with formation of a floor crack that was parallel to the face and in the approximate center of the face behind the shields. Mine personnel described the July 2003 outburst as a very high pressure event, comparable to the sound of a jet engine. Mine personnel indicated that, although accompanied by a high level of noise and rapidly rising methane levels, coal outbursts or coal ejections were not associated with the events. It was reported that the Harris Mine, also in the Eagle seam adjacent to the Upper Big Branch Mine, has experienced similar floor bursts.

The Upper Big Branch Mine is developed in the Eagle coal seam, which is overlain in different areas by up to six mined coal seams. The Powellton seam is 170 feet above, the Cedar Grove is 430 feet above, the Hernshaw is 640 feet above, the Winifrede is 720 feet above, the Coalburg is 820 feet above, and the Five Block is 1075 feet above the Eagle seam. The Lower Eagle seam, which ranges in thickness from approximately 12 inches to 2 feet, lies variably from 5 to 25 feet below the Eagle seam and has not been mined. Maximum overburden thickness on the Eagle seam is just over 1200 feet and ranged from -1000 to 1200+ above the two floor burst locations. The interburden between the Eagle and Lower Eagle seams at both floor burst locations was 12 to 13 feet. Based on observation of overlay maps, it appears that only mine workings in the Powellton, Cedar Grove, Hernshaw, and Winifrede seams occur above the Upper Big Branch Mine. A barrier-to-pillared transition area in the Powellton seam occurs directly over the area of the recent floor burst on the Headgate 17 Panel, as does a room-and-pillar working in the Winifrede seam. It was reported that the longwall had been struggling with difficult roof conditions prior to the outburst, possibly due to this barrier in the Powellton seam above.

The mine has constructed a series of contour maps that portray the overburden thickness above the Eagle seam, the interburden thickness between the Eagle and Lower Eagle seams, the structure contours on top of the Lower Eagle seam, and the thickness of the Eagle seam. The mine interprets the major controlling factors on floor burst events as an interaction between high overburden (1100 feet) combined with a thin interval between the Eagle and Lower Eagle seams (<13 feet).

Observations

Observations began in Headgate 17 opposite the longwall face, at approximately 38 Crosscut. Observations were conducted to evaluate the possible effects of an overlying barrier/gob boundary that is located in the Powellton seam. The roof of the #2 Entry was composed of gray shale that hosted extensive carbonized plant debris and exhibited significant delamination adjacent to and behind the longwall face position. Observation through the open crosscuts indicated that the roof had caved behind the longwall shields, including #3 Entry and portions of the crosscut between Entries 2 and 3. It appeared that the proximity of the longwall face exerted more influence on roof conditions than the overlying barrier/gob boundary in the Powellton. Any observable effects of the barrier/gob boundary were subtle. Observations proceeded to approximately 44 Crosscut/#1 Entry to include the transition beneath both barrier pillars and the pillared gob in the Powellton. Although there were variations in the degree of rib sloughing and roof degradation, there was not a marked change that could be clearly associated with overmining. A series of irregular slickensides were observed in the #1 Entry traverse and appeared to be of the compaction style.

Observations resumed in Headgate 18 in the #3 Entry/26 Crosscut intersection. The traverse proceeded up the #4 Entry to document any geological structures that might project from the floor burst locations. Between 36-41 Crosscuts, a series of prominent slickensides were observed, although the remainder of the traverse was characterized by very regular, undisturbed roof and ribs. The slickensides were consistently oriented along a bearing of between N 25-55° W and were mainly concentrated between 36-39 Crosscuts. The bearing of the slickenside zone projects through the July 2003 floor burst area that occurred in the Headgate 16 Panel. The February 2004 floor burst location is approximately 500 feet northeast of the line that connects the Headgate 18 slickenside zone and the July 2003 floor burst location (Drawing 1). Observations continued in the #4 Entry to 45 Crosscut and then returned down the #3 Entry to document the continuity of the observed slickenside zone.

Observations in Headgate 18 resumed in 65 Crosscut where two four-entry gate roads bounding a mined-out longwall panel are located in the overlying Powellton seam. Observations proceeded from 65 Crosscut to 80 Crosscut to document the transition from barrier to gob and back to barrier beneath the mined-out longwall panel. Only very slight differences in rib conditions were observed. Rib sloughing was very slight along the entire 65-80 Crosscut interval, and ribs were very straight with sharp corners. A slightly higher degree of rib sloughing was present outby the overmined area beneath approximately 1100 feet of overburden. This suggests that, at least before longwall extraction causes redistribution of stress, overburden exerts more influence on rib condition than overmining.

Discussion and Conclusions

Several factors may have influenced the two floor bursts that occurred in July 2003 and February 2004. These factors include: (1) critical overburden value of 1100+ feet; (2) critical Eagle/Lower Eagle interburden thickness of 12 feet; (3) location of barrier pillars in the overlying Powellton seam; and (4) projected zone of geologic weakness.

Both outbursts occurred in areas that are characterized by 1100-1200 feet of overburden in combination with an interburden thickness between the Eagle and Lower Eagle seams of 12-13 feet and a thickness of the Lower Eagle seam of 1.25-1.5 feet. Although the February 2004 outburst site is located directly beneath a barrier pillar in the overlying Powellton seam, the site of the July 2003 outburst is located beneath a room-and-pillar section that is not indicated on mine maps to have been pillared. Additionally, observations of roof and rib conditions in Headgate 17 and 18 indicated that the influence of overmining is not readily recognized. Thus, although abutment stress associated with overmining may represent some influence, perhaps in conjunction with other factors, it is not clear that overmining is the most significant influence. If there is any influence of overlying barrier pillars in the Powellton seam, it appears to be slight and may be only manifested during longwall extraction as stress is redistributed during gob caving. Mine management stated that increased pressures were often experienced while longwall mining beneath barrier blocks in the overlying Powellton seam.

One of the interesting aspects of the fractures that developed in the floor appears to be their parallel nature to the longwall face. Mine personnel also reported that shield pressures increased dramatically in the center of the face concurrent with fracture formation and methane release. Furthermore, the shields that experienced dramatically increased pressure were approximately coincident with the extent of the subsequently formed floor fracture. Mine personnel reported that the fracture formed behind the shields. This may suggest that the position of the shield line, in conjunction with high overburden and thin interburden, may have significantly influenced the formation of floor fractures. It appears that the roof weighting was being transferred through the shields to the mine floor and may have produced the shearing force that fractured the interburden between the two coal seams.

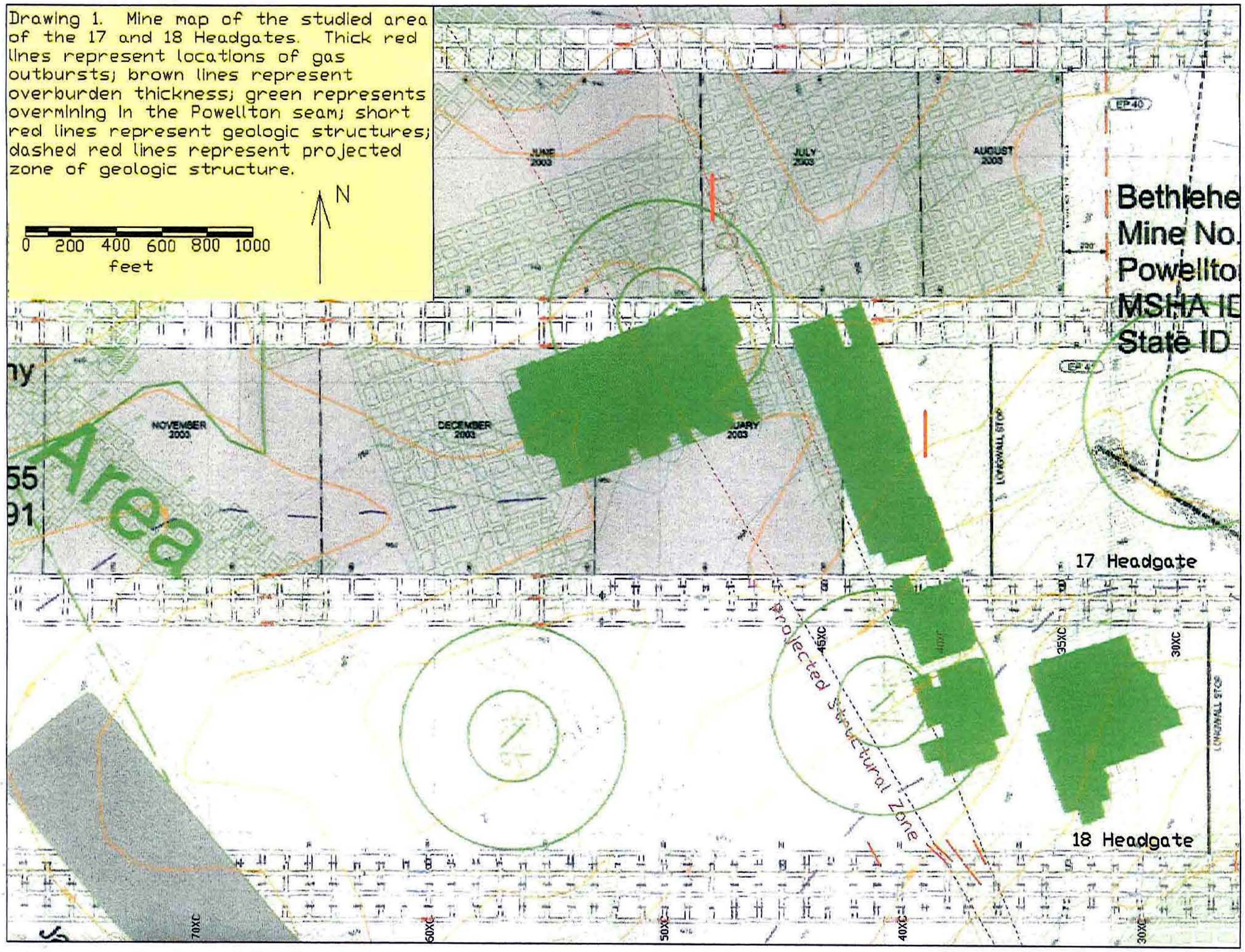
Another factor that may have influenced the formation of the floor fractures is represented by the zone of sub-parallel slickensides observed in the 36-39 Crosscut area in Headgate 18. Although by themselves the individual slickensides appear to be minor features, their occurrence within a restricted zone that projects through the location of the July 2003 floor burst site may be more than mere coincidence. The zone of slickensides could represent a subtle fault zone that is simply not expressed in the Eagle coal seam. Similarly, the slickensides might represent a change in lithology from sandstone to shale. In either case, the zone of geologic discontinuity could represent a dismembered block of rock that could have formed a cantilever effect onto the shields. In combination with high overburden and thin interburden, the cantilevered body of rock might then act as a platen on the shields, transmitting sufficient stress to fracture the floor. A similar situation is believed to have caused three pillars to burst in a coal bump at a Western longwall mine; the pillars were adjacent to a subtle fault zone that did not offset the coal, but did apparently dismember the roof beam, possibly allowing the hard sandstone roof to cantilever onto the pillars. Mine maps indicated that a lineament projects directly through the site of the February 2004 floor burst location, although no evidence of this lineament was found during the underground observations. However, lineaments commonly do not project vertically with depth, but instead may represent inclined fault or fracture zones, so that observations directly beneath the projected lineament might not reveal parallel geologic structures.

The reportedly extreme high-pressure outflow of the gas during the outbursts does not seem consistent with a usual occurrence of methane bleed-off from a thin coal seam. Although it has been assumed that the source of the methane is from the underlying Lower Eagle seam, it should be considered that the Lower Eagle seam may simply represent an impermeable caprock for a larger gas trap. Natural gas may be ponded in structural highs beneath the Lower Eagle seam, after rising into domes and subsequently being trapped from further rise by relatively impermeable coal or shale. Seam elevation contours on the Lower Eagle seam indicate that there is a local structural high area that trends northeast through the Longwall Stop-line of the current, Headgate 17 Panel. There is not a well defined structural high beneath the site of the July 2003 floor burst, although the contours indicate that this site is above the rising flank of the same localized structural high as the February 2004 event. It should also be noted that since the Lower Eagle seam has not been mined, seam elevation data is most likely limited to drill core and well logs. The spacing of these holes may not be sensitive to rises in the elevation of the Lower Eagle seam that could form domes, which could be acting as reservoirs for methane gas.

Mine personnel indicated that degasification wells are planned for the next longwall panel in an effort to bleed off any gas prior to encroachment of the longwall face. This appears to be a reasonable plan to reduce the future occurrences of floor bursts, but will not mitigate the floor fracturing that may be due to the other controls discussed. In order to more efficiently direct the placement of degasification wells, it could be beneficial to construct a hazard map, based on superimposing areas with 1,100 feet or more of overburden, less than 13 feet of interburden between the Eagle and Lower Eagle seams, the projected structural zone identified in Headgate 18, and overmined areas. Correlating these areas with the floor bursts that have occurred in the mine may reveal possible problem areas or the areas best suited for methane drainage holes.

If you should have any questions regarding this report or if we can be of further assistance, please contact John Cook at 304-547-2313 or Sandin Phillipson at 304-547-2015.

Attachment



Drawing 1. Mine map of the studied area of the 17 and 18 Headgates. Thick red lines represent locations of gas outbursts; brown lines represent overburden thickness; green represents overmining in the Powellton seam; short red lines represent geologic structures; dashed red lines represent projected zone of geologic structure.

U.S. Department of Labor

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Ventilation Division

JUL 15 2004

MEMORANDUM FOR STEPHEN J. GIGLIOTTI Initials - RK
Acting District Manager, Coal Mine Safety and Health,
District 4

Signature

THROUGH: EDWARD J. MILLER
Chief, Pittsburgh Safety and Health Technology Center

Signature

JOHN UROSEK
Chief, Ventilation Division

Signature

M. TERRY HOCH
Chief, Roof Control Division

Signature

FROM: GEORGE AUL
Mining Engineer, Ventilation Division

Signature

MICHAEL GAUNA
Mining Engineer, Roof Control Division

SUBJECT: Methane Floor Outbursts at Performance Coal Company's Upper Big Branch Mine - South, MSHA I.D. 46-08436

Summary

On May 4, 2004, Acting District Manager, Coal Mine Safety and Health (CMS&H), District 4, requested assistance for controlling gas emissions from floor outbursts at Performance Coal Company's Upper Big Branch Mine. On May 26, 2004, a meeting was held at the mine site to share information with Performance Coal Company personnel pertaining to floor methane outbursts encountered in other Appalachian coal seams. Those in attendance are listed in Appendix A.

The Performance Coal Company operates the Upper Big Branch Mine located near Whitesville, West Virginia. Coal was extracted from the Eagle Coal Seam using both continuous mining machine and longwall mining methods. The mine has encountered floor outburst problems associated with longwall retreat mining.

In the Pocahontas No. 3 coal field, floor outbursts were determined to be associated with methane trapped in fracture zones below the coal seams. Methane was released from the underlying fracture system(s) through the stressing and/or stress relief of the underlying strata from the longwall panel extraction. Experience suggests that locating and degassing floor methane zones through a drilling program was highly problematic. Consequently, because of the uncertainties with floor methane outbursts, the historical means for handling the situation relies on contingency plans to mitigate such an event. Items to consider include increased air quantities along the longwall face and in the bleeder system, training, safety procedures, ground condition monitoring, mitigation plans, and gas sampling.

Background

The Upper Big Branch mine experienced a floor methane outburst in February 2004 on the 17 Longwall panel. Previously, a similar floor methane outburst occurred in the adjacent 16 Longwall panel in July, 2003. It was reported that the Harris Mine, also in the Eagle seam adjacent to the Upper Big Branch mine, has experienced similar events on longwall panels. As requested by CMS&H, District 4, information was shared with Performance Coal Company personnel pertaining to floor gas outbursts encountered in other Appalachian coal seams.

Discussion

The floor methane outbursts encountered at the Upper Big Branch Mine have a stratigraphic similarity with outbursts encountered in the Pocahontas No. 3 Coal Seam in Virginia. In the areas that the outbursts occurred, the mined coal seam is near the base of the existing coal series in the region. The Eagle coal seam is the lowest mineable coal seam at the base of the Kanawha Formation. The stratigraphically lower New River Formation containing the Beckley coal series and the underlying Pocahontas Formation containing the Pocahontas coal seams do not exist.

In the Pocahontas No. 3 Coal Seam, the floor methane outbursts were determined to be associated with gas trapped in reservoirs deep below the coal seam. Methane was released from the underlying fracture system(s) through the stressing and/or stress relief of the underlying strata from the longwall panel extraction. The gas from under the Pocahontas No. 3 seam possessed a different composition than the gas associated with coal bed methane, indicating a non-coal bed, deeper source for the gas. It is suggested that a similar mechanism could account for the Upper Big Branch mine outbursts. This mechanism is considered likely since the outbursts do not occur during section development and only are associated with longwall panel extraction.

Gas reserves exist below the coal seam in the Upper Big Branch mine area. Numerous gas wells are present on the property which reportedly target gas sands situated approximately 2,500 feet below the Eagle coal seam. Consequently, methane trapped in zones below the Eagle Coal Seam could be released into the mine through fractures opened by longwall coal extraction. Gas analyses of the Eagle coal seam gas and the floor gas have not been completed. A comparison of the hydrocarbon content of the two gases may reveal the source of the gas.

Considerations

Locating and degassing floor methane zones through a drilling program is highly problematic. The fracture zones are not visible underground and their position can only be ascertained as generalized trends. The locations of the gas zones are revealed by methane released from fractures produced by disturbance of the extracted longwall. Gas well stimulation programs may not be effective if the well is not located in the exact area of the gas zone.

Consequently, the historical means for handling the situation relies on contingency plans to mitigate such an event. Items for consideration include:

1) Increased longwall face airflow will more effectively dilute the methane released from the outburst closer to the source and safely remove it from the face area. Increasing airflow after an event does not address the condition when the hazard potential was greatest.

2) Provide adequate ventilation in the longwall bleeder system. A floor gas outburst can occur in the caved zone behind the longwall shields. Increased airflow in the bleeder system would be more effective in diluting additional gas released by the outburst. Airflow in the bleeder entries can be improved by removing restrictions, such as water. Bleeder system performance is paramount for providing adequate dilution of gob gases, especially near the active areas.

3) Be aware of the conditions associated with the occurrence of an outburst, such as approximate panel position. Insure that all crews recognize that mining has advanced into a zone with a potential for a floor outburst. Consider developing a plan to outline procedures to manage the sudden release of gas from the floor outburst. Insure that all crews understand the plan especially with regards to personnel restrictions and removal of electrical power.

4) Use any precursors such as rapidly yielding shield legs or unusual noises to indicate that a floor outburst may be initiating. Monitor shield leg pressures in outburst prone areas so the longwall crew can be rapidly removed from the face.

5) The floor outburst zone appears to be in close proximity to future longwall stop positions. Consequently, ventilation requirements and examinations during longwall recovery operations in areas susceptible to floor outbursts could be critical. Normally, longwall recovery operations are accomplished with reduced airflow, because the minimal mining alleviates methane problems. Longwall face airflow similar to that used for mining may be required during recovery.

6) Consider restricting cutting and welding activities in areas that have a high probability of floor gas outburst occurrence. If this type of work must be conducted, special precautions should be applied. Listed below are some procedures develop by other mining companies that have experienced similar problems:

- A diligent effort should be applied while checking for methane. Gas tests taken more often and closer than 1 foot from the floor may be useful in detecting gas emissions from small fractures in the floor.

- Gas checks should be taken underneath the pan line where methane may accumulate. Raising the pan line allows better access for testing and permits airflow to dilute accumulations of methane.

- Fire extinguishers, water, and rock dust should be at the work site.

- A welding mat or blanket may be used to catch hot material to prevent it from coming in contact with a methane feeder. After the work is completed, the hot material should be cooled and removed from the face area.

7) Consider developing a plan for sealing the fractures after the outburst occurs. Chemical grouts that are reactive with water may be poured or injected into the fracture to help slow the flow of gas. Store additional supplies near the longwall face so that they are readily available.

8) Should a methane outburst occur, it would be beneficial to sample the gas and immediately conduct an analysis for the higher order hydrocarbons. This gas chemistry should be compared to the composition of the Eagle seam(s) methane to determine if the gas is similar or dissimilar. The gas chemistry could determine if the source is coal bed methane or another methane source. A means for collecting gas would involve drilling a hole in the pillar rib in the face area and immediately installing a glue injection packer fitted with a closed valve. Coal bed gas could be accumulated in the hole and be collected for analysis.

If you should have any questions regarding this report, or if we can be of further assistance, please contact George Aul at (304) 547-2318 or Mike Gauna at (304) 547-2311.

Appendix A

Personnel Who Attended May 26 Meeting

MSHA Personnel

George Aul, Mining Engineer, PSHTC, Technical Support
Michael Gauna, Mining Engineer, PSHTC, Technical Support
Don Winston, Mining Engineer, CMS&H, District 4

Performance Coal Company Personnel

Tim Comer, President, New River Energy Corporation
George Levo, Senior Mining Engineer, Performance Coal Company
Mike Milam, Performance Coal Company, Upper Big Branch Mine
Bill Potter, Performance Coal Company, Upper Big Branch Mine

cc: ROOF(M. Guana)
Roof Control Files
VENT(G. Aul)
(D. Beiter)
(R. Stoltz)
Vent Files-SUB-D75

MSHA:TS:GAul:06/23/04:TRI:B2:304-547-2318:T\Pghvent/ghU big branch vent_1.doc