Australian Forensic Pty Ltd
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Our Ref: 205285Rpt01MN:rr

Your Ref: To be advised Attention: Andrew Smith, John Tolhurst

Date: 18 May 2020

By email only to
andrew.smith@dnrme.qld.gov.au
john.tolhurst@dnrme.qld.gov.au

The Manager
Mines Inspectorate (Coal)
Department of Natural Resources, Mines and Energy
Mackay & Rockhampton Offices, Qld

(By email only)

FIRE INVESTIGATION

INCIDENT LOCATION Longwall 104
AngloAmerican Grosvenor Mine
MORANBAH Q 4744

DATE OF INCIDENT Wednesday 6 May 2020, about 2.57pm

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INTRODUCTION

On 7 May the writer was initially approached by telephone to assist in a fire scene examination at Grosvenor Coal Mine Underground Longwall Operations. In consequence of that and the following email exchanges, arrangements were made to travel to the site and meet with Queensland DNRME personnel and later attend to an examination of the area of Longwall 104. A copy of emailed instructions is attached as Appendix 1.

Under NFPA921[1,2], the nature of a fire or explosion investigation is, inter alia, to firstly identify the origin and then the cause of the incident. The cause is taken to be the circumstances, conditions or agencies that brought a fuel and ignition source together. The purpose of this report is to assist in your investigations.

BACKGROUND

Limited background information was available in accepting the brief. Five miners were injured in an underground fire incident. My report is based both on a site examination and certain assumptions arising out of discussions with your personnel, which follow in the content of this report. At this time, I am satisfied with that information, however should anything arise in investigations that you may consider might alter the assumptions, then provision of that information might be necessary, but in the light of the information at hand, it is not expected to significantly alter my interpretation of the available evidence.

EXAMINATION

OVERVIEW, DATA

Longwall 104 comprised a coalface of about 300m length between the Maingate and Tailgate with 149 Chocks numbered from the Maingate end. The coalface was typically 4.2m high with the overall profile rising slightly in elevation between Chock 1 and about Chock 90 then descending sharply through to about Chock 114 in the area of a fault and 3m ceiling cavity. The face profile obtained in briefings follows.

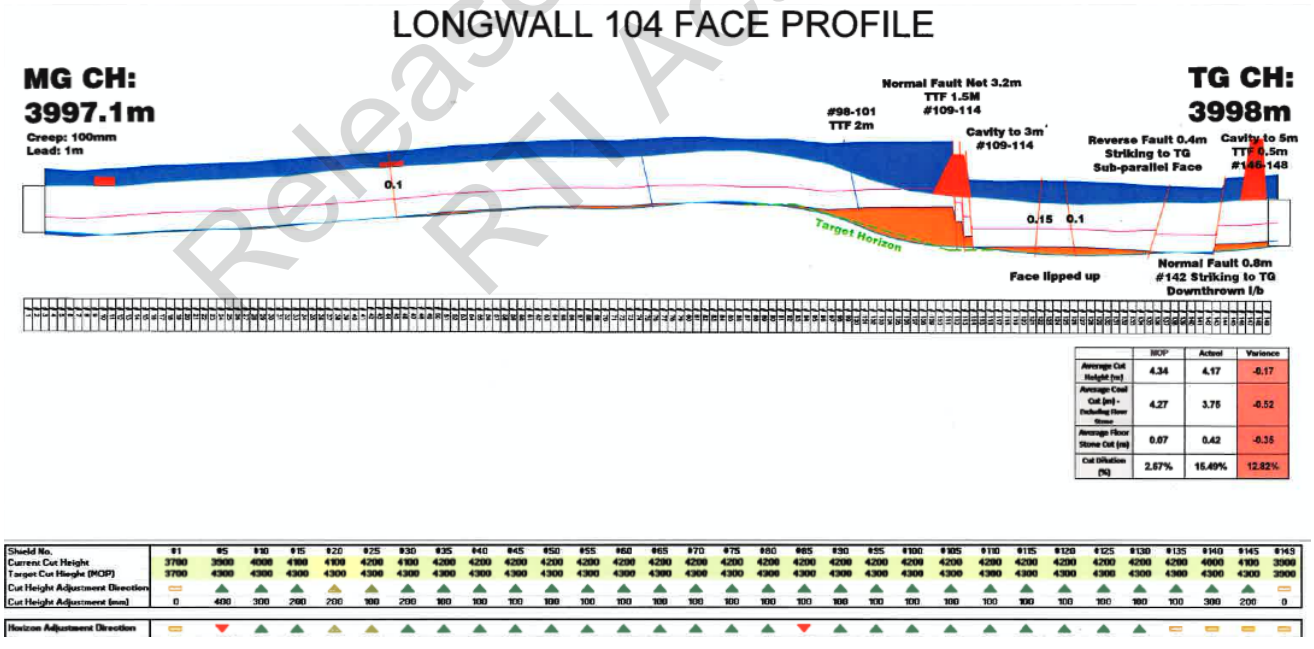


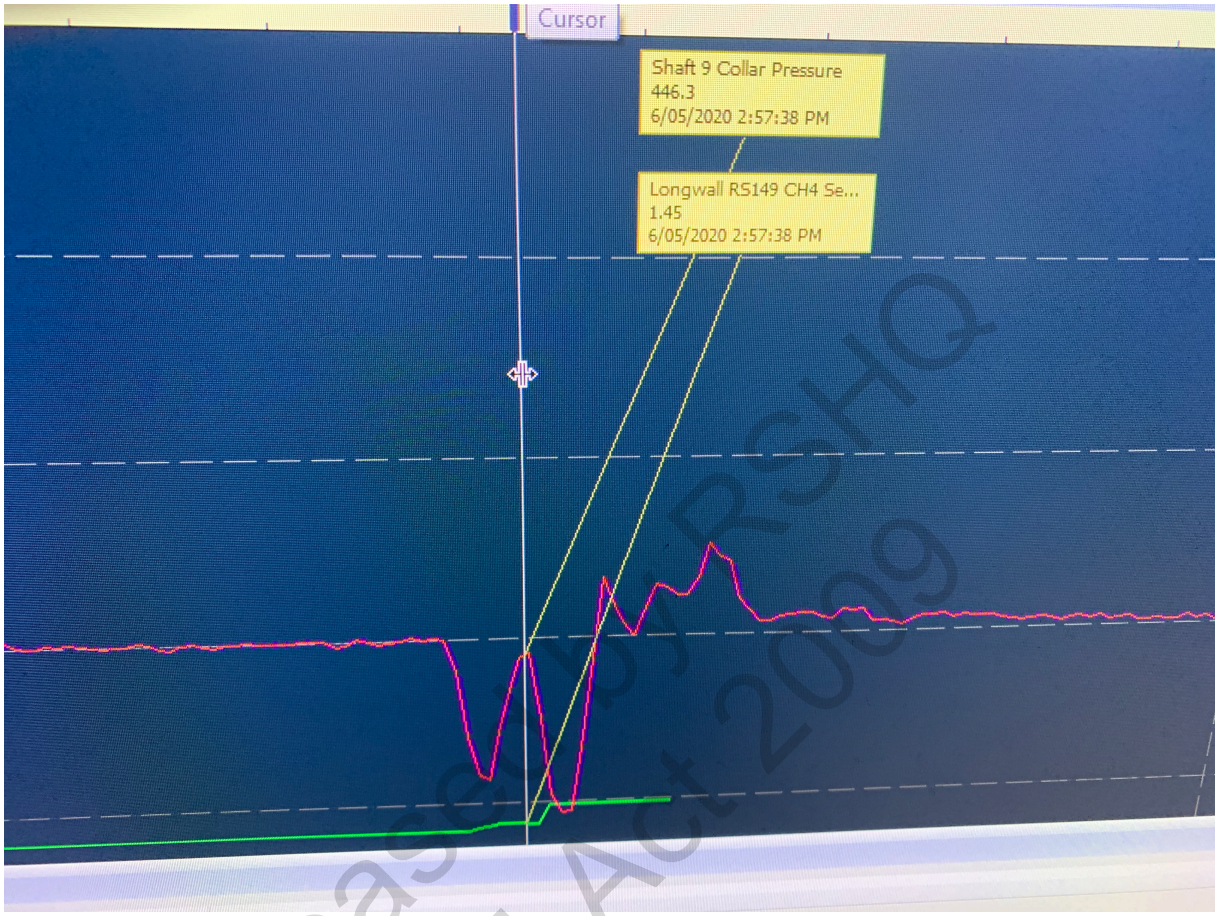
Image 1 The Longwall profile

Airflow was 70m^{3}sec^{-1} from Maingate to Tailgate, giving rise to varying air speed 2-3msec^{-1}.

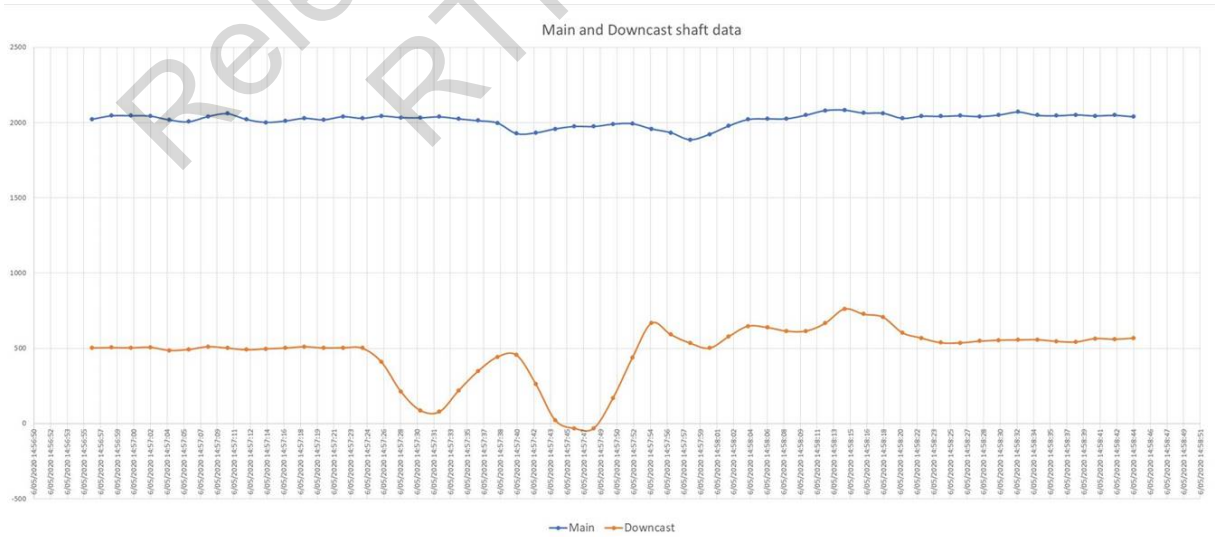
At the time of the incident, the Shearer was stationary in the area of Chock 120. A fitter, sch4p4(6) Perso had investigated the replacement of a lump breaker shaft on the Shearer. He was returning to the Maingate and was at Chock 5 when he felt a wind wave, then about 10-15 seconds later a second wave.

[1] National Fire Protection Agency, NFPA921 Guide for fire and explosion investigations, 2017 edition, Gaithersburg, Ma, cl 3.3.26
[2] Ibid, cl 4.2

Though I have not been provided a printout of data, I saw a screenshot of graphical data captured by Mark LYNDON, an electrical inspector of the Inspectorate, that confirms two spikes in pressure data measured at a goaf well about 15 seconds apart (Image 2) and an image of some other data (Image 3) collected by you. Though not familiar with the measurement tools, the data is meaningful to the extent that it comfirms the reported observations o sch4p4(6) Personal inform



Images 2 & 3 Reproductions of the screenshot and other data indicating two pressure waves



INJURED MINERS, LOCATIONS

Five miners were injured in the incident; their identities and locations were provided:

sch4p4(6) Personal informati

Chock 133
Chock 132
Chock 131
Chock 120
Chock 100

The writer understands that of these, sch4p4(6) Personal info suffered the most significant burns. The indicated locations of these personnel and sch4p4(6) Personal inf are provided by the representation of Image 4, where their names are given by their initials.

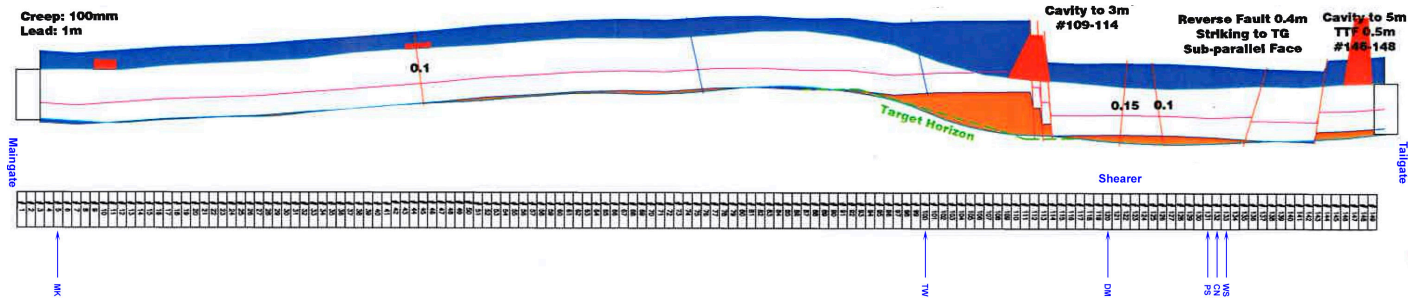


Image 4 Indicated locations of personnel

SEQUENCE

Beyond the initial data, the examination followed the sequence:

1. examination of items recovered from injured miners in a topside administration building
2. examination of the area of Chocks and the Longwall between the Maingate and Tailgate, extending to road 37 about 50m retreating along the Tailgate.

CLOTHING, BELTS

Bagged clothing items recovered from the personnel carrier were individually spread on a table for inspection. Items were photographed both by the writer and your investigator Inspector NUGENT. Those seen that seem to bear some significance are mentioned here. The damage sustained was indicative of sudden heat sufficient to melt light synthetic materials and cause some ignition. As such, this indicated temperature of several hundred degrees centigrade impacting, but only momentarily.

The shirt worn by sch4p4(6) Pers s seen in Images 5 & 6, and demonstrated most significant damage to the upper back. In Image 6, one notes that the predominant heat damage at the back is toward the left side.

Image 5 The front of the shirt worn by sch4p4(6) t Chock 131

Image 6 The back of the shirt worn by sch4p4(6) P

sch4p4(6) Pers's underground belt is seen in Image 7, viewed from the rear. The heat damage here appears to be consistent with the shirt damage, exhibiting most significant effect from the centre to left side.

Image 7 The underground belt worn by sch4p4(6) Pe

Damage to the underground belt worn by sch4p4(6) Personal is seen in Image 8. It exhibits local fire damage to the rear of the right hand side pocket. It tends to indicate that, with respect to the right pocket, a directionality from the left.

Image 8 Underground belt – sch4p4(6) Pers t Chock 133

The underground belt for sch4p4(6) Personal inform is seen in Image 9 and is burnt from the left.

Image 9 Belt from sch4p4(6) Perso at Chock 120

Of the clothing presented sch4p4(6) Pers demonstrated least damage. His belt is seen in Images 10

Images 10 & 11 sch4p4(6) underground belt from Chock 100

The writer saw some miners' helmets in the gear unwrapped. The writer could not make any meaningful observations about directionality of heat passage on those items. It is understood that other recovered items were secured elsewhere in the topside facility, but there was no opportunity for those items to be examined.

It is impossible to determine the standing or squatting orientation for the of each of the personnel at the time of the passage of the momentary atmosphere of several hundred degrees, though on face value alone, some consistency appears to emerge where the gear from Chocks 120 to 131 indicated heat travel from the direction of the Maingate, while the direction at Chock 100 was opposite, and the limited evidence also tends to point to development from their rears. Regarding orientation of personnel, however, discussions with Inspectorate members suggested that it may be expected that generally the personnel would face the coalface while at the time of the incident, sch4p4(6) Personal inf (Chock 133) could be facing the Tailgate while operating controls to move a Chock. Those orientations sit well with the consistency described.

UNDERGROUND

There appeared to be varying intensities of fire damage to combustible elements at the Chocks along the Longwall from about Chock 107 through to Chock 141. Very little heat damage was seen closer to the Maingate end. For example, the limited heat damage observed at the cover of the communications module and an overhead LED light at Chock 100 is seen in Images 12 & 13, while some degree of flame exposure was evident at Chock 101 (Image 14).

Images 12 – 14 Limited damage to fixtures at Chock 100 (above) with slight damage observed at some surfaces at the adjacent Chock 101

At Chocks 107 & 108 greater damage was observed to coverings on hoses (Images 15 & 16), and the cover on the communications module at Chock 110 (Image 17) suffered significantly greater damage than that at Chock 100.

Images 15 – 17 Increasing fire damage in surfaces from Chocks 107 to 110

The writer searched for other directional indicators. A label on Chock 107 (Image 18) indicated that a flame advanced across it from the Tailgate direction (from the left in this image), while other indicators nearer the Tailgate demonstrated flame advancement from the Maingate end. Image 19, for example, shows a plastic label over the elevated valve bank at Chock 123 that is melted from the Maingate side (right in this image) with local damage to the covering on adjacent hoses.

Images 18 & 19 Directionality indicia in plastic surfaces on Chocks 107 and 123 that point to a flame developing from between

Even though the hoses above the rear walkway of Chock 123 demonstrated local fire damage, the damage seen at some hoses over the rear over Chock 133, and the plastic label on its valve bank were more severely damaged (Image 20), while another burnt label was surrounded by a streaming surface character indicative of a fire developing form the Maingate end.

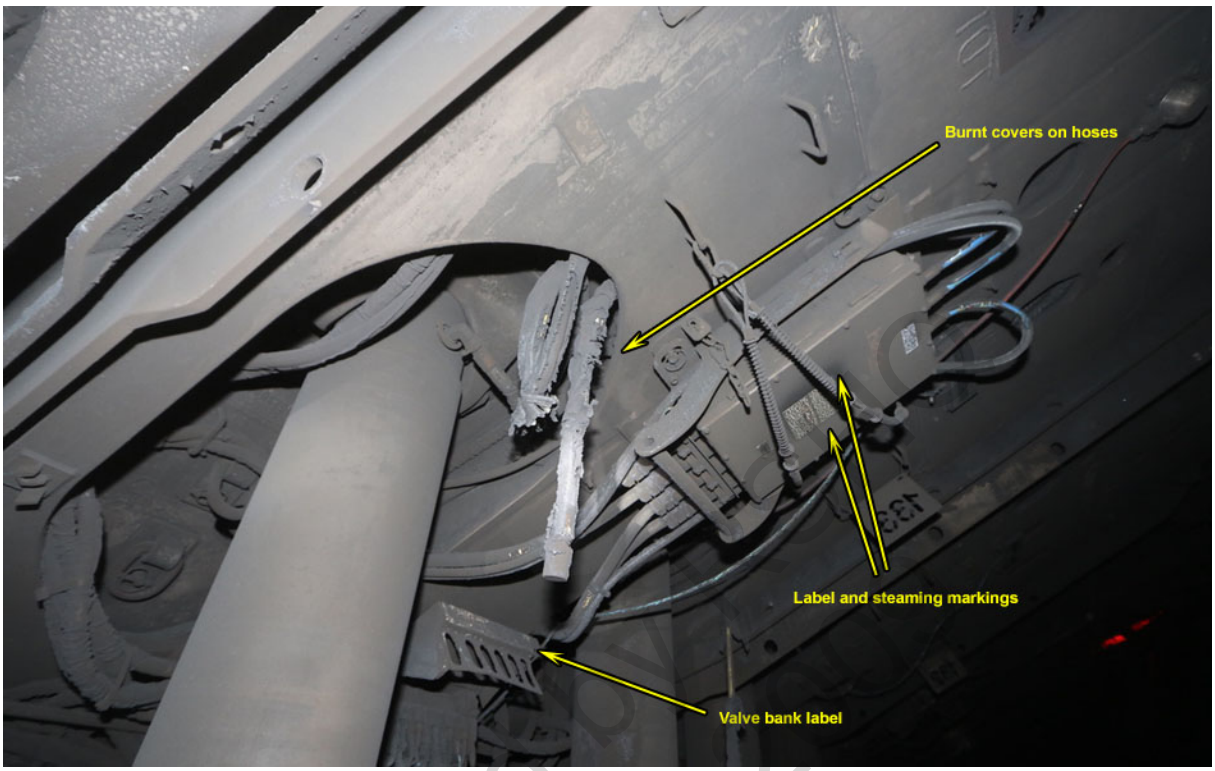


Image 20 Some evidence seen high at Chock 133

Such was the fire pattern. Both a general directionality and evidence of localised intensity were seen about the Chocks before the Longwall. The area of the valve back at Chock 136 provided evidence of more significant damage rearward of the valve bank and to its left (Tailgate aspect) while the plastic label was directionally burnt from the right (Maingate side) (Image 21).

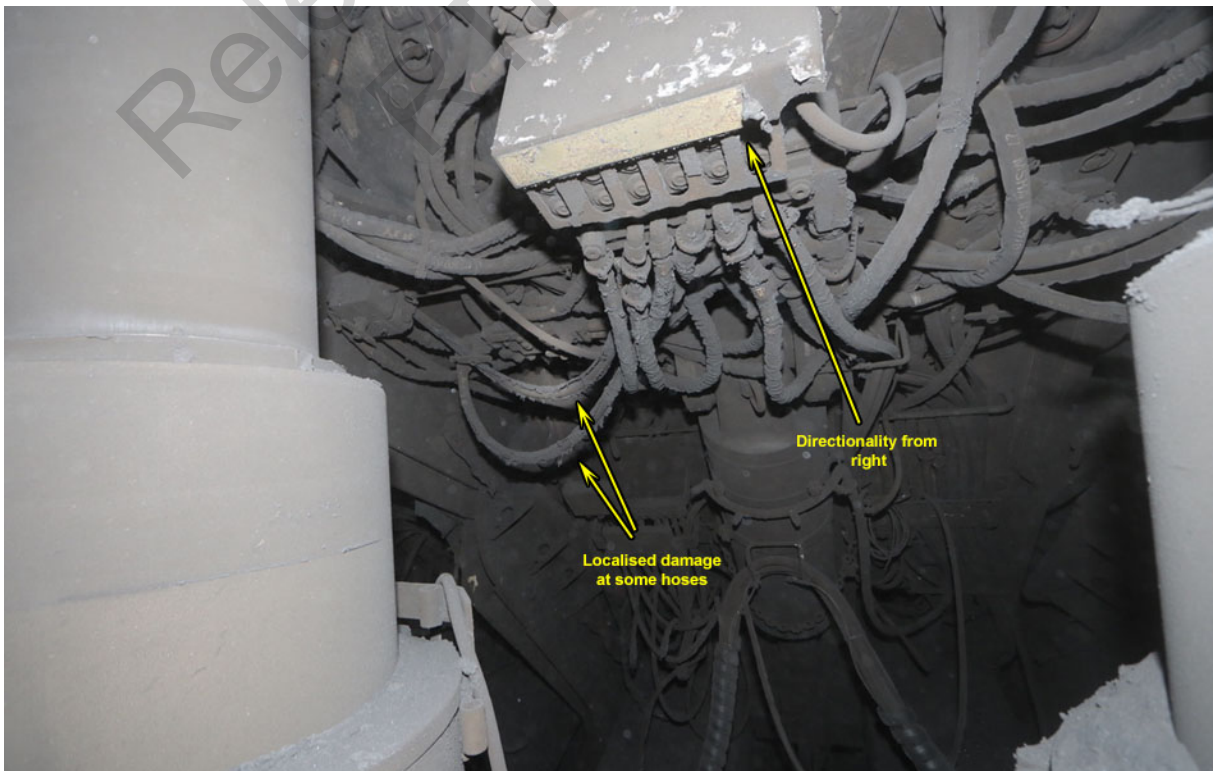
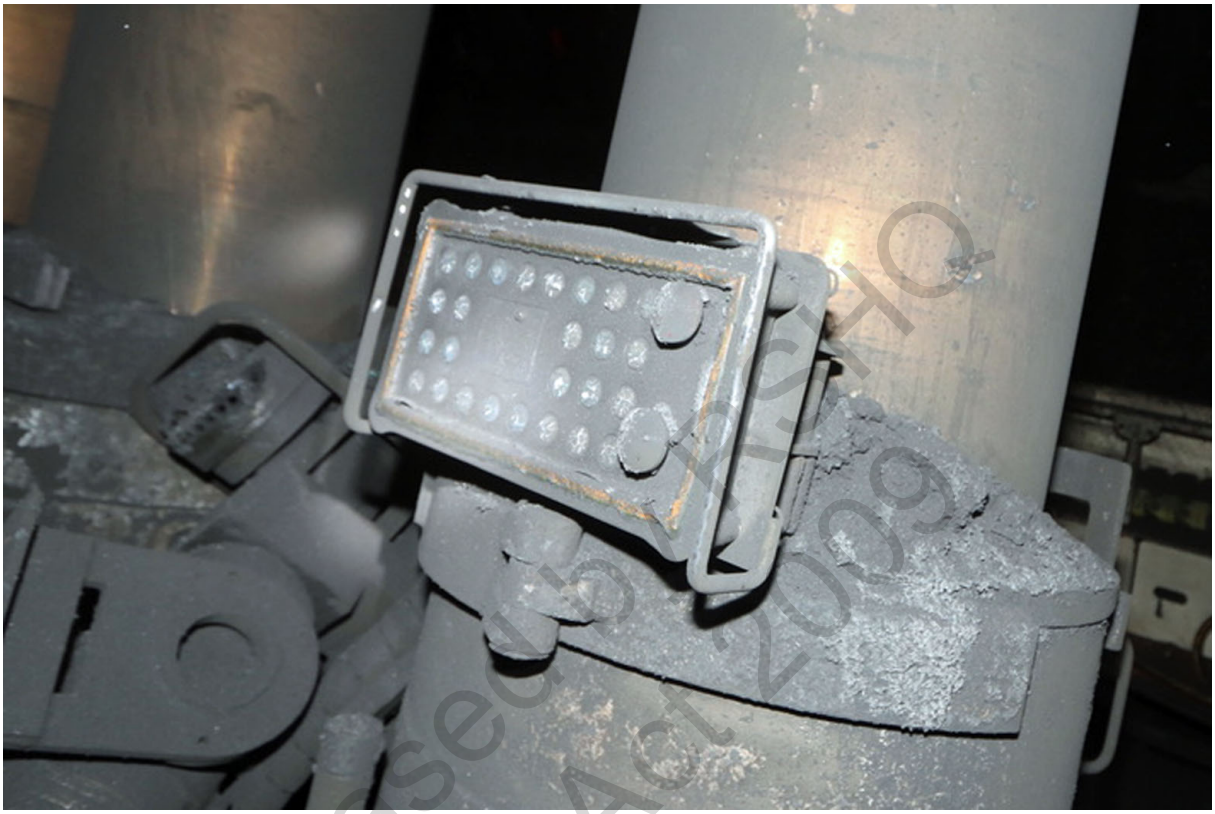


Image 21 Some evidence seen high at Chock 136

The damage appeared to diminish beyond the Tailgate end of the Longwall to a point just past the side access roadway number 37 in the Tailgate. By following the directionality indicia, I found that the general area of Chock 111, which demonstrated significant local damage, appeared to be the centre from which the directional indicators travelled. The extent of damage to a controller for Chock 111 is seen in Image 22. By contrast, the conroller in this position on the adjacent Chock 110 was substantially less damaged (Image 23), and overhead damage at the valve bank at Chock 111 was substantial (Image 24).



Images 22 & 23 Substantial damage at the rear controller of Chock 111 compared to lesser damage at Chock 110

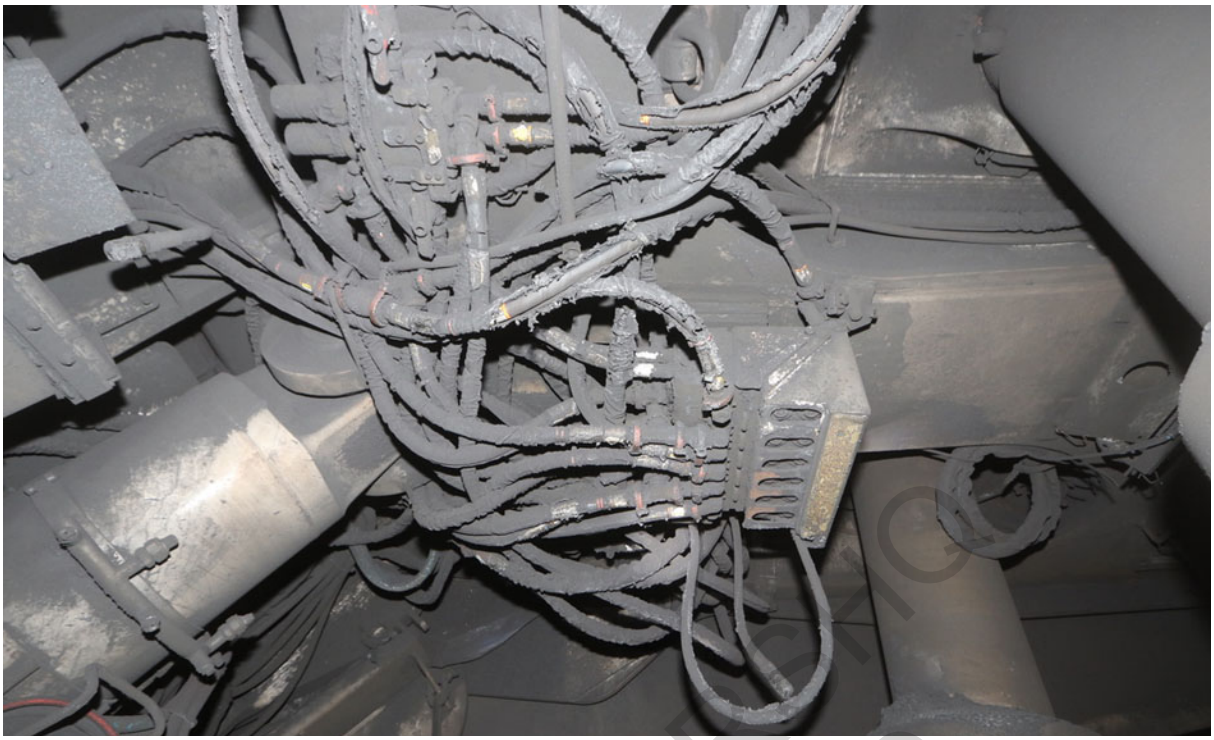
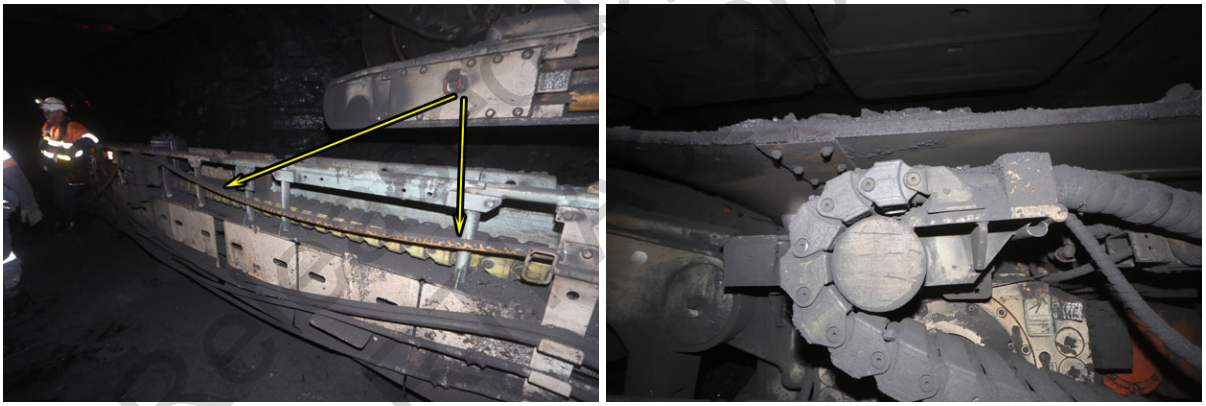


Image 24 The valve bank at Chock 111

Some reasonably low elevation fire damage was observed on cable covers and the bretby of the Shearer in the vicinity of Chock 120 (Images 25 & 26).



Images 25 & 26 Reasonably low elevation fire damage at the Shearer

The fire indicia both in the clothing and in the Longwall indicate to the writer, that

- there were localised areas of greater and lesser intensity of fire damage
- the generality of directional indicators appears to point to a firefront developing from the general area centering about Chock 111
- the fire patterns were mostly elevated, but some low elevation areas of intensity were observed
- the fire appears to have primarily developed in upper areas toward the rear, behind miners expected to be positioned at the pontoon walkway at the coalface side of the Chocks

Evidence of a number of separate areas of fire intensity is common, in my experience, to ignition in the vapour phase. This behaviour is typical of structural gas deflagrations. In my opinion, it is likely to relate to either the variations in stoichiometric mixing of the gas with air, the actual amount of gas in a location, or both. While methane has an explosive range of 5-15%, most energetic ignition occurs at around 9.5%.[3] So, even though sch4p4(6) Personal inf was said to have been the most badly burnt of the miners, this might only be due of the local gas concentration.

[3] Journal of Loss Prevention in the Process Industries 40 (2016) 507-523

Air movement by ventilation was estimated to be in the range 2-3msec^{-1}. Flame travel in the vapour phase varies makedly depending on a number of factors, but is typically orders of magnitude greater, so will overcome the ambient ventilation from Maingate to Tailgate.

The sudden overpressure is also likely to uplift fine particles. I would expect a pressure wave from methane deflagration to uplift coal dust and ignite it. This was evident in the evidence, such as seen in Image 27, where uplifted coal dust has ignited, but then condensed onto the side of the handle of a shovel from the direction of ventilation travel.

Image 27 Ignited coal dust has condensed onto the side of surfaces by passing ventillation

CAUSE

Examination for the cause of the incident was problematic by the very nature of the environment. It was impossible to explore the goaf for an ignition source. So, both a self heating reaction close to the back of the Chocks or spark ignition due to falling debris in the goaf appear plausible.

The first matter at hand was the issue of the two pressure waves. It was clear that there had been sudden collapse of the roof in the goaf, evidenced in Image 28 at the Tailgate about 15m to the rear of the Chocks. Whether it is possible that this was responsible for the first overpressure could be explored by examining historical data for previous blocks where roof falls have occurred. Such an examination of data could show the expected range of waves from such events for comparision. Geotechnical experts may also be of assistance.

The alternate possibility seems to be that there were two ignitions. Unless there is a way of locating data in support of this, one could not draw the conclusion, but it at least provides an explanation of the graphical data in Images 2 & 3 and the reported observations of sch4p4(6) Personal inf Assuming that the first overpressure was the result of the ignition of methane, the overpressure may have then caused distribution of the gas to create another pocket within the gas' explosive limits, which might have ignited at the same ignition source as the first. An alternate theory is the possibility that the second overpressure was the result of the ignition of coal dust uplifted by the intial pressure wave. The Inspectorate investigators have much greater experience in underground operations than the writer, so I defer to their expertise.

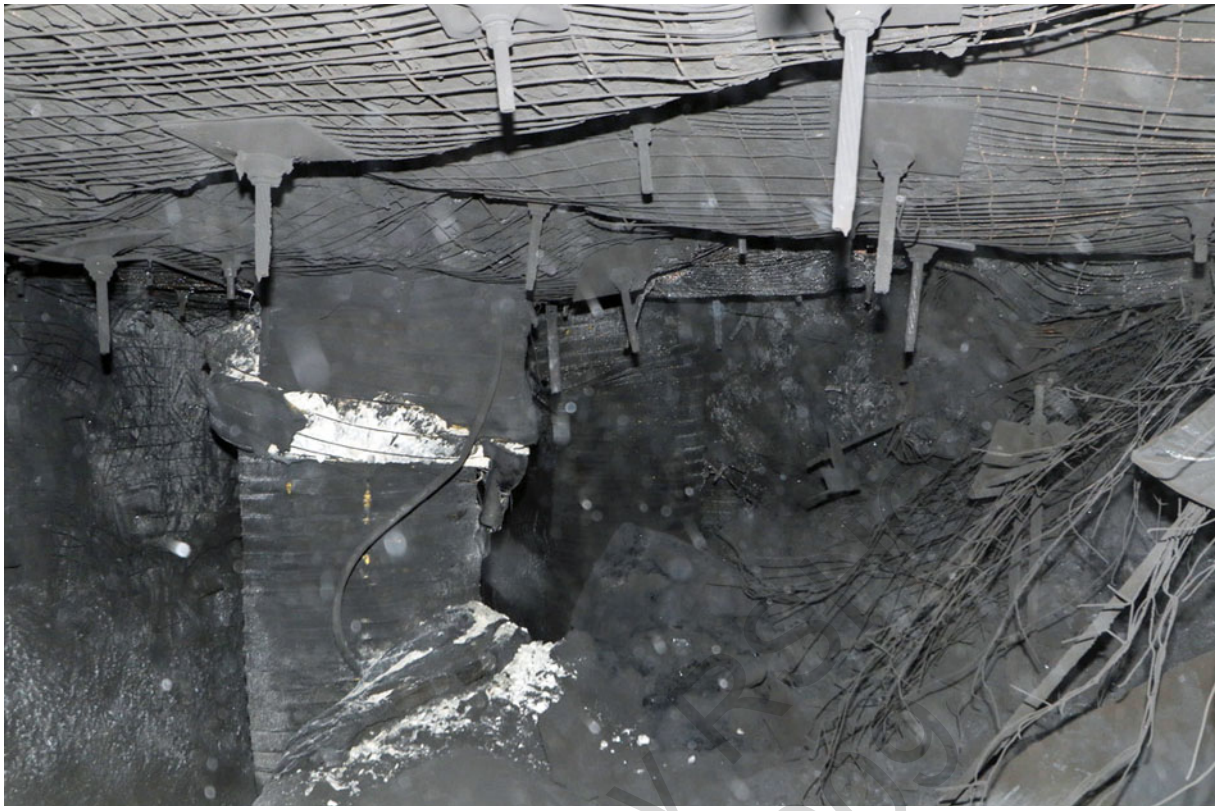


Image 28 Evidence of a roof fall in the goaf to the rear at the Tailgate

In undertaking my examination I was mindful to search for ignition sources within the Chock and Longwall area. None were seen. The Inspectorate electrical inspectors were on hand, and so were briefed with my findings relating to the directionality of the firefront from the vicinity of Chock 111. This in hand, it was suggested to undertake an initial examination of the electrical installations between Chock 111 and the Shearer.

When the writer examined the clothing items beforehand, nothing was seen to indicate a possible ignition source from contraband, though it has to be said that the items presented were not the complete clothing of the personnel at the Longwall.

I noted that while measures were in place to prevent airflow into the goaf, there were gaps between the Chocks of around 50mm through which I was able to see coal at the roof. In my view, it is possible that oxygen concentration at those gaps might be similar to ambient within the Longwall area, while deeper within the goaf, oxygen contration would be expected to be low, and methane concentrations higher than its explosive limit. Because of this, it seems plausible that if self-heating of coal could have happened to provide an ignition source, then the location would have to be close to the rear or top of the Chocks. It is also interesting that Chock 111, where the evidence suggested was centeral to the early flamefront, was below a 3 metre cavity (Image 29). This raises a question that gas in this cavity might have something to do with the initial ignition, perhaps because of the sudden disturbance by roof collapse elsewhere.

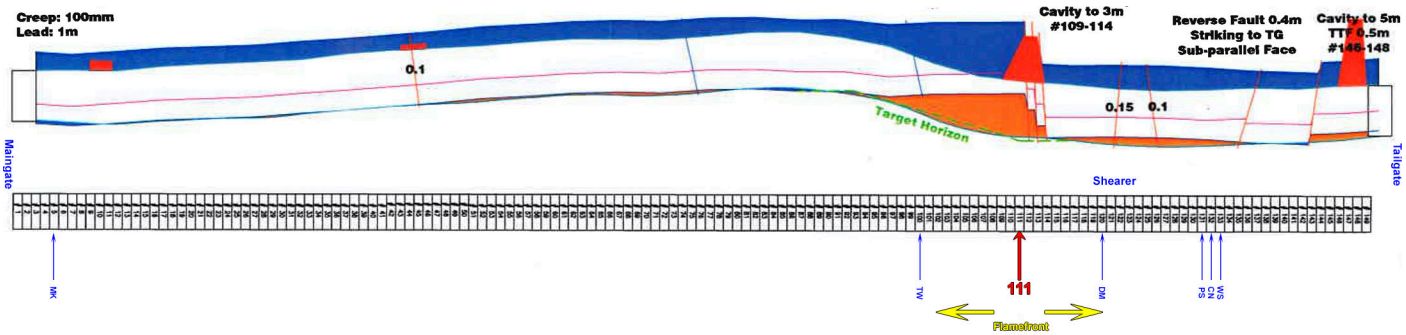


Image 29 The location of Chock 111

The link between the collapsed roof and the fire indicates that a wave of gas was suddenly pushed through the Chocks from the goaf in varying concentrations along the Longwall. Though the ignition source is as yet unidentified, it might have existed just within the goaf in the vicinity of Chock 111, and so the fire then spread to the left and right rapidly in the gas that contemporaneously entered from the goaf. If personal gas monitoring devices had not detected a rise in gas concentration, the suddenness of gas being forced through the chocks and immediacy of its ignition may provide the explanation.

CONCLUSION

The evidence indicates that the flamefront originated in the vicinity of Chock 111. Evidence in the sighted clothing from some personnel provides consistency, with fire appearing to approach from the right of sch4p4(6) Pe and from the left of sch4p4(6) Personal information The source of ignition is not yet concluded.

CLOSING

Though the cause was not established from my examination, it is hoped that the content of this report may be helpful in your ongoing investigations.

Yours faithfully
Australian Forensic Pty Ltd

sch4p4(6) Personal information

M.I. NYSTROM
BAppSc(Chem), Grad Cert Fire Inv, FRACI, FAIPI, CChem, MIFIREE, MIAAI, ANZIIF(Snr Assoc), CIP
Copy of emailed Instructions

Thursday, May 7, 2020 at 2:54:57 PM Australian Eastern Standard Time

Subject: FIRE SCENE EXAMINATION AT THE GROSVENOR COAL MINE
Date: Thursday, 7 May 2020 at 2:50:19 pm Australian Eastern Standard Time
From: SMITH Andrew
To: Murray Nystrom
CC: DOBSON Shaun, NEWMAN Peter
Priority: High
Attachments: image001.png, image002.jpg

Good afternoon Murray,

Further to my telephone call to you this afternoon , could you please confirm your availability to assist with a fire scene examination at the Grosvenor Coal Mine at the Underground Longwall operations facility. You would be required to attend the underground mine and be inducted onsite and conduct examinations on the longwall installation site. Any equipment such as Camera's and other detection equipment would be subject to examination by the Mines EEM to ensure that it is suitable to be taken underground into that environment. If available could you please indicate your likely arrival time into Moranbah so that we can liaise with you to facilitate your access to the mine.
If you are able to give an indication as to costings for Travel time/Klm's + scene examination + report it would be appreciated.

Please do not hesitate to contact me.

Queensland Government

Andrew Smith
Principal Investigations Officer
Mines Inspectorate (Coal) | Resource Safety and Health
Department of Natural Resources, Mines and Energy

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