**Q 4 What the evidence establishes about the nature and cause of the serious accident at Grosvenor mine on 6 May 2020, including:**

**The relative likelihood of a strata collapse or a methane explosion in the goaf being the mechanism by which an explosive concentration of methane was expelled on to the longwall face.**

**The relative likelihood of the ignition source being frictional ignition, electrical fault, static electricity or PUR induced heating/spontaneous combustion**

**Neither a strata collapse or a methane explosion in the goaf was “the likely mechanism by which an explosive concentration of methane was expelled on to the longwall face.”**

**The major source of the explosive concentration of methane on the Longwall face was in high probability the methane gas “bubbling out the floor”.**

**Depending on the location of the overpressure event and the way the pressure wave and “wind blast” travelled, will determine if it was possible for additional methane came out of the goaf onto the face or not.**

**We know from the evidence from the witnesses that the effects were much greater on the face near the tailgate than it was on the maingate.**

**I believe as I have posted previously that there are signs of an advanced spontaneous heating back as far as the 19th of March, when ethylene was detected by the Gas Monitoring System.**

**That being right at the back of the tailgate in the region of TG 104 C hdg 39 to 41 cut through.**

[**https://www.qldminingcrisis.com.au/2021/03/24/my-grosvenor-spontaneous-combustion-scenario-ethylene-detected-in-march-and-april/**](https://www.qldminingcrisis.com.au/2021/03/24/my-grosvenor-spontaneous-combustion-scenario-ethylene-detected-in-march-and-april/)

**https://www.qldminingcrisis.com.au/2021/03/18/britton-ventilation-arrangement-in-grosvenor-mine-designed-to-maximize-potential-losing-control-of-goaf-and-initiating-spontaneous-combustion/**

**https://www.qldminingcrisis.com.au/2021/04/05/the-theories-advanced-by-various-expert-witnesses-over-the-last-3-weeks-to-justify-their-theory-do-not-account-for-known-facts-at-grosvenor-ethylene-was-first-detected-39-to-41-c-t-c-heading-this-ar/**

**It was the methane gas bubbling out of the floor that created an explosive mixture within 13 seconds from the first “Overpressure Event”.**

**Due to the description of the effects of the explosion, it appears the Methane Ignition resulted in a Low Velocity Methane Deflagration/Explosion**

**As those on the face at the time of the face of LW 104 when the methane stated and testified; the ventilation on the face ceased altogether in the 13 second interval.**

**This has allowed the methane General Body level in the tailgate end of the face to increase from its roughly 1% normal concentration, up to (and likely in excess of), the lower explosive limit.**

**Because of the delay time in gas detectors, the rise to the lower explosive limit occurred faster than the methane detectors could detect and drop power off the face.**

**All the electrically powered equipment on the LW 104 face retained power and the recently repaired AFC continued to run up until power dropped off the face.**

**The exact time power would have dropped would be when the Bretby and Maingate Cameras ceases recording as it is on the same power feed, and should have stopped recording and transmitting when power dropped from the Face.**

**The actual ignition source appears to be located in the tailgate of the Longwall Face**

**The Grosvenor LFI Investigation Report or Serious Accident 06052020 identifies these as potential ignition sources in Section 6.6 on page 44**

**6.6 Ignition Sources**

***The following potential ignition sources were identified as part of the re-entry risk assessment completed following the event. Currently, the ignition source remains unknown and is part of the ongoing investigation into the cause of the event on 6th May 2020.***

* 1. ***Rock on rock frictional ignition***
	2. ***Spontaneous combustion***
	3. ***Air moving slowly over or through broken/uncompacted coal***
	4. ***Propensity of coal to spontaneously combust***
	5. ***Electrical sources***
	6. ***Batteries - Ignition Of methane or hydrogen***
	7. ***Cable damage/component failure/short circuit causing extemal electrical arcing (to apparatus)***
	8. ***Damaged cap lamp exposing hot filament as an ignition source***
	9. ***Diesel equipment unsuitable as installed/ faulty/ damaged/ modified***
	10. ***Frictional static discharge caused by compressed air or air movement e.g. Venturi***
	11. ***Lightning strike surface resulting in conduct to underground***
	12. ***Voltage surges***
	13. ***Contraband***
	14. ***Frictional heat contact of steel with rock Impact/Sparking - steel on steel.***
	15. ***Transport collision with steel structure***
	16. ***Embers or flames from surface fires***
	17. ***Hot particles from welding cutting around top of borehole***
	18. ***Sparking from fill material dropped down boreholes***
	19. ***Exothermic chemical reactions***
	20. ***Explosives***
	21. ***External surfaces internal combustion engines***
	22. ***Mechanical***

***It is recommended that each of the above potential ignition sources, and any subsequent identified potential ignition sources, continue to be reviewed.***

**REFERENCES USED**

**1) GROSVENOR LFI INVESTIGATION REPORT for SERIOUS ACCIDENT -06052020 (page 5 of 10)**

**2) MINEWORKERS STATEMENTS, RECORD of INTERVIEW and TRANSCRIPT (page 6 of 10)**

**3) 19.-LW104-GOAF-DRAINAGE-RISK -ASSESSMENT (page 6 of 10)**

**REASONS**

1. **Nine out of the 14 HPI’s were as a result of floor methane gas emissions between the 18th of March and 21st of April 2020.**
2. **Anglo made a decision not to attempt drainage of the floor seams.**

***“No pre drainage of the GML seam has been conducted for LW104 and is expected to release gas readily due to the GML reservoir size combined with proximity to the working seam up to approximately CH4000-2000 (MG104 20-36c/t”)***

***UIS drilling in developments in the GML floor seam indicates that it is not readily pre-drainable, however, whilst being drilled holes do release free gas from time to time. It is also clear that floor gas can be generated from mining induced stress.***

1. **Grosvenor Management identified through the LW104 Goaf Drainage Risk Assessment (GRO-10699-RA-LW104 Goaf Drainage) that floor methane ingress to the face would occur from the start of LW 104 commencing at 40 to 41 cut through.**

***1.13 Sudden floor emissions on the LW103 faceline***

***Where the GML seam is ~1m from the GM floor sudden emissions have occurred causing both shearer trips at 1.25% CH4 and shearer stoppages due to an increase in the TG CH4 to >2%. AGM.002.001.0984***

***Figure 11 shows the location of the longwall at the 2nd January when floor emissions were contributing to the LW stoppages. It can be seen the LW emissions occurred north of the region associated with development floor emissions. Prior to LW103, registering of gas spikes at the shearer was not common.***

 ***The gas originates from the GML seam, which when it is close to the floor of the GM seam, causes sudden emissions of gas into the longwall faceline.***

***In relation to shearer delays, Figure 12, note the 2% delays in the TG correlate to spikes measured at the shearer (white line) whilst the shearer is cutting to the TG. This must either be floor gas or gas from the cut***

1. **Grosvenor Management made a conscious decision NOT TO perform the floor gas drainage program that was identified and committed to as Part of the Risk Assessment GRO-10699-RA-LW104 Goaf Drainage that forms part of the Second Workings Procedures that must be provided to the Inspectors prior to Secondary Extraction Commencing.**

**I do not understand how after the Mines Inspectors got provided with the Second Workings SOP’s and Associated Risk Assessments; that they decided that it was “An Acceptable Level of Risk to the Safety and Health of Mine Workers” to allow mining to commence in LW104.**

**The quote below that is contained within the LFI will be dealt with in a later Submission dealing exclusively with 2nd Workings Notices to Inspectors as currently required under the Coal Mining Safety and Health Regulations 2001**

***“There were also discussions with the DNRME in advance of submitting the Second Workings SOP, particularly given the change in regulation, with no concerns raised.”***

**According to LFI Incident Number: IN.00226742 & IN.00228255 there were *“also discussions with the DNRME in advance of submitting the Second Workings SOP, particularly given the change in regulation, with no concerns raised.***

 **Incident Title: Withdrawal from Mine and Ignition of Gas LW104**

**Incident Date: 8 June 2020**

**Report Date: 24 January 2021**

***The strategy to manage C heading as part of the Tailgate 104 return was supported by ventsim modelling, detailed in the Second Workings SOP and submitted through to the DNRME.*** ***There were also discussions with the DNRME in advance of submitting the Second Workings SOP, particularly given the change in regulation, with no concerns raised.***

1. **GROSVENOR LFI INVESTIGATION REPORT for SERIOUS ACCIDENT -06052020**

**https://coalminesinquiry.qld.gov.au/wp-content/uploads/2021/04/LFI-investigation-report-for-serious-accident-06052020.pdf**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date of Exccedance** | Time ofExceedance | s243(a) Sensor ("149 Sensor") | Tailgate Sensor — 400m outbye("Inbye Sensor") | Tailgate Sensor — 3-4 c/t("Outbye Sensor") |
| 18/03/2020 | 21:33 | 0.97% | 2.56% | 2.3% |
| 19/03/2020 | 06:50 | 0.94% | 3.01% |  |
| 20/03/2020 | 02:30 | 0.81% | 2.84% | 2.57% |
| 20/03/2020 | 03:30 | 0.85% | 2.55% | 2.1% |
| 20/03/2020 | 14:36 | 0.99% | 3.55% | 3.1% |
| 22/03/2020 | 22:22 | 1.08% | 2.54% | 2.54% |
| 23/03/2020 | 06:28 | 0.8% | 1.99% | 2.55% |
| 04/04/2020 | 02:22 | 2.97% | 1.34% | 1.87% |
| 06/04/2020 | 23:31 | 1.36% | 2.12% | 2Æ6% |
| 07/04/2020 | 14:21 | 1.1% | 2.04% | 2.52% |
| 21/04/2020 | 00:58 | 3.08% | 1.48% | 1.49% |
| 21/04/2020 | 01:54 | 2.55% | 1.66% | 1.49% |
| 21/04/2020 | 13:06 | 2.66% | 1.6% | 1.42% |
| 21/04/2020 | 23:06 | 5.04% | 1.47% | 1.38% |
|  |  |  |  |  |

**Nine out of the 14 HPI’s were as a result of floor methane gas emissions between the 18th of March and 21st of April 2020.**

**Page 15**

**THERE ARE TWO DISTINCT TYPES OF EVENTS.**

**THOSE IN YELLOW COMING FROM FACE or FLOOR. S243 Sensor in the Tailgate does not change.**

**THOSE IN BLUE COMING AT TAILGATE END OF ROADWAY FROM GAS MIGRATION FROM GOAF. The 400m and Outbye Sensor quantities at no stage go near 2%.**

**21/04/2020. 5% Explosive**

**2) MINEWORKERS STATEMENTS, RECORD of INTERVIEW and TRANSCRIPT**

**This is made abundantly clear from the Statement and Testimony of Wayne Sellars (burnt Mine Worker) and the ERZC on shift Adam Maggs Record of Interview**

***Wayne Sellars (burnt miner) Statement***

***16. I recall there was methane coming up through the floor, it was pretty much a constant bubbling out of the floor along the longwall face for about two thirds of the face. The maingate end wasn't too bad, but around the faulted area we had a number of trips on the shearer due to floor gas.***

***There were times when the sensors in the cutting drums stopped the shearer cutting. We understood that was because of methane coming out of the floor at those times. When that happened, we would have to wait for the methane to clear before we could start the shearer back up. This mainly occurred around the tailgate end.***

***Through the faulted area wasn't so bad because we were so far into the stone because of the throw of the fault, it was when we got to the tailgate side of the fault that we started to get a few trips on the drum.***

***Q. During the life of longwall 104, do you recall instances of methane essentially coming up through the floor of the longwall?***

***A. Yes.***

***Q. Do you recall whether that was something that happened all the way through from 9 March onwards or did it start to happen towards 6 May?***

***A. It had been there for a while, actually, yes. I can't recall if it was right at the very start, but, yes, we had methane coming through the floor, bubbling through the floor, for quite some time, yes.***

***Q. When you say "bubbling through the floor", are you talking literally that there were bubbles?***

***A. Yes, because there was water on the longwall floor, through hollows and stuff like that - it would be bubbling up through the water, yes.***

***Q. On those occasions where you observed the bubbling occurring, did the shearer always stop by way of its automatic shut-off?***

***A. Not all the time. It was only when it got a high gas reading when we were cutting along the face. The majority of that was through that fault.***

***ADAM MAGGS ERZC RECORD of INTERVIEW***

***MR TOLHURST: Have you ever found CH4 blowers coming from the floor?***

***MR MAGGS: Yes.***

***MR TOLHURST: Are you able to provide any comment around that?***

***MR MAGGS: They were quite common. Not so much blowers, but we had a little bit of floor heave. 103 block – we’ve had a little bit around there. You get your blowers and that, but, you know, your consistent bubbling of – when you’ve got a little bit of water around that pan line and that, especially around the maingate area and that. But I spoke about it earlier, our general body is never high.***

***I can’t even get off scale or anything, that type of stuff, if you put it down right at that bubble, it doesn’t lift any increase in general body or anything like that.***

***MR TOLHURST: You mentioned block 103. What about block 104?***

***MR MAGGS: We haven’t had much floor heave. We’ve had bugger all floor heave. We’ve had a little bit around that maingate, but – there was some bubbling and that, but I wouldn’t really call them blowers. I’d call it migrating out of the floor. We did have some blowers in 103 where it’d knock the sensor straight out.***

**3) 19.-LW104-GOAF-DRAINAGE-RISK -ASSESSMENT**

**https://coalminesinquiry.qld.gov.au/wp-content/uploads/2021/04/19.-LW104-Goaf-Drainage-risk-assessment.pdf**

***4 Pre drainage***

*• Pre-drainage of the GM-Seam has been conducted from a combination of both SIS (owned by Arrow) and infilling of UIS drilling where required to achieve gas content of <4m3/t for development production and <2m3/t for Longwall production. Gas content of the GM seam is proven to be below 2m3/t outbye of CH1600 (MG104 17c/t) an no additional gas drainage has been implemented for this region.*

*• Pre-drainage of the P-Seam over LW104 has been conducted from SIS Boreholes drilled from Arrow. UIS drilling of the P-Seam was attempted from MG104 22c/t that resulting in 837m of drill string being stuck in the P-Seam inbye of MG104 22c/t.*

*•* ***No pre drainage of the GML seam has been conducted for LW104 and is expected to release gas readily due to the GML reservoir size combined with proximity to the working seam up to approximately CH4000-2000*** *(MG104 20-36c/t)*

***Floor emissions from the GML appear to be caused either by mining induced shearing, bed separation and high-pressure desorption followed by sudden release into the longwall or longwall goaf***

***The design of LW104 goaf gas management is based on a review of LW103 gas experience, anticipated changes in the LW104 gas reservoir and aspirational peak longwall tonnage. The proposed design is modified from LW103 in three areas:***

***1. Significantly increased surface capacity to drain and flare goaf gas***

***2. Increased density of goaf drainage points (holes) along and across the longwall***

***3. Floor holes to prevent shearer trips associated with the Goonyella Middle Lower seam and floor holes to address potential emissions from deeper floor reservoirs around known structures.***

***1.13 Sudden floor emissions on the LW103 faceline***

***Where the GML seam is ~1m from the GM floor sudden emissions have occurred causing both shearer trips at 1.25% CH4 and shearer stoppages due to an increase in the TG CH4 to >2%.***

*AGM.002.001.0984*

***Figure 11 shows the location of the longwall at the 2nd January when floor emissions were contributing to the LW stoppages. It can be seen the LW emissions occurred north of the region associated with development floor emissions. Prior to LW103, registering of gas spikes at the shearer was not common. The gas originates from the GML seam, which when it is close to the floor of the GM seam, causes sudden emissions of gas into the longwall faceline.***

***In relation to shearer delays, Figure 12, note the 2% delays in the TG correlate to spikes measured at the shearer (white line) whilst the shearer is cutting to the TG. This must either be floor gas or gas from the cut****.* ***The shearer spikes were not enough to trip the shearer (1.25%) however contributed to 2% in the return causing shearer stoppages. It is notable that the shearer spikes occur predominantly whilst the shearer is cutting from MG to TG, although the TG drive CH4 increases from TG to MG.***

***1.14 Sudden floor emission in the goaf, LW103.***

***On the 11th of July a sudden floor emission occurred on LW103, the event occurred south of the interburden split that defines the emission events encountered in the development headings (Figure 13) and is consistent with gas coming from the floor in the goaf. The longwall was at ~1700m chainage, the gas was reported as coming from behind 55 chock.***

***In general, the height of the peak relates to the gas content (and thus gas pressure) of the source reservoir, the volume of gas released relates to the size of the source reservoir. The comparatively small amount of gas released suggests the source is the GML rather than the Harrow Creek or Dysart upper seam (Figure 14).***

***Similar events have occurred in LW102 and LW101.***

***The longwall front abutement causing shearing in the floor seams followed by bed separation and change in pore space. This allowing desorption to occur which, where the interburden is brittle and fractures underneath the longwall face or goaf, subsequently results in sudden emission.***

***AGM.002.001.0987***

***2. Long term pre drainage of the GM seam (by Arrow) resulting in de-stressing of the GML seam and desorption of free gas. The gas however is trapped in the GML due to the very low permeability of the interburden. This hypothesis has been proposed by G and R Williams (Wilbur Systems) .***

***1.15 Mitigation of floor emissions arising from the GML seam***

***UIS drilling in developments in the GML floor seam indicates that it is not readily pre-drainable, however, whilst being drilled holes do release free gas from time to time. It is also clear that floor gas can be generated from mining induced stress. This implies a pressure relief system may be appropriate i.e. drilling UIS holes in the GML or interburden along the face to relieve free gas rather than pre-drain***

***The relief hole spacing is not known although it is likely to be ~10m. Floor holes for gas relief could be drilled from three directions road.***

1. ***Across the panel from MG104 (red holes in Figure 15)***
2. ***From face start line outbye (black holes in Figure 15)***
3. ***From an outbye UIS stub inbye (yellow holes in Figure 15)***

***Options 1 and 3 allow gas captured from mining induced stress to be drained away from the longwall face.***

***Option 2 will relieve free gas encountered while drilling however may allow gas generated by mining induced stress to relieve into the goaf.***

***Each option requires standpipes to extend underneath the face start line or the maingate conveyor.***

***Each option could also be considered with a fracturing program to allow gas to relieve onto the faceline.***

***This would require an extensive interburden fracturing program, the benefit of which is not yet known in a longwall environment.***

******

***1.16 Mitigation of floor emissions arising from the HCL and DY seams***

***In addition to potential emissions from the GML seam, the lower seams may be the source of longwall gas and sudden emissions****.* ***These seams comprise the Harrow Creek (HL) and Dysart Upper (DYU). Gas emissions from these horizons is considered more likely where faulting exists which can become a conduit in the goaf.***

 ***In LW104 two fault sets have been mapped through the LW104 panel, these faults may provide conduits for lower seam gas emission into the workings in LW104. A possible cross measure UIS arrangement is shown below (Figure 16). Alternatively access from MG103 38ct stub might be possible.***

***A section of the floor seams under the GM seam in the inbye portion of LW104 are shown below. The thickness of the seams is typically <0.5m making them dubious UIS drainage targets (Figure 17).***

***It is recommended that cross measure UIS holes are established through the fault plane into the HCL and DYU. One branch should be close to the face start line.***