SAFETY & SUSTAINABLE DEVELOPMENT

LEARNING FROM INCIDENTS

INVESTIGATION REPORT – SECTION 201 COAL MINING SAFETY AND HEALTH ACT 1999

GROSVENOR MINE

Metallurgical Coal

Incident Number: IN.00226742 & IN.00228255
Classification : RSHQ HPI
Investigation Level: Five
Incident Title: Withdrawal from Mine and Ignition of Gas LW104
Incident Date: 8 June 2020
Report Date: 24 January 2021

Disclaimer

This report has been prepared and submitted to meet the requirements of section 201 of the *Coal Mining Safety and Health Act 1999* (Qld) (**CMSHA**).

Section 201(3) of the CMSHA requires that this report is not admissible in evidence against the site senior executive, or any other coal mine worker mentioned in the report, in any criminal proceedings other than proceedings about the falsity or misleading nature of the report.

Furthermore, the discussion of facts and the views expressed in the report, as determined by the relevant investigation team, are not intended to establish any admission at law on behalf of Anglo corporations, their employees, agents or contractors (at any tier) or any other party. This report neither determines nor implies liability.

This report is confidential and has been provided as required under the CMSHA. It is not to be distributed outside of Grosvenor Mine or Resources Safety & Health Queensland (**RSHQ**) except where required by law.

Learning from Incidents Investigation Report

1 INTRODUCTION

On 8th June 2020, due to a pending and increasing spontaneous combustion situation developing at the Grosvenor Mine, the decision was made to restrict and close off the ventilation to the longwall 104 **(LW104)** ventilation circuit. During the risk assessment it was identified that a potentially dangerous environment may be formed after the ventilation change and in combination with a potential ignition source due to the oxidation event, a control was implemented to close access to the underground mine after the ventilation change had been completed. The underground mine had already been restricted to personnel on 6th June 2020, except for those involved in critical tasks generated by the Incident Management Team **(IMT)**. The Shift Undermanager and two ERZ Controllers facilitated the ventilation change steps underground on 8th June 2020, with the last step completed at 1:15am, after which time they withdrew from the mine, arriving at the surface at around 1:30am. The final step of the ventilation change took place at Shaft 9 on the surface at 1:37am.

Following the ventilation change, there is data to support that at approximately 2:45am, there was an ignition of methane in LW104. Of note, no personnel were underground at 2:45am due the planned withdrawal earlier that morning.

An initial report was prepared using information available at the time and forwarded to an inspector within 1 month of the incident as required by section 201 of the CMSHA. The incident scene has been inaccessible since the controlled withdrawal occurred on 8th June 2020. The environment underground has been subject to ongoing monitoring since this incident, and a more in-depth data analysis and review has now been undertaken to support the submission of this secondary report into the potential causes and recommendations to prevent reoccurrence.

2 INVESTIGATION TEAM

The following personnel assisted in the collation and review of information for this report.

Name	Position	Investigation Role
Kate Bachmann	Safety, Health & Environment Manager	Facilitator
Ravindu Goonawardene	Technical Services Superintendent	Technical Expert
James Moreby	Ventilation Officer	Technical Expert
Darren Brady	External Consultant	Technical Expert
Boyd Buschmann	ERZ Controller	Operational Expert
Neal Bryan	Undermanager	Operational Expert
Tekaani Rawiri	ERZ Controller	Operational Expert
Reece Campbell	Longwall Operator Site Safety & Health Representative (SSHR)	SSHR Operational Expert
Joshua Pokarier	Longwall Operator	Operational Expert

3 BACKGROUND

3.1 Withdrawal of Persons from the Mine

Monitoring of the LW104 faceline rear shield area for temperature and Carbon Monoxide **(CO)** concentrations was implemented on the 18th May 2020 after the LW104 gas ignition incident that occurred at Grosvenor Mine on 6th May 2020. This was in place to monitor any areas that had the potential for an accelerated oxidation event and allow for early response and action to be taken as per ***GRO-6953-TARP Active Goaf Spontaneous Combustion.***

On 2nd June 2020 at 3:00pm, an Incident Management Team **(IMT)** was formed due to reaching Level 2 of the Active Goaf Spontaneous Combustion TARP (Graham's Ratio equal or greater than 0.5 and less than 1). The IMT convened daily (at a minimum) and through data analysis and technical review, developed a range of strategies to mitigate the situation. This included inertisation and injection of void fill foam behind the maingate roof supports to reduce the oxygen ingress into the goaf. A full list of actions assigned and implemented by the IMT from 2nd June 2020 onwards can be found in the daily minutes which have been previously provided to Resources Safety & Health Queensland **(RSHQ)**.

Tube bundle **(TB)** sampling was undertaken to monitor the evolving spontaneous combustion event using the locations identified in Figure 1.

On 6th June 2020, the IMT reviewed the ventilation predictions provided by an external expert, which were as follows:

- CO Make Level 3 TARP Trigger likely to be reached by midnight 6th June 2020 (both at TB #22 and #26)
- Graham's ratio was not likely to reach the Level 3 trigger for TB #26 before 22nd June (at which time Goaf Stream Graham's ratio would be potentially 10)
- Data set for TB #22 too small to be reliable
- Graham's ratio was likely to be over 1 before midday 6th June 2020 and over 2 just after midnight 7th June 2020 (assuming the rate of increase in intensity of the heating stayed the same).

The decision was subsequently made by the IMT, despite still being in Level 2 of the TARP, that commencing night shift on the 6th June, access to the underground workings would be restricted as a precautionary measure to only those involved in conducting critical tasks generated by the IMT e.g. amending the nitrogen injection lines, installing additional tube bundle monitoring lines etc.

On 7th June 2020, the current ventilation and gas management strategies were deemed to not have achieved the desired results, with carbon monoxide levels observed to be continuing to increase despite the control measures implemented. Two main strategies were subsequently proposed by the IMT, being to complete a ventilation change (of which two possible ventilation changes were proposed) or further increase inertisation. The ventilation change was determined to be the most appropriate course of action.

The two proposed potential ventilation changes were:

- Reduce ventilation around the LW104 companion road via restricting the opening at the top of Shaft 9 (MG103 C40-C41): Intent being to reduce the differential pressure across the LW104 goaf perimeter seals.
- Close the LW104 Tailgate Regulator: Intent being to reduce the pressure across the LW goaf as much as possible.

The IMT ultimately chose to implement the second option based on proposed benefits (as the second option provided significantly more impact around pressure differential reduction based on the ventilation modelling undertaken).

The risk assessment to support this task was completed on 7th June 2020 (***GRO-10758-RA-Ventilation Changes to Mitigate Accelerated Oxidation*)** and presented to the DNRME on the same day.
The underground steps of the ventilation change included:

- setup of tube bundle monitoring points at designated locations;
- opening the homotropal regulator in the longwall belt road;
- closing the TG regulator.

These steps were completed at around 1:15am on Monday 8th June 2020, with Coal Mine Workers **(CMWs)** involved in the task returning to the surface at 1:30am. The underground mine was restricted to all CMWs thereafter.

The final step, which was conducted on the surface of the mine, was to adjust the knife gate on shaft 9 to reduce the quantity and pressure across the longwall face. This was completed only upon confirmation that all personnel had returned to the surface from underground.

Monitoring of impacts and results of the ventilation change were then able to take place remotely.

Figure 1: Sampling Locations (as at 8th June 2020)

3.2 Ignition Event in LW104

The ventilation change on 8th June 2020 was observed to effectively reduce the Graham's Ratio and CO make in the longwall return, as illustrated by the results from TB #26 below.

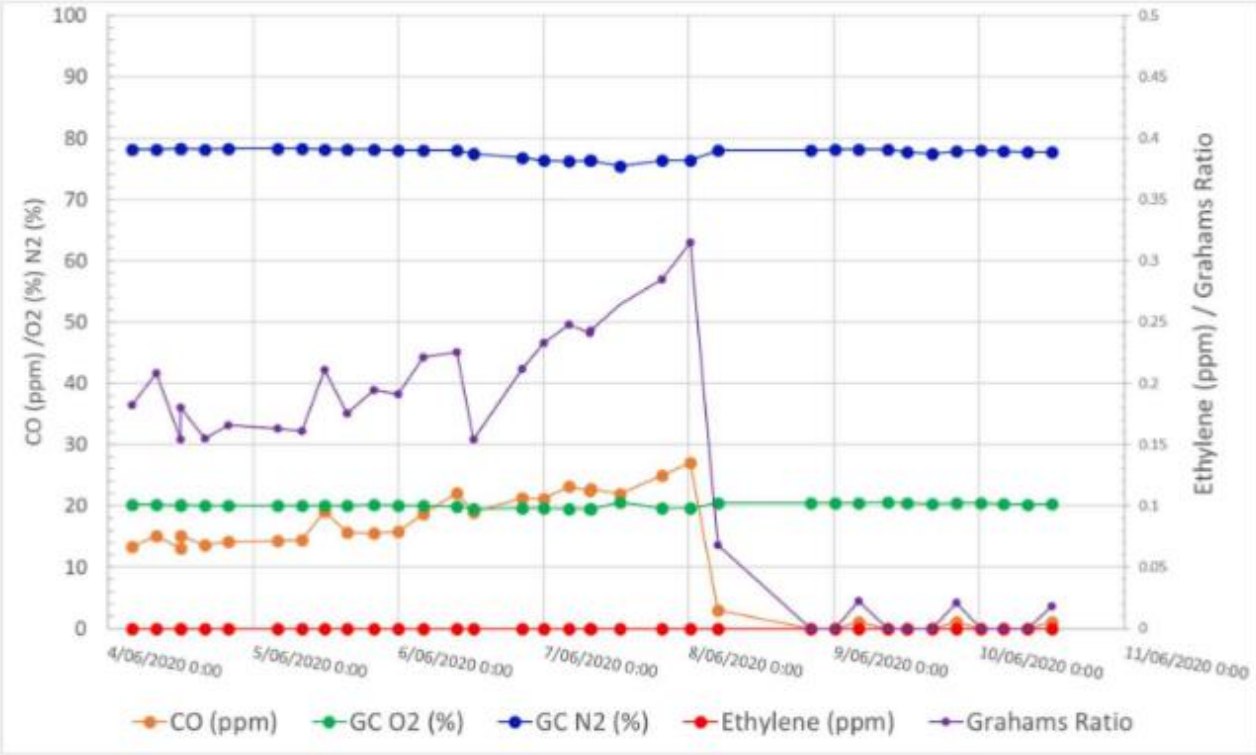


Figure 2: TB #26 GC @ TG104 3-4CT B HDG

However, the below observations were also made following the ventilation change:

- Increasing methane **(CH_4)** levels in LW returns;
- Increasing CH_4 levels at real time sensor #62 (LW104 x-drive) (Figures 3-5)
- Vacuum pressure increase identified on tube bundle #36, #40 & #34
- Changes on the shaft 6 pressure sensor (Figure 6)

These observations suggested that an overpressure event had likely occurred between 2:45am and 3:00am on Monday 8th June.

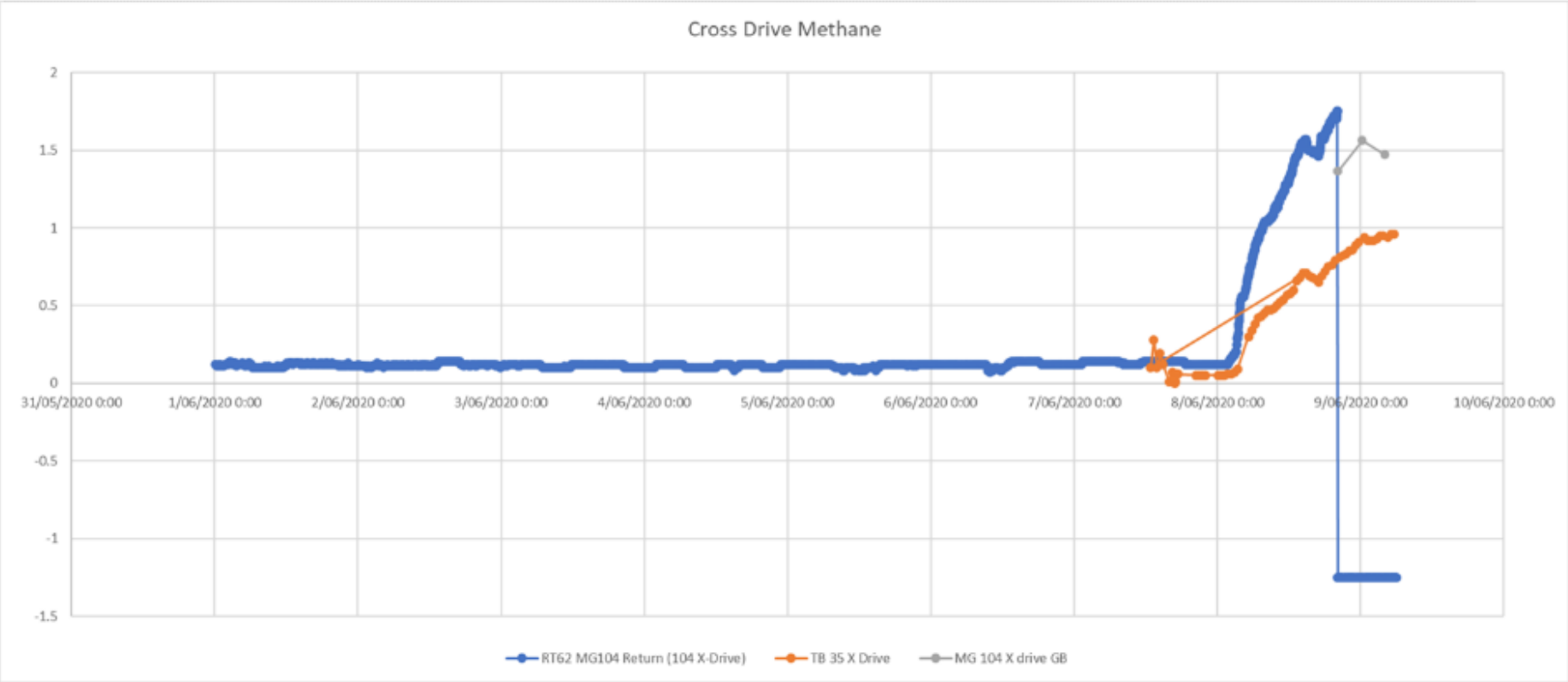


Figure 3: Cross Drive Methane Levels 1st June – 9th June 2020

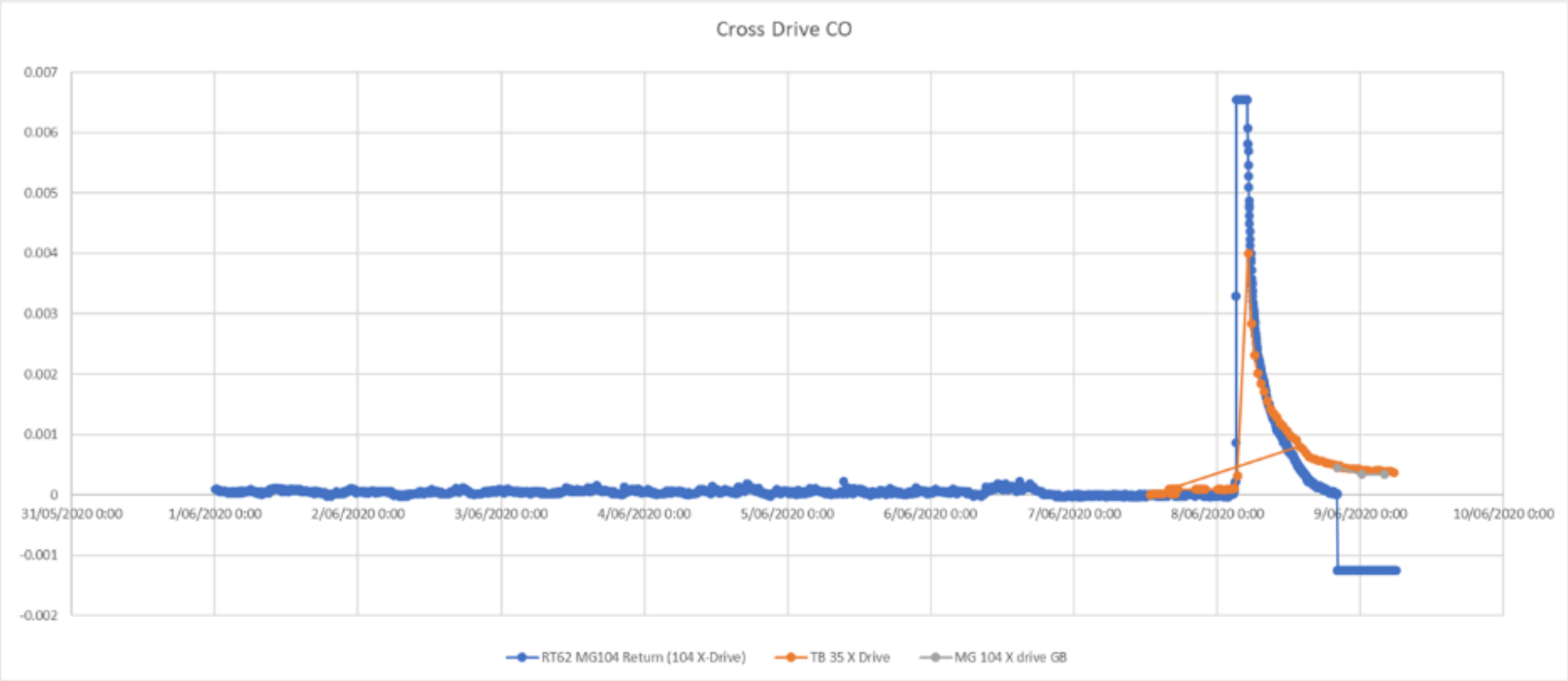


Figure 4: Cross Drive Carbon Monoxide Levels 1st June – 9th June 2020

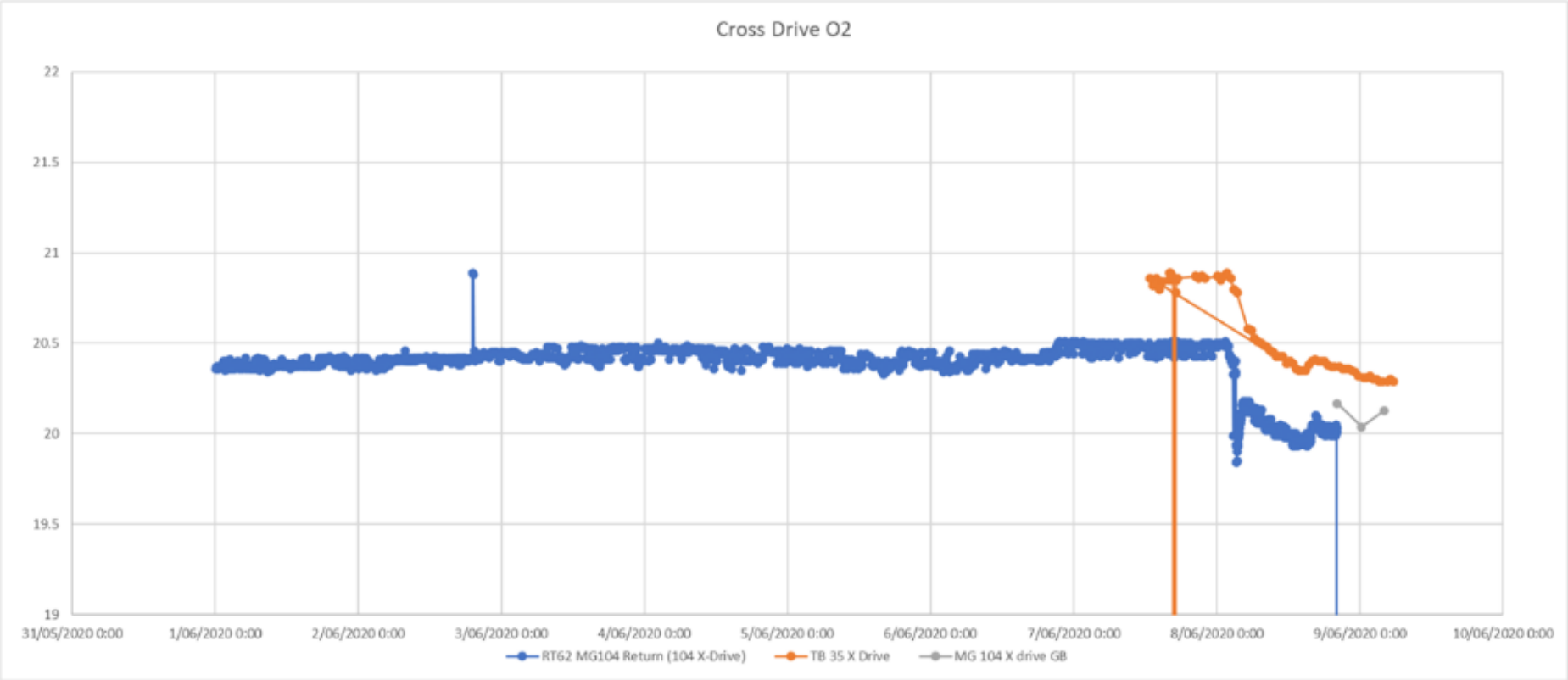


Figure 5: Cross Drive Oxygen Levels 1st June – 9th June 2020

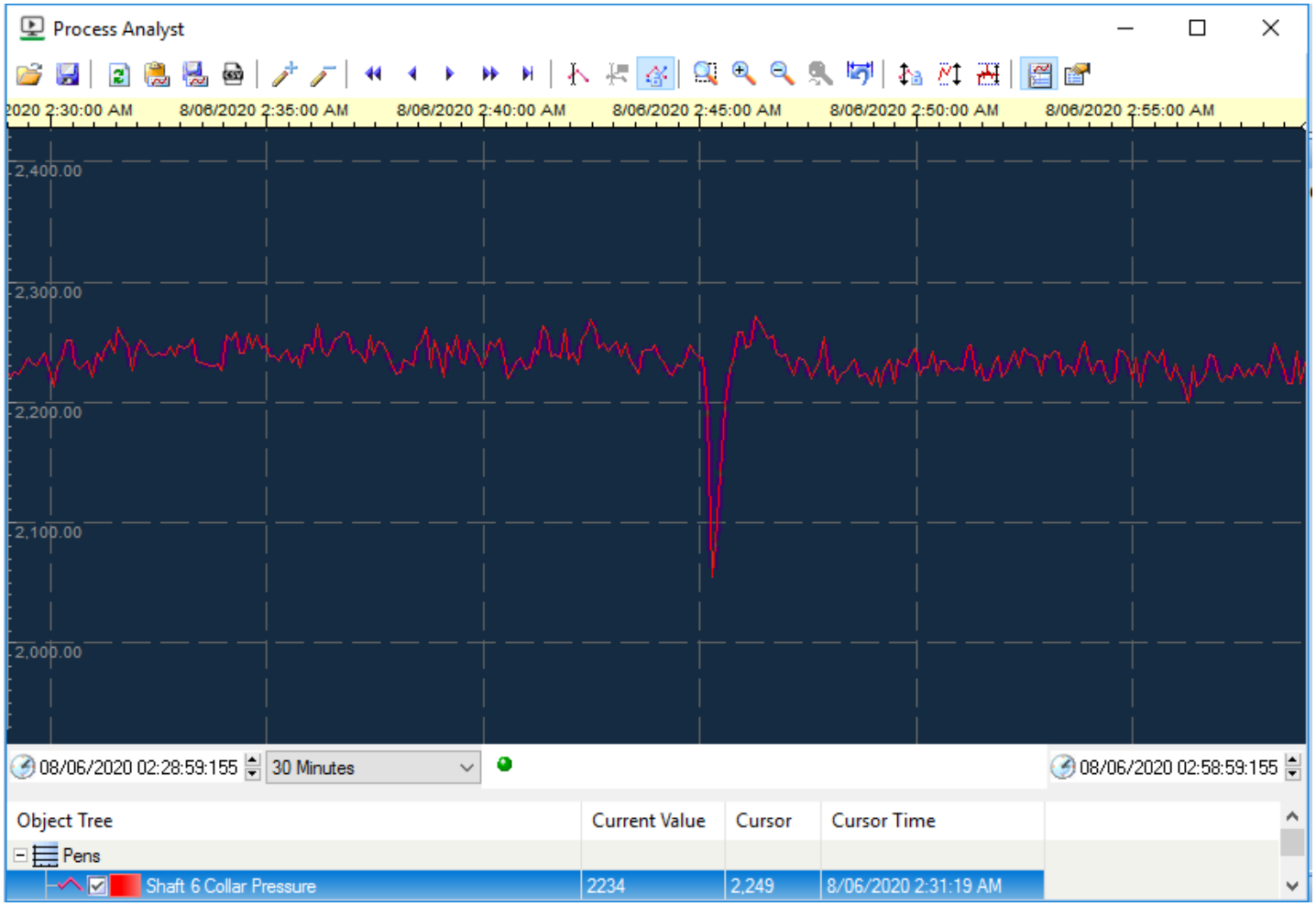


Figure 6: Shaft 6 Collar Pressure 8th June 2020

Further analysis of the Tube Bundle system identified that the overpressure may also have been an ignition of gas. This was determined by the Ethylene and CO concentrations detected at the tailgate C-Hdg stopping between 36 and 37c/t (Figure 7).

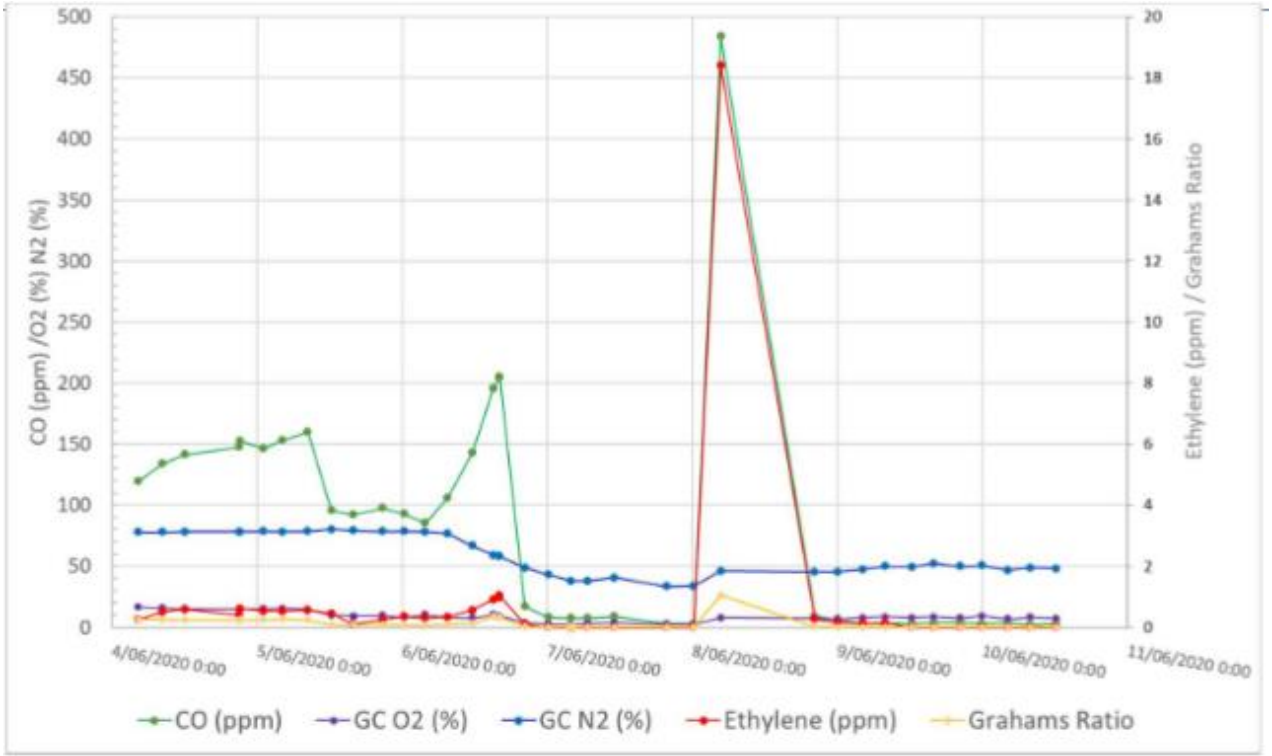


Figure 7: TB #13 GC @ TG104 36-37CT C HDG STOPPING

A camera was subsequently deployed from the surface into the underground workings via a borehole. The footage captured did not provide any firm evidence of an ignition having occurred, with no signs of heat or flame path (Figure 8 and 9). It did however support the occurrence of an overpressure event, with damage observed to the flexi stopping at 36c/t in MG104 that had been built prior to withdrawal of persons from the mine (Figure 10). This is also the likely cause of the loss of monitoring at several of the tube bundles, which were likely damaged as a result of the overpressure event.

Figure 8: MG104 "C" heading 34-35c/t (looking outbye)

Figure 9: MG104 "C" heading 35c/t (looking through c/t toward "B" heading)

Figure 10: Flexi Stopping at 36 c/t in MG104

4 INVESTIGATION

4.1 Timeline

Date	Summary of Events
4th Dec 2019	LW104 second workings Risk Assessment facilitated with workforce cross section Action Plan from RA loaded into Enablon 9th January 2020. This included an action assigned to the Grosvenor Ventilation and Gas Superintendent due 15th February 2020 as follows: *Produce SWI for managing C heading roadway outbye the 103 EPS. Include hard controls for stonedust, gas monitoring, barricading, access, etc.).* Entered into Enablon as TS.01218825.
5th Jan 2020	Preliminary Report 'Spontaneous Combustion TARP Trigger Review' issued to Grosvenor Ventilation and Gas team. Report had been commissioned by Grosvenor and prepared by Darren Brady of Serinus Pty Ltd. *"Report details an assessment of the applicable Grosvenor gas monitoring data provided (tube bundle and gas chromatograph covering all three longwalls to date) and available gas evolution testing results to support the ongoing use of existing trigger levels where appropriate or make recommendations to change to more appropriate triggers based on detailed scientific justification."*

Date	Summary of Events
	Recommended Spontaneous Combustion Trigger Levels Active Goaf

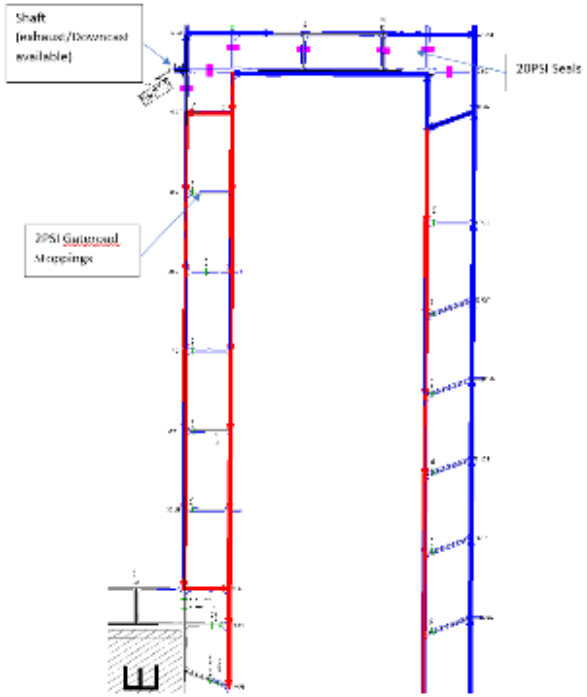
Location	Normal	Level 1 Response	Level 2 Response	Level 3 Response
Longwall Return	CO Make < 40l/min **AND** Graham's Ratio < 0.3 **AND** $CO/CO_2 < 0.1$	40l/min ≤ CO Make < 50l/min **OR** 0.3 ≤ Graham's Ratio < 0.5 **OR** $CO/CO_2 \geq 0.1$ **OR** Longwall Retreat less than #	50l/min ≤ CO Make < 150l/min **OR** 0.5 ≤ Graham's Ratio < 1.2 **OR** Sweating, smell or haze (confirmed by ERZ Controller)	CO Make ≥ 150l/min **OR** Graham's Ratio ≥ 1.2 **OR** Smoke (coming from goaf)
Active Goaf Seals	CO < 130ppm **AND** Graham's ratio < 0.4 **AND** No Ethylene	130ppm ≤ CO < 200ppm **OR** 0.4 ≤ Graham's Ratio < 0.6 **OR** 0ppm < Ethylene < 1ppm **BUT** CO < 130ppm **OR** Ethylene > 1ppm **BUT** CO < 200ppm	200ppm ≤ CO < 800ppm **OR** 0.6 ≤ Graham's Ratio < 1.2 **OR** 0ppm < Ethylene < 1ppm **AND** CO ≥ 130ppm **OR** Sweating, smell, heat or haze (confirmed by ERZ Controller)	CO ≥ 800ppm **OR** Graham's Ratio ≥ 1.2 **OR** Ethylene ≥ 1ppm **AND** CO ≥ 200ppm
Goaf Stream	CO < 100ppm **AND** Graham's ratio < 0.4 **AND** No Ethylene	100ppm ≤ CO < 150ppm **OR** 0.4 ≤ Graham's Ratio <0.6 **OR** 0ppm < Ethylene < 1ppm **BUT** CO < 100ppm **OR** Ethylene ≥ 1ppm **BUT** CO < 150ppm	150ppm ≤ CO < 700ppm **OR** 0.6 ≤ Graham's Ratio < 1.2 **OR** 0ppm < Ethylene < 1ppm **AND** CO ≥ 100ppm **OR** Sweating, smell or haze (confirmed by ERZ Controller)	CO ≥ 700ppm **OR** Graham's Ratio ≥ 1.2 **OR** Ethylene ≥ 1ppm **AND** CO ≥ 150ppm **OR** Smoke (coming from goaf)

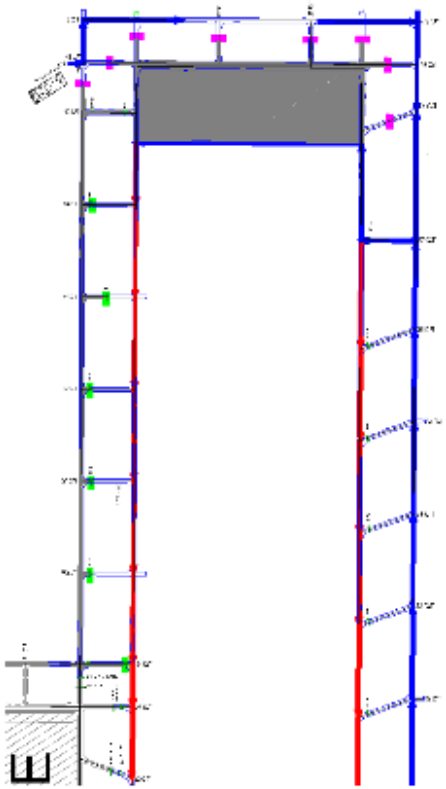
Level 1 slowed retreat rate trigger best determined by Grosvenor

6th Jan 2020	*Coal Mine Safety and Health Regulation 2017* reprinted removing 'abandoned workings' from s345 requirements. Note - Grosvenor had originally planned to class and treat C Heading roadway as abandoned workings.

Date	Summary of Events
	Extract from regulation printed pre 6th January 2020: **345 Parts of mine exempted from ventilation requirement** The following parts of an underground mine are exempted for sections 343 and 344— (a) a part sealed off from the rest of the mine workings by a type B, C, or D seal; (b) a goaf area, or abandoned workings in which normal work is not being carried out; (c) a roadway that persons are prohibited and prevented from using for normal work or travel; (d) a place where persons are using self-contained breathing apparatus to carry out work other than normal work, unless the work is associated with a routine operation in outburst prone conditions. Extract from regulation as at 6th January 2020:

Date	Summary of Events
	345 Parts of mine exempted from ventilation requirement The following parts of an underground mine are exempted for sections 343 and 344— (a) a part sealed off from the rest of the mine workings by a type B, C, or D seal; (b) a goaf area; (c) a place where persons are using self-contained breathing apparatus to carry out work other than normal work, unless the work is associated with a routine operation in outburst prone conditions.
13th Feb 2020	Email from Grosvenor Ventilation and Gas Superintendent to UMM and Anglo Ventilation and Gas Technical Specialist– *"Here is the proposed ventilation startup for LW104. Please review and provide your thoughts."* Two options for LW104 ventilation (planned sequence) attached to email as follows: **Stage 1: Installation Face to TG103 40c/t** • TG103 40c/t B-C Hdg VCD Open • Dual Returns down to TG103 34c/t • Single return outbye of TG103 34c/t • Barricades to be installed in cut-throughs to prevent access into C Hdg from TG103 B Hdg • TG103 C Hdg to be stonedusted prior to access removed

Date	Summary of Events
	 **Stage 2: Longwall face retreated past TG103 40c/t** • TG103 40c/t B-C Hdg VCD to remain Open • TG103 34c/t B-C Hdg VCD to be closed • TG103 C Hdg 34 to 40c/t now part of Goaf • Tube Bundle to monitor TG103 34c/t as part of active goaf.

Date	Summary of Events
	
14th Feb 2020	Email above (including attachment) forwarded from UMM to DNRME Inspector of Mines – *"We will have a second TG roadway for the first couple of pillars in LW104 and looking for a suitable way to manage this. We have multiple options and just want to run our preferred option past you to see if we have missed anything. (Especially with the new legislation changes)".*

Date	Summary of Events
21st Feb 2020	LW104 second workings Risk Assessment signed off by UMM and SSE for upload to SHMS.
25th Feb 2020	TS.01218825 closed in Enablon by Grosvenor Ventilation and Gas Superintendent with completion comments – "*Sequence of managing the TG is included in the Second workings SOP".* Extract from Second Workings SOP: ***Management of the Tailgate roadway from 41c/t to 34c/t*** *Each cut-through from TG104 34c/t to 41c/t C Hdg will be barricaded and once passed considered goaf.* *TG104 34ct Doors will remain open from start-up and remain open as the longwall retreats from start-up and then passes TG104 34ct.* *The immediate cut-through outbye the longwall face will have the VCD open to allow ventilation to pass into C Hdg which will then return through TG104 34c/t to re-join the main return ventilation. Brattice may be required to help air into C Hdg Roadway but will be managed on a case by case basis.* *Once the longwall is 40m from the cut-through the VCD is to be closed and the next outbye VCD is to be opened to re-establish the ventilation in C Hdg. This process is shown in the following illustrations:*

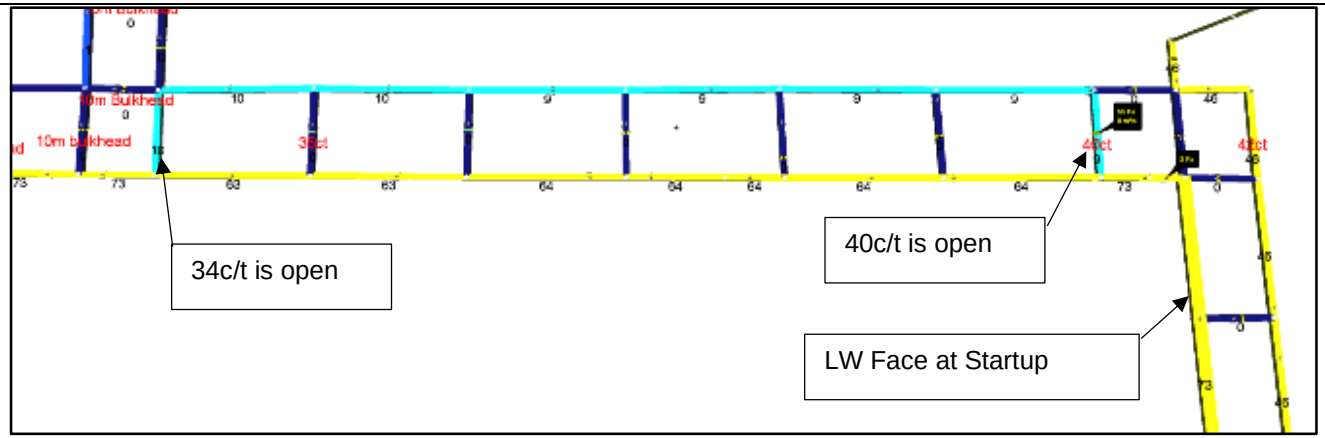


Figure 1 – LW Face at start-up

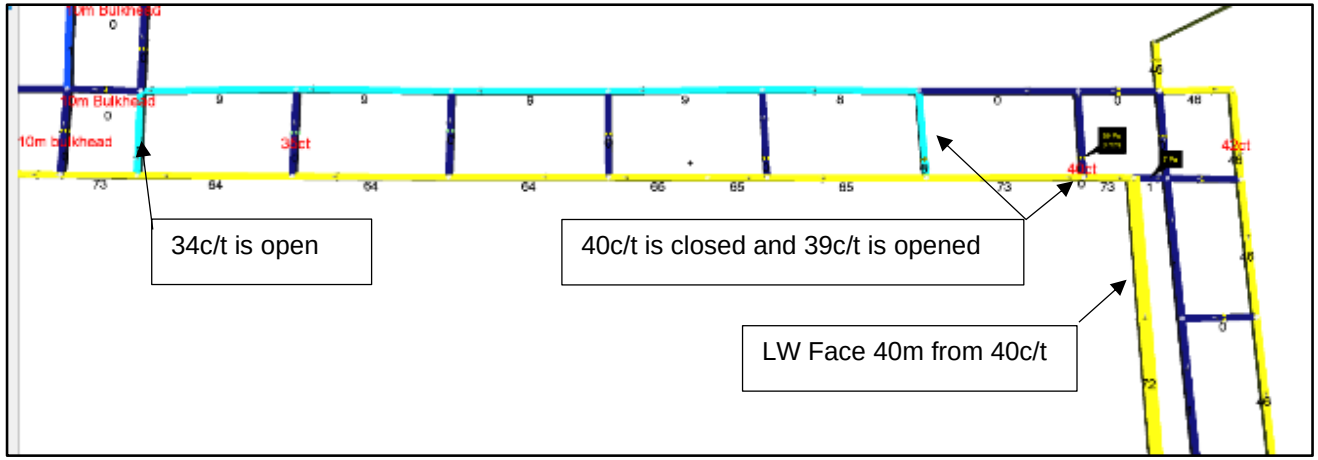


Figure 2 – LW Face is 40m from TG104 40ct

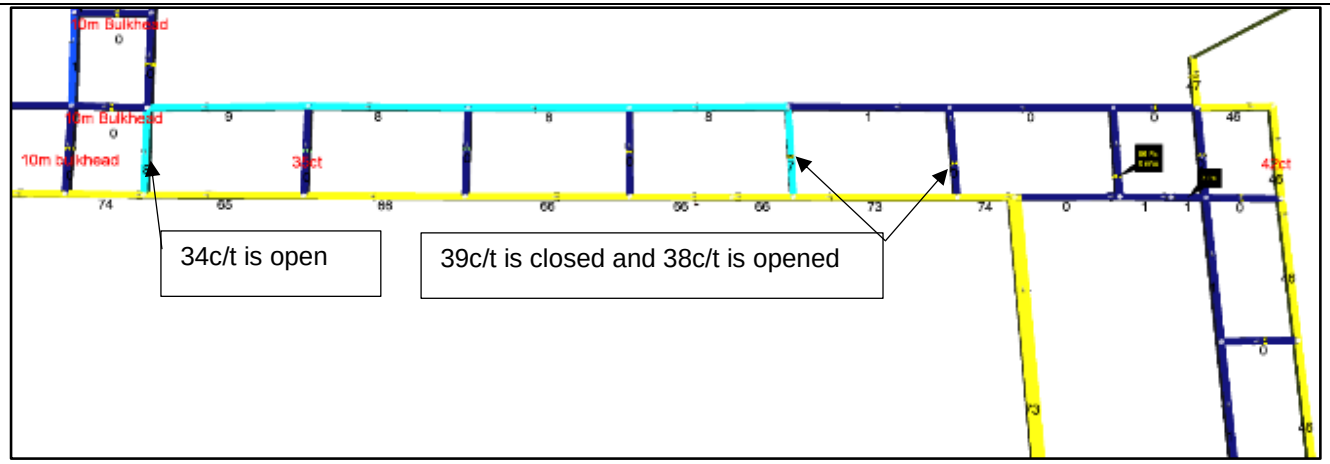


Figure 3 - LW Face is 40m from TG104 39ct

The above process is repeated until 36c/t. The final process is shown below.

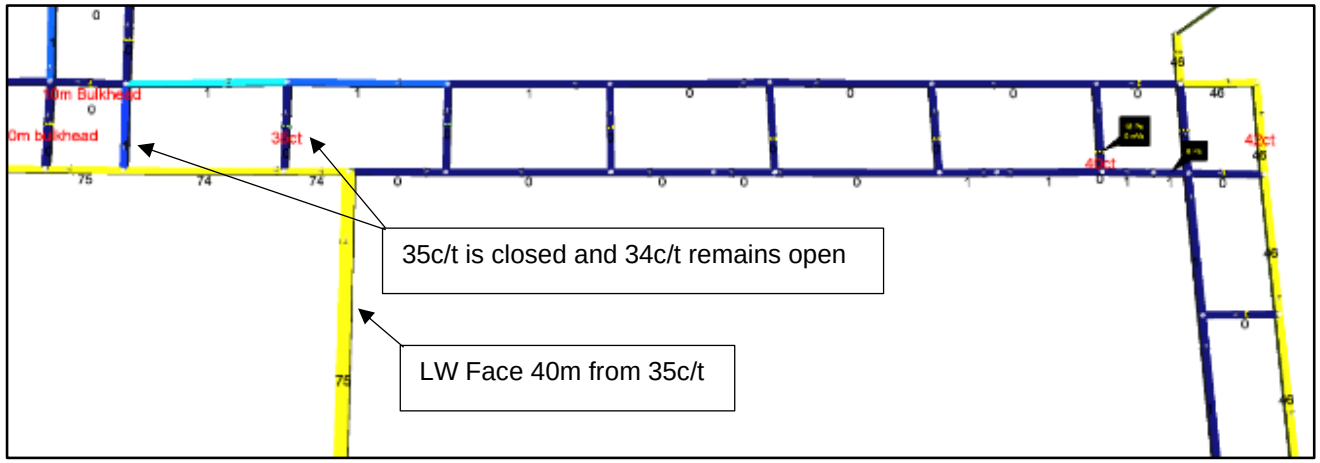


Figure 4 – LW Face is 40m from TG104 35ct

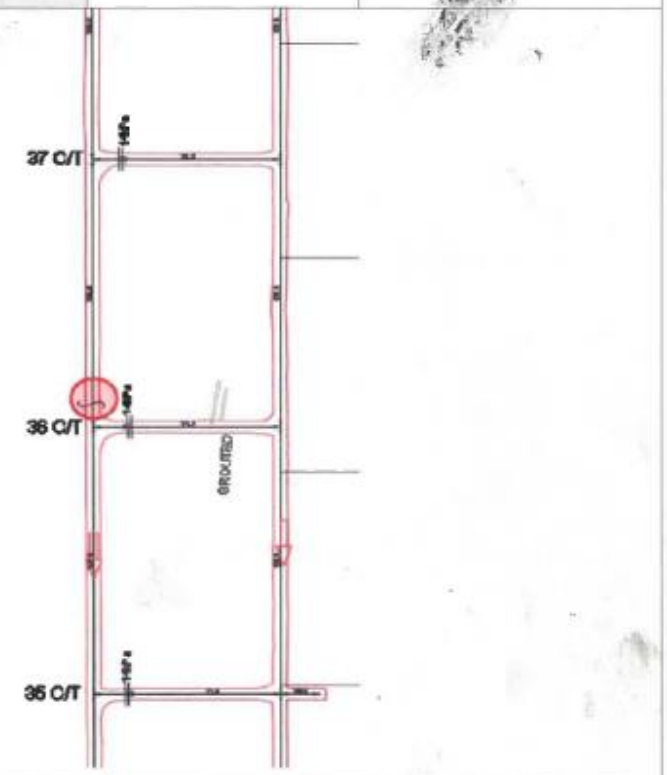
Date	Summary of Events
	The longwall will then pass TG104 34c/t and leave the VCDs open. This is to ensure C Hdg Roadway is not sealed from the goaf. Each change will be captured by minor ventilation change process.
2nd Mar 2020	Second workings SOP signed off by UMM and SSE for upload to SHMS.
6th Mar 2020	UMM emailed DNRME Inspector of Mines notice to Commence Second Workings LW104 under s230, with the following attachments: - Notice to Commence Second Working Letter - LW104 Second Workings Risk Assessment. - LW104 Second Workings Standard Operating Procedure. Reply from DNRME Inspector of Mines - "C*onfirming I have received your notice for second workings LW104 pursuant to s320 of the Regulations".*
9th Mar 2020	First shear of LW104
6th Apr 2020	Gas exceedance at TG104 3-4 B Hdg Outbye Return Monitor at 11:31pm. Action was assigned by ERZC to 'build adequate stoppings frames before longwall approaches CTs. Crossed out by V&G Superintendent and noted as 'Already captured in IMT'.

Date	Summary of Events
7th April 2020	Gas exceedance occurred at the TG104 3-4ct B Hdg Outbye return monitor at 2:21pm. IMT meeting called at 3:30pm due to two gas exceedance events during previous 24 hours. Minutes from IMT note that a possible contributing factor includes: ○ *VCD TG104 38-39c/t Leaking – Silent Sealed VCD in the TG (Completed 3:52pm – needs additional work)*

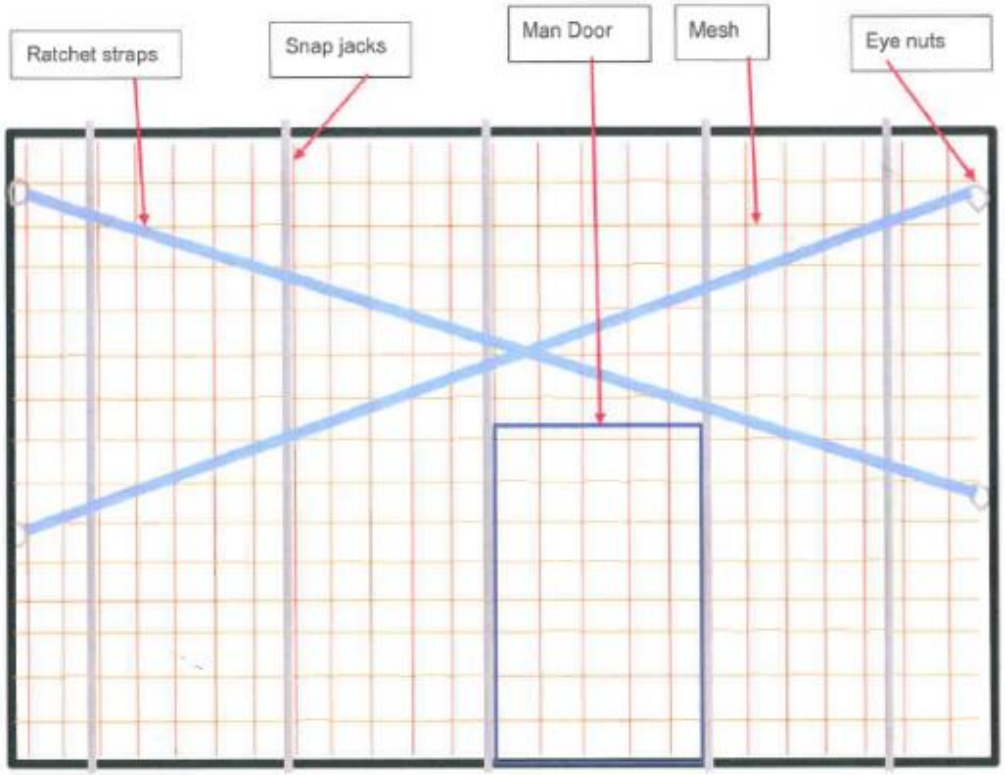
Actions from IMT Meeting		
Action	**Who**	**When**
Update sequence. Permits and vent changes to reflect VCDs in TG	MJ/BM	9/4/20
Establish second gate at #90 with same conditions as #115 (completed)	MV	Completed 7/4/20
Confirm with UMM on minor change to second workings (Confirmed minor change and update to Second workings not required – communication to oncoming crew of plan to occur 9/4/20)	WN	Completed 8/4/20

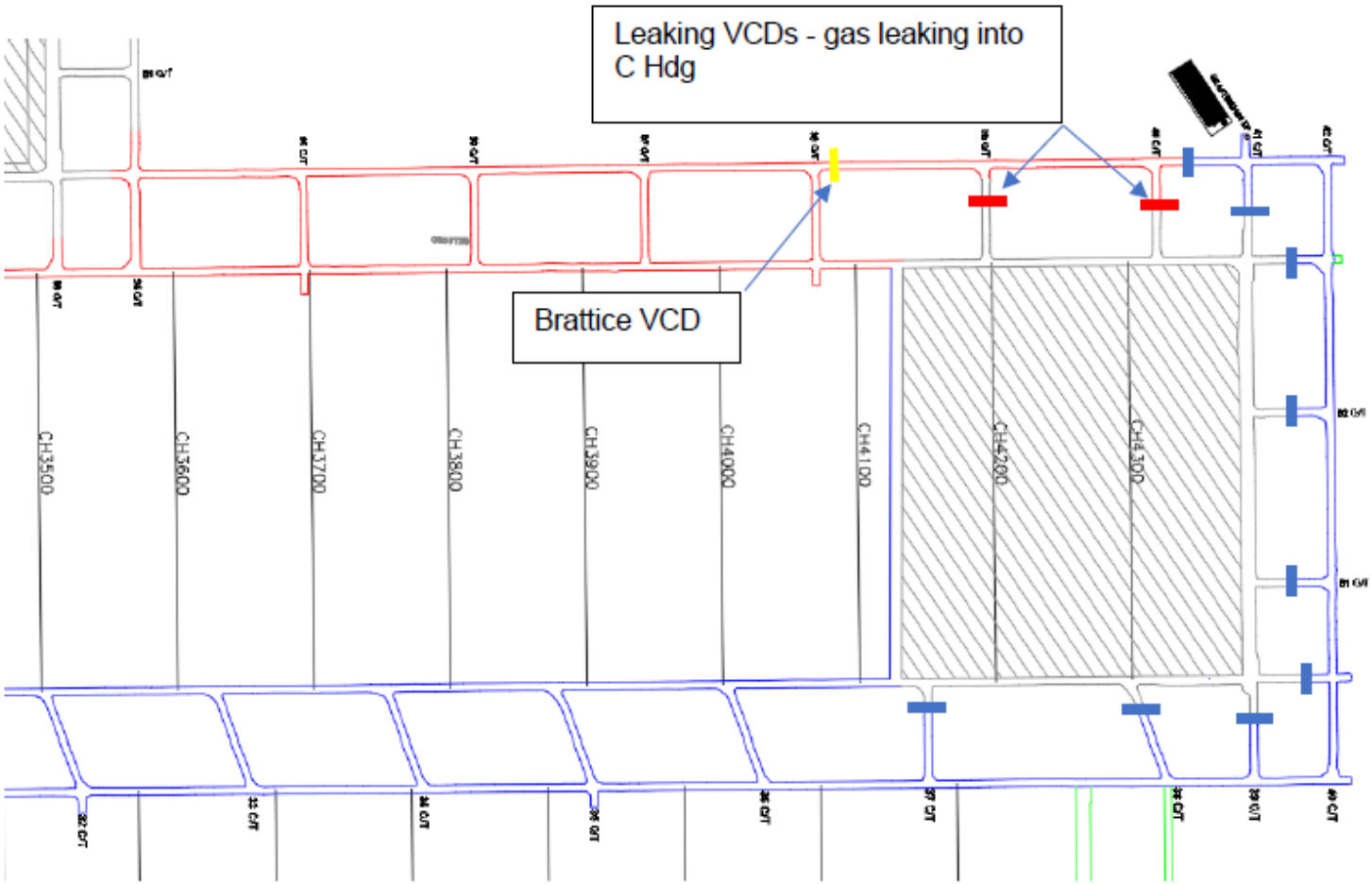
9th April 2020	VCD Permit 4012 issued for MG103 36-37ct C Hdg Substantial Stopping. Works completed same day and signed off by ERZC.

Date:	09/04/2020	**VCD Register Permit #:**	4012
Construction / ~~Demolition / Alteration~~ Strike out which over not applicable		**Location/s:**	MG103 36-37ct C Hdg



Details of VCD:	Install framework for Substantial stopping.
Rating:	Non-rated – 5 x snap jacks, mesh and 2 x ratchet straps

Date	Summary of Events
	
1st May 2020	LFI Investigation Report for gas exceedances on 6th and 7th April 2020 finalized and signed. One of the key findings was that the VCDs within the cut-throughs were considered damaged (not able to inspect them as they are in goaf area). These VCDs were allowing the ventilation to pass through the goaf and allow gasses to bleed out into C Hdg Roadway. Extracts from LFI report below.


Leaking VCDs - gas leaking into C Hdg
Brattice VCD
CH3500
CH3600
CH3700
CH3800
CH3900
CH4000
CH4100
CH4200
CH4300

Date	Summary of Events

Change Analysis

Normal Practice	Situation or practice at the time of the incident	Gap (difference)	Impact of Difference
Single Return in Longwall Panel	Dual Return Roadways back to 34c/t	VCDs within c/t assumed damaged allowing goaf atmosphere to enter C Hdg	General body concentrations of CH4 exceeding 2.5% at Tailgate O/B Sensor

Why Analysis

CH4 Greater Than 2.5% in Tailgate Return

VCD less than adequate to prevent leakage from goaf into General Body

VCD constructed after production commenced

Planned VCDs within cut-throughs damaged and allowing goaf atmosphere to enter C Hdg of TG104

Action assigned to Grosvenor Ventilation and Gas Superintendent - *upgrade and install in front of LW the VCDs in the TG (ensure the permits and vent changes are updated).* Action listed as due 8th May 2020, however noted in LFI report as "completed".

Date	Summary of Events
6th May 2020 2:57pm	Gas Ignition on LW104 face occurred resulting in serious injury to 5 CMWs Underground evacuated and power to the underground isolated
6th May 2020	Directive issued by DNRME – *no persons are to re-enter the UG workings until the UMM can demonstrate to an inspector of mines, that an acceptable level of risk has been achieved to permit re-entry to occur.*
9th May 2020	Directive Corrective Action submitted to DNRME to lift Directive issued 6th May 2020 MRE received from DNRME regarding permission for re-entry to commence New directive issued by DNRME – *the SSE is to ensure that the area defined by a mine's inspector as the accident site on Longwall 104 is isolated from all persons unless they are accompanied by a Mines Inspector*
10th May 2020	Re-entry to Underground Coal Mine in presence of DNRME (as per risk assessment)

Date	Summary of Events
12th May 2020	Commenced return to site of all Underground CMWs on their scheduled start of roster date to undertake safety, compliance and non-production (ancillary) activities to maintain the integrity of the mine Strata Risk Management Team (SMRT) formed at 10:30am in response to deteriorating conditions on the LW face, particularly around the TG corner and TG roadway area Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM: All, latest results are attached and I can see no indications of an increased oxidation rate, nor any sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8 Substantial stopping brattice stopping TG104 C 36-37 CT repaired (per original permit – snap jacks, ratchet straps, mesh). This had been damaged following the ignition on 6th May 2020.
13th May 2020	Commenced return to site of Surface Coal Mine Workers outside MIA

Date	Summary of Events
	Subsequent SMRT held at 4:10pm to formalise and document recovery process to achieve goals from previous meeting
14th May 2020	Following documents provided via email by SSE to Deputy Chief Inspector of Coal Mines: • Preservation of Longwall 104 Incident Scene Risk Assessment • Preservation of the Longwall 104 Incident Scene TARP (Draft) • Longwall 104 Incident Scene Activity Log • Toolbox Talk detailing process for Entry into LW104 Incident Scene This was accompanied by a letter for application for implementing risk-based control and communications process for managing the LW104 Serious Accident Scene. Confirmed that within the Longwall 104 Incident Scene area, approval to rectify compliance issues and any safety improvements/hazards must be received from Deputy Chief Inspector of Coal Mines. Observation on night shift ERZC report - *"TG goaf stream had slight smell of ground consolidation products".* Subsequent discussion with ERZC confirmed that "*I noted it due to something that smelled different to a normal LW GOAF stream/return" and* "*it did not smell like it was burning or smell of heat*". There were no further similar observations by the ERZC or other ERZCs on their reports thereafter. Of note, PUR was last pumped on 3rd May 2020. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM: All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2
15th May 2020	Following documents provided via email to Deputy Chief Inspector of Coal Mines: • Preservation of Longwall 104 Incident Scene TARP • Proposed preservation of incident scene permitted tasks (noting verbal approval from DNRME still required)

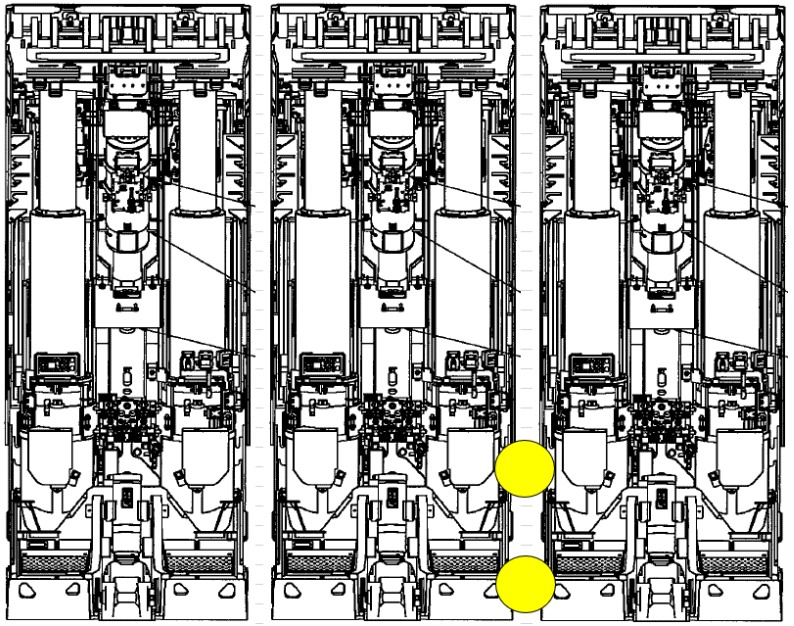
Date	Summary of Events
	Email returned from Deputy Chief Inspector of Coal Mines: • Amended preservation of incident scene permitted tasks • Confirmation that prior to any task, UMM to communicate and seek approval from DNRME Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM: All, latest results are attached and I can see no indications of abnormal oxidation, or analysis issues at this time. There are a few I'm not sure of location due to naming by the ERZC. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm Observation on night shift ERZC report – *"Bag samples taken from goafstream, TG general body return 36 to 37ct, and CHG 36 to 37ct (richest goaf stream)".*
16th May 2020	Strata Risk Management Team formed due to deteriorating conditions in the TG roadway, triggering Level 2 LW Strata Control TARP. Notes on TG conditions (and photos from minutes): • Rill material located adjacent the TG shield is restricting access to the TG. Pipes set up adjacent to rill material • The TG corner is heavily deformed and broken

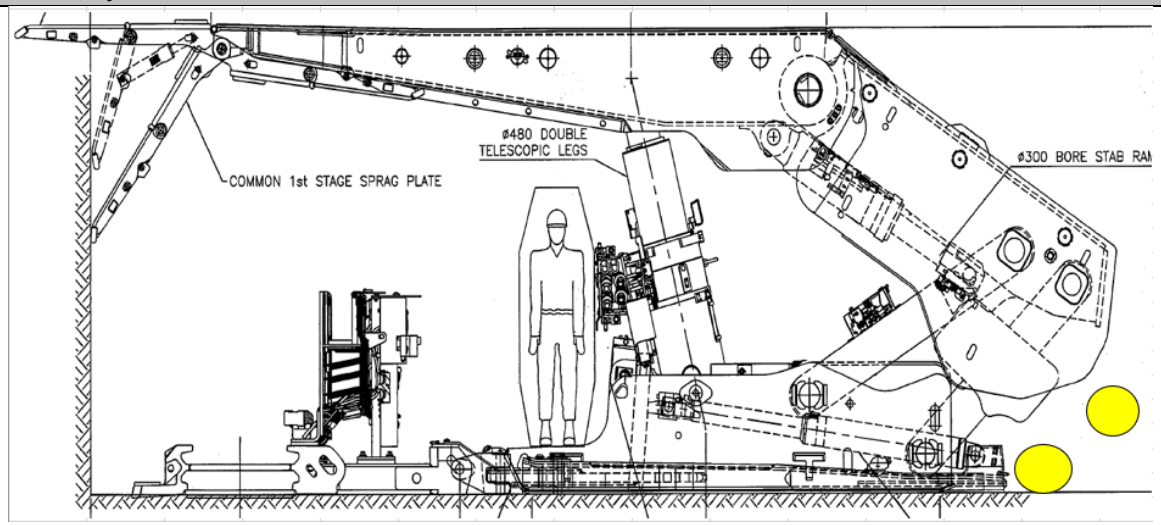
Date	Summary of Events
	 Figure 2: TG looking inbye from ~10m outbye face  Figure 3: TG looking inbye at the goaf from TG face

Date	Summary of Events
	 Figure 4: TG looking inbye from ~5m outbye  Figure 6: Access to TG from MG and #149 Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Thanks for the info Mark, I'll have those Baros updated. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
17th May 2020	Observation on day shift ERZC report – *"Bags taking from TG B hdg goaf stream and also bag taking from C hdg inbye 36ct edge of substantial stopping via tube installed on the rib (clearer version of goaf stream)".* Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8

18th May 2020	Implemented process for monitoring of LW104 faceline rear shield area for temperature and CO concentrations moving forward. These were recorded on a sheet and provided to the Undermanager each shift. Location for temperature checks: 

Date	Summary of Events
	 Ongoing bag sampling around #96 shield implemented moving forward, due to this being identified as the highest temperature and CO concentration from first survey. Note – ERZ Controllers used MX-6 to determine the highest CO concentration in the rear walkway and then take a bag sample from that (using similar logic to taking a conventional goaf stream adjacent to the TG roof support). Bag samples sent to Joncris for trending and review hereafter. Dayshift ERZC marked bag sample location at #96 with information tag, with approval from DNRME inspector. The following options were identified for preparation of the longwall being stood for an extended period: <u>Make C Hdg part of LW104 Active Goaf</u> • Option 1 - Install Flexi stopping C 36-37ct on outbye side of current brattice substantial stopping and inject from MG103 40-41ct C hdg Seal • Option 2 - TG104 C HDG 34ct to 37ct installation of 140kpa seals, inertisation (extend from 34ct) and tube bundle monitoring (use TB#12 and TB #13 from TG Seals and extend to 34ct and 37ct)

Date	Summary of Events
19th May 2020	Butchers flap rehung along tailgate area/carport on dayshift with approval from Deputy Chief Inspector of Coal Mines.
20th May 2020	Sherwood curtain erected in tailgate under JSEA with approval from Deputy Chief Inspector of Coal Mines. 400m tailgate roadway sensor changed out with approval from DNRME inspector. Following issues raised at morning Fewzion meeting with Undermanager, ERZ Controllers and operational / compliance representatives: • Classification of TG C heading and which TARP to apply to this area (General Body or Active Goaf) • High levels of CO at #96 shield • High levels of CH4 and CO behind TG104 C Heading 36-37c/t substantial stopping Subsequent discussion with Ventilation Officer to clarify the TARPs in application. Email below received by Undermanager from VO: *"…in regards to classification of and TARP used for bag samples taken from behind the TG104 C hdg 36c/t Substantial Brattice Stopping. The area is classified as Active Goaf and as such GRO-6953-TARP-Active Goaf Spontaneous Combustion is to be used".* Undermanager also contacted Michael Brady of Joncris Sentinel Services regarding the other issues raised at the morning meeting in relation to gas levels at #96 shield and behind the substantial stopping. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached. I had a request to look at 36-37ct from one of the Shift Managers but I don't see anything unusual with that location. I am however, keeping a close eye on the Goafstream, as there are a couple of results there that are beginning to raise an eyebrow. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • GR has increased at the Goafstream Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8 Email received from ISHR (CFMEU) to UMM requesting PGD and bag sample results taken from #96 shield and TG104 37-38 C hdg since the 18th May 2020. Also, any trending of CO make done of these including from TG 3-4ct 4-way. Also requested that the data be sent daily *"until the issue is resolved".*
21st May 2020	Sherwood curtain removed and venturi turned off at the TG under instruction of DNRME. SSE presented Spontaneous Combustion Mitigation options to DNRME. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. *The high Air Free results for the goafstream are correlated to the high oxygen (no face movement means a lot of things settle down – check temperature & raw Co for example) and these aren't a concern now I've gone back through the data and put Narrabri out of mind.* *All going well we should see #94 determine what 'normal' is for this location as it's not a point sampled and we have to take into account the airwash going in from the MG side.* *I see plenty of evidence of floxal gas into seal areas, and thanks for the plan Wes. I see no evidence of floxal gas at the goafstream.* Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • Face #96 Shield – GR 0.595. Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
22nd May 2020	SMRT meeting held at 8:30am to review convergence information since last SMRT held on 16/05/20, review current status of support installation as per 2020_051, review the plan for TG shield convergence considering feedback from the DNRME, and review the status & proposed plan of achieving hydraulic power onto the face. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. **Dick Hart has a sample named (on GC Sheet) as MG104 2ct B Hdg but I'm pretty sure this isn't the right name. Can I get a correct location please?** Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • #94 Shield – GR dropped to 0.33 Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
23rd May 2020	Permit to Relocate TB#13 from TG104 24ct seal to TG104 36-37c/t completed. Data requested by ISHR on 21st May submitted via email from UMM (Temperature and CO on LW104 shields and return airway including bag sample results). UMM noted "*All recorded values show no indications of abnormal oxidation. Both Ben and myself are of the belief that we do not currently have any spon comb issues and as such regarding this matter resolved".* ISHR replied seeking copy of raw bag sample results for 21st and 22nd as requested (including higher order carbons), "*so that I may review and I will not require any further if results indicate normal".* UMM forwarded requested results. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. #94 has settled, goafstream GR value is correlated to the higher than usual O2 due to no coal cutting and resultant increased gas make. Higher the O2, the smaller the O2 Deficiency and with a stable CO value, we are getting the current GR values. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI; Goafstream GR >0.3 Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
24th May 2020	Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. **Goafstream GR still above 0.3 – same comments as yesterday apply** Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI Goafstream GR >0.3 Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
25th May 2020	Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. **Goafstream CO and related indicators are gradually increasing and vigilance is still required.** Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • **FYI – Goafstream GR >0.5 over last 2 samples.** Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
26th May 2020	Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI - Goafstream GR >0.4 Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8 Second email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI – Goafstream GR - >0.38 Sealed Goaf – • Oxygen Level of >8% <12% • Carbon monoxide ≥ 100ppm ≤ 200ppm • Grahams ratio ≥0.1 <0.8
27th May 2020	Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM: All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI – Goafstream GR >0.36, #94 Shield >0.42

Date	Summary of Events
29th May 2020	SMRT weekly meeting held at 8:00am to review current face conditions, convergence since last meeting, TG roadway conditions, status of achieving longwall face pressure, consolidation plan. Dayshift ERZC noted leakage from Substantial stopping in TG C heading 36-37ct. Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM: All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI - #94 Shield GR >0.52
31st May 2020	Email from Michael Brady of Joncris Sentinel Services to Dr Bharath Belle, CRO, Undermanagers, Ventilation Officers, Ventilation and Gas Superintendent, Technical Services Manager and UMM:

Date	Summary of Events
	All, latest results are attached and I can see no indications of abnormal oxidation, sample collection or analysis issues at this time. Johnno, will call you later. Comparing with the Spon Com TARP Triggers, I note no values exceeding; • CO Make >42l/min <53 l/ min • Graham's Ratio >0.3 <0.5 • CO/CO2 > 0.2 Active goaf – • Carbon monoxide ≥ 130ppm ≤ 200ppm • FYI - #94 Shield GR >0.52
2nd June 2020	Spontaneous Combustion Management Team (SCMT) formed at 3:00pm due to a combination of increase CO make and shield #96 triggering L2 TARP Active Goaf – Spontaneous Combustion Graham's Ratio > 0.5 Mitigation Strategy Options discussed: • Reduce goaf drainage of GRO4M001.5 down to 300l/s and monitor change • External specialist to assess current readings • Use smoke tubes to detect possible ventilation flow between rear walkway and goaf • Install fixed sample points at #91, #96 and #101 for consistency with bag samples • Establish sample point location at #96 • Cavity fill MG and / or ingress paths • Silent seal substantial stopping in TG 104 C Hdg 36-37 ct • Construct seals in TG 104 between B and C Hdg at 35 and 37 ct

Date	Summary of Events
	Further Options discussed: • Investigate potential for dry ice in between shields for inertisation • Consider turning off GRO4M001.5 and other Goaf drainage holes • Investigate options of injecting floxal into GRO4M001.5 or other goaf wells • Investigate other monitoring options • Nitrogen Foam injection unit on standby at Dysart • Current nitrogen to 104 goaf 1 notch to all balance chambers, 1 notch to goaf edge at TG104 41-42 B Hdg and MG104 39ct B-C Hdg Actions documented in Ventilation & Gas Advice Form (2020_01)
3rd June 2020	Spontaneous Combustion Management Team (SCMT) re-convened at 4:00pm chaired by UMM Additional Mitigation Strategy Options discussed: • Turn on nitrogen to MG104 all seals x 1 notch to goaf edge (already 1 x notch in balance chamber) • Change plant to 2% and if volume is required put back to 3% (permits to be completed) Actions documented in Ventilation & Gas Advice Forms (2020_02a, 2020_02b, 2020_02c) Strategies completed on 3rd June (including night shift): • Reduce goaf drainage of GRO4M001.5 down to 300l/s and monitor change • Use smoke tubes to detect possible ventilation flow between rear walkway and goaf • Install fixed sample points at #91, #96 and #101 for consistency with bag samples • Turn on nitrogen to MG104 all seals x 1 notch to goaf edge (already 1 x notch in balance chamber)

Date	Summary of Events
	Detection of Oxygen leakage paths in Longwall rear walkway using Smoke tubes. • On Wednesday 3/6/2020 I assisted the Deputies on shift with their heat and convergence measuring. While this took place, I used smoke tubes to test for paths of oxygen ingress, from the Maingate brattice along to #6 shield and in the rear walkway from #6 to #106 shield. • There was airflow into the goaf around the brattice wing positioned at the maingate between the pillar and #1 chock. There is also airflow into the goaf above the brattice curtain, lining the front of chocks #1 to #6. • Smoke tubes where used to verify the behavior of the ventilation in the back of the shields between #6 to #106. • Testing included checking behind the pontoon area near the floor, around the laniscape and comp set ram, side shields and in-between the individual chocks. • No unusual behavior of the ventilation was noted, the turbulent velocity could be seen removing the smoke from the rear of the shields, back into the main ventilation circuit. Reece Campbell Also completed on night shift: • Additional snap jacks installed by the ERZC to sure up the TG104 C Hdg 36-37c/t Substantial stopping
4th June 2020	Spontaneous Combustion Management Team (SCMT) re-convened at 12:00pm chaired by UMM Additional Mitigation Strategy Options discussed: • Get the floxal plant to full capacity

Date	Summary of Events
	• Turn GRO4L003-1 off completely • Run dedicated Tube bundle to #96 • Site intro for the Tomlinson boiler • Setup so samples from goaf holes that are shut in can be obtained with tube bundle. Source equipment required to achieve. • Emergency sealing options - Order E pass seals Actions documented in Ventilation & Gas Advice Forms (2020_03a, 2020_03b, 2020_03c) Strategies completed on 4th June (including night shift): • GC data sent to external specialist to assess current readings • MG104 36c/t injection point opened up to goaf edge • DSI mobilised in 35ct and pumped mine fill from 1-6 chock to reduce ventilation flow into goaf (pumped approx 70m3) • Tested airflow with smoke tube - nil air movement through grout plug

5th June 2020	Spontaneous Combustion Management Team (SCMT) re-convened at 12:00pm chaired by UMM
	
	New actions:
	• Complete smoke tubes to detect possible ventilation flow between rear walkway and goaf
	• Send new data to external specialist for review (ongoing)
	• Complete the ventilation modelling to reduce face across the face
	  ○ What changes that need to be completed to regulating the end panel shaft
	  ○ Knife gate, TG regulator
	  ○ Optimal pressure across the face
	• Tomlinson boiler to be commissioned and ready for use
	• Develop a preliminary scope of works for Emergency Sealing options to be reviewed at the IMT meeting
	• Nitrogen Foam injection unit in Dysart to be mobilised. Foam to be purchased.
	
	Strategies completed on 5th June (including night shift):
	• Location for Tomlinson Boiler identified
	• Completed smoke tubes

Date	Summary of Events
	• Silent seal substantial stopping in TG 104 C Hdg 36-37 ct Full list of actions and progress updates available in SCMT minutes.
6th June 2020	Spontaneous Combustion Management Team (SCMT) re-convened at 08:00am chaired by UMM Key new items / actions: • Shut down Goaf wells • TG regulator set to Level 3 • Ensure no personnel in TG • Ventilation department to generate predictive trends for TARPs • Ensure 3rd Floxal unit available • Ventilation crew to start construction of #36ct seal • Increase nitrogen at rear seals Full list of actions and progress updates available in SCMT minutes. Spontaneous Combustion Management Team (SCMT) re-convened at 12:15pm chaired by UMM (now attended by SSE) Team discussed ventilation predictions conducted by external expert as follows: • Likely that the CO Make Level 3 Trigger will be reached by midnight tonight (both tube 22 and 26) • Graham's ratio is not likely to reach the Level 3 trigger for tube 26 before the 22 June (at which time Goaf Stream Graham's ratio would be 10) • Data set for Tube 22 too small to be reliable • Of significance is the prediction of Goaf Stream results - Graham's ratio was noted as likely to be over 1 before midday 6th June 2020 and over 2 just after midnight the next day (assuming the intensity stayed the same) Key new items discussed at SCMT • Update ventilation model to optimise face ventilation and goaf seal pressures

Date	Summary of Events
	• Finalise ventilation change procedure and implement to reduce pressure across perimeter road seals. • Finalise vent change procedure and present for review / approval to reduce LW face quantity • Split MG104 belt and monorail Full list of actions and progress updates available in SCMT minutes. After shutting in goaf wells at 8:40am, the TG Outbye sensor reached and exceeded 2.5% CH4 at 12:50pm. Note – reported as HPI and LFI later completed. Spontaneous Combustion Management Team (SCMT) re-convened at 4:00pm chaired by UMM Decision made to proactively control personnel from not entering the mine on nightshift, other than personnel under direction of the IMT to make amendments to Nitrogen injection lines. Undermanager was actioned to address N/S crews before sending them home. Portals no roaded once all personnel were out of the mine at the end of day shift and pins removed from the portal sealing doors. Full list of actions and progress updates available in SCMT minutes.
7th June 2020	Spontaneous Combustion Management Team (SCMT) re-convened at 7:30am chaired by UMM Current ventilation strategies were deemed to have not achieved inertisation of the combustion source, with two mains strategies discussed moving forward – conduct a ventilation change or increase inertisation. IMT agreed to prioritise the ventilation change to reduce the LW face ventilation quantity as much as possible to reduce as much differential pressure across the goaf as possible. Full list of actions and progress updates available in SCMT minutes. ***GRO-10758-RA-Ventilation Changes to Mitigate Accelerated Oxidation*** completed and presented to DNRME

Date	Summary of Events
	Permit to Change Ventilation VC0091 completed and signed off by VO, Undermanager and UMM (email approval also from EEM) Multiple emails between SSE and Chief Inspector of Coal Mines detailing completion of actions from RA 10758 to support commencement of ventilation change by Night Shift Undermanager (final email acknowledgement from DNRME at 10:29pm) Permit to Change Ventilation VC0091 signed on by ERZ Controllers & Undermanager on shift JSEA completed – 'Conduct Gap Analysis of RA for VC0091' to confirm timings associated with closing TG regulator and exiting the mine
7th June 2020 11:45pm	Ventilation Change Procedure steps commenced
8th June 2020 1:15am	All ventilation change steps underground completed
8th June 2020 1:30am	CMWs involved in the task return to the surface Underground mine was restricted to all CMWs
8th June 2020 1:37am	Final step in ventilation change completed from surface (adjust the knife gate on shaft 9)
8th June 2020 1:40am	CRO contacted to confirm Ventilation Change complete
8th June 2020 2:45am	Ignition of methane in LW104

4.2 Control Analysis

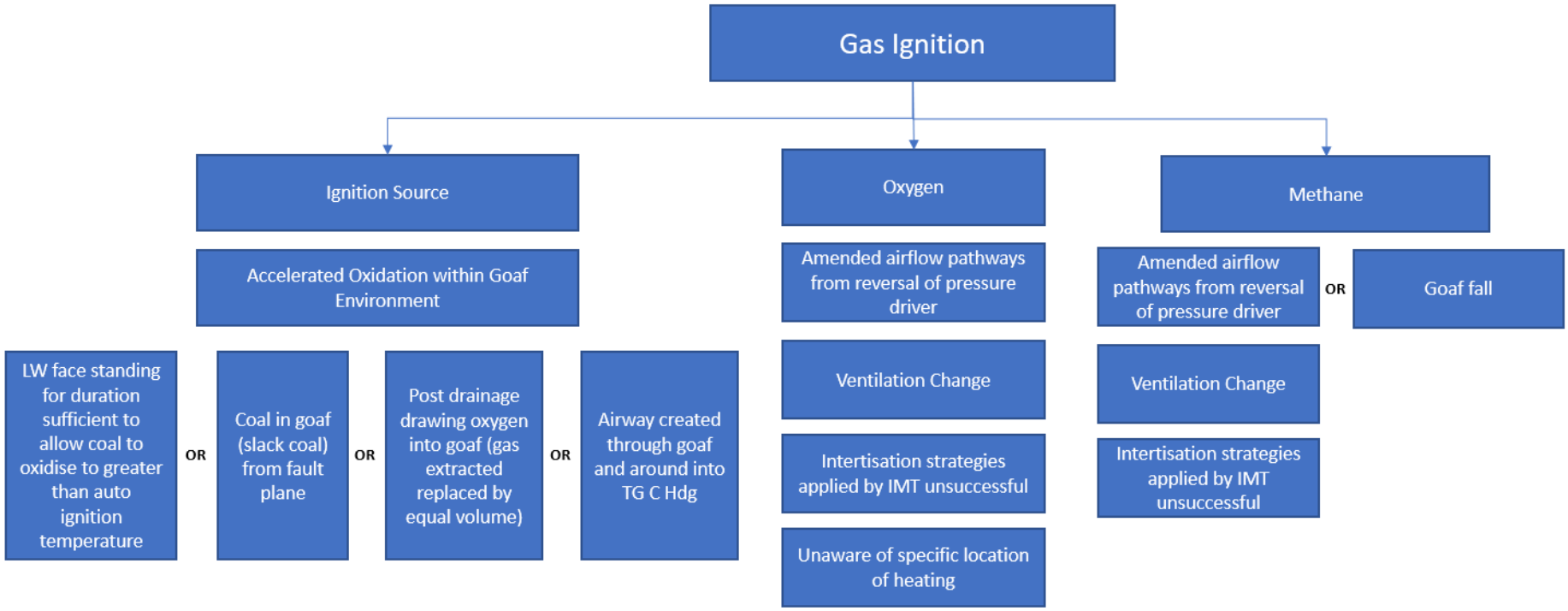
Unwanted Event: Spontaneous Combustion			
Hazard: Heating Event			
Absent OR Failed control and support systems	**How did they perform?**	**Why?**	**Outcome**
VCDs in MG103 B-C Hdg c/t's (inbye of 34c/t)	Compromised	Suspected abutment load from LW goaf caving greater than anticipated	Ventilation pathway created from goaf into C Heading
			Potential pathway for oxygen through goaf over heating source
		No passive support protection installed either side of VCDs in c/t (compared to standard seal passive support)	Ventilation pathway created from goaf into C Heading
			Potential pathway for oxygen through goaf over heating source
		Observed conditions differed to predictive ventsim modelling	Ventilation pathway created from goaf into C Heading
			Potential pathway for oxygen through goaf over heating source
C Heading Substantial Stoppings VCD	Compromised	VCD unable to handle pressure exerted by ventilation system	Ventilation pathway created from goaf into C Heading
			Potential pathway for oxygen through goaf over heating source
Active Goaf TARP Triggers	Partially Effective	No triggers contemplated for Goaf Stream Spontaneous Combustion indicators	Lost opportunity for earlier evacuation
		No triggers contemplated for point source Spontaneous Combustion indicators (e.g. shield #96)	Potential lost opportunity for earlier intervention / escalation (e.g. additional monitoring, further detailed analysis of data, investigative processes)
		Withdrawal triggers not conservative enough	Lost opportunity for earlier evacuation
Ventilation System	Impeded	Deteriorating strata conditions on the LW face	Increased ventilation resistance and in turn pressure across the face
		Restricted access to incident scene as a result of the 6th May 2020 incident	Mine personnel restricted from implementing controls to manage strata at the TG
	Partially effective. Did not fully manage CH4 at TG if post drainage fails	Extent of pre-drainage (reliant on post drainage to be fully effective)	Reliance on high longwall ventilation quantities and pressure to manage TG methane load
			Increased spontaneous combustion risk
Methane pre-drainage	Partially Effective	Underlying and overlying methane bearing seams have significant impact on LW TG methane levels	Reliance on post drainage measures

		Elevated methane levels in TG roadway when post drainage system reduced	Reliance on higher post drainage density (TARP driven) leading to potential to move oxygen and explosion fringe around goaf
Inertisation Strategy	Partially effective. Extent of flow to LW104 (did not achieve inertisation)	Resistance in reticulation system (lack of ring main circuit – single series pipeline only)	Low nitrogen flows at inbye of LW104 system
		Monitoring system did not identify nitrogen flow	No clear understanding of flow and therefore volume at specific locations within the mine
		Significant amount of nitrogen used in adjacent LW103 goaf for TG gas management purposes	Limited remaining nitrogen for LW104 utilisation

4.3 Change Analysis

Normal Practice	Situation or practice at the time of the incident	Gap (difference)	Impact of Difference
Bleeder road to ventilate second roadway	Dual Return Setup	C Heading part of Tailgate	Undesirable air circuit if VCDs fail (goaf reporting to C Heading)
Install permanent seals in TG	14kPa VCDs constructed in MG103 B-C Hdg c/t's (inbye of 34c/t)	Lower strength of seals	Ventilation setup relied on integrity of VCDs in MG103 c/t's
Longwall progressing outbye	Longwall stationary since 6th May 2020	Promoted / easier oxidation of coal in goaf, particularly with fractured coal from fault plane	Increased spontaneous combustion risk
Maximum resource recovery	Slack coal left behind from Longwall negotiating fault plane	Coal resource left in goaf	Increased spontaneous combustion risk
No ignition of gas (6th May 2020 event)	Potential residual heat generated from 6th May event (no evidence from data)	Promoted / easier oxidation of coal in goaf	Increased spontaneous combustion risk
Implementation of measures to reduce SC risk (e.g. VCD construction, control strata at TG end of LW to maintain goaf stream path etc.)	Limited opportunity for early intervention	Restricted access to incident scene as a result of the 6th May 2020 incident	Potential lost opportunity to implement control measures before Spontaneous Combustion escalated
Sufficient methane pre-drainage (potentially multiple coal seams required)	Additional post drainage and high ventilation quantities required to manage TG methane levels	Reliance on post drainage measures	Greater differential pressure across LW face and goaf
Roof supports left back in line with shearer	Roof supports double chocked around shearer	Higher resistance on LW face (reduced cross sectional area)	Greater differential pressure across LW face and goaf

4.4 Why Analysis



5 FINDINGS

5.1 Contributing Factors – Spontaneous Combustion

The below factors are most likely to have contributed to the Level 2 spontaneous combustion event commencing 2nd June 2020 and subsequent decision to withdraw personnel on 8th June 2020.

1. Standing of Longwall

Following the events of 6th May 2020, the longwall at Grosvenor remained stationary and the area was quarantined as an incident scene under the control of the DNRME. The impact of this was twofold. Firstly, Grosvenor mine personnel had limited ability to conduct rectification works on hazards that may have reduced Spontaneous Combustion Risk, for example VCD construction / repair or control of strata at the tailgate end of the longwall to maintain an uninhibited ventilation pathway. Furthermore, due to the fault plane on the face, the roof supports had been advanced (double chocked) in this area; resulting in reduced cross sectional area and in turn increased resistance. Secondly, lack of retreat always presents a heightened risk of spontaneous combustion as it allows a continual ventilation pathway through the goaf environment. This coupled with fractured coal in the goaf due to navigating through the fault plane presented an even further heightened risk of spontaneous combustion.

It is acknowledged that due to the serious nature of the events on 6th May 2020 and the need to conduct a thorough investigation to determine its cause, moving the longwall was not an option.

2. TG104 Ventilation Setup

A contributing factor to the ventilation pathway through the goaf that is possible to have accelerated the oxidation process, was the setup of the ventilation system for the LW104 block. In previous longwall blocks at Grosvenor, the bleeder (companion) road has been used to ventilate the second roadway. LW104 was the first block at Grosvenor where a dual return was used as there was no bleeder road as it had been successfully sealed in as part of the LW103 sealing prior to commencing production in LW104.

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. As such, the mine proceeded with the documented plan to run dual returns down to TG104 34c/t and thereafter a single return outbye of TG104 34c/t. The strategy included the installation of 14kPa VCDs in each cut-through from TG104 34c/t to 41c/t. While with the benefit of hindsight an alternative option could have been to install standard seals instead, it is important to note that these were not required by any regulation or procedure and the dual return setup was only planned to be short term until the longwall passed TG104 34c/t.

The 14kPa stoppings are suspected to have been compromised due to the abutment loading from LW104 (with further potential damage from the 6th May 2020 ignition event). This was identified during the investigation into the gas exceedance events that occurred on the 6th and 7th April 2020. Actions from both the IMT and the Learning from Incidents (LFI) report, recognised the issue and the substantial stoppings were implemented as a means to control the goaf stream reporting to C Heading. Had the longwall continued to retreat past 34 c/t, it is highly unlikely that there would have been any major issues with this approach, however when combined with the events of 6th May 2020, whereby the longwall was stood for a significant period and access into the tailgate was restricted, a pathway of least resistance began to form as fresh air

from the ventilation system passed through the goaf and around into C Heading rather than via the tailgate end of the longwall.

Ventsim model suggests around 50Pa-70Pa differential pressure on the TG104 C36-C37 stopping (based on the ventilation quantities in and around the LW circuit on the 6th of June). This takes into account modelling the ventilation control device in 40c/t damaged (with minimal resistance) and a brattice substantial stopping installed at C36-C37. 50Pa-70Pa pressure for a 3.7 metre by 5.4 metre roadway equates to around 100-140kg of force against the stopping. This would not be deemed to be excessive for a substantial brattice stopping constructed as per the installation permit (with snap jacks, mesh, ratchet straps etc).

Note however that the ventsim simulation does not take into the account the following:

- The shields at the shearer being double chocked,
- The additional TG support (props and cogs which were erected in the TG between the PCB's and the block side rib)
- The TG floor heave reducing the TG roadway height to ~2.1m between the block side rib and PCB's
- The poly pipes layed across the TG carport to allow for ventilation in case we lost it
- The gap between the TG carport and the underside of the canopy on #149 shield only being approximately 1.3m
- Impact on ventilation system from goaf holes being turned on/off

Therefore, the 50Pa-70Pa is an estimated only based on the limitations of the model.

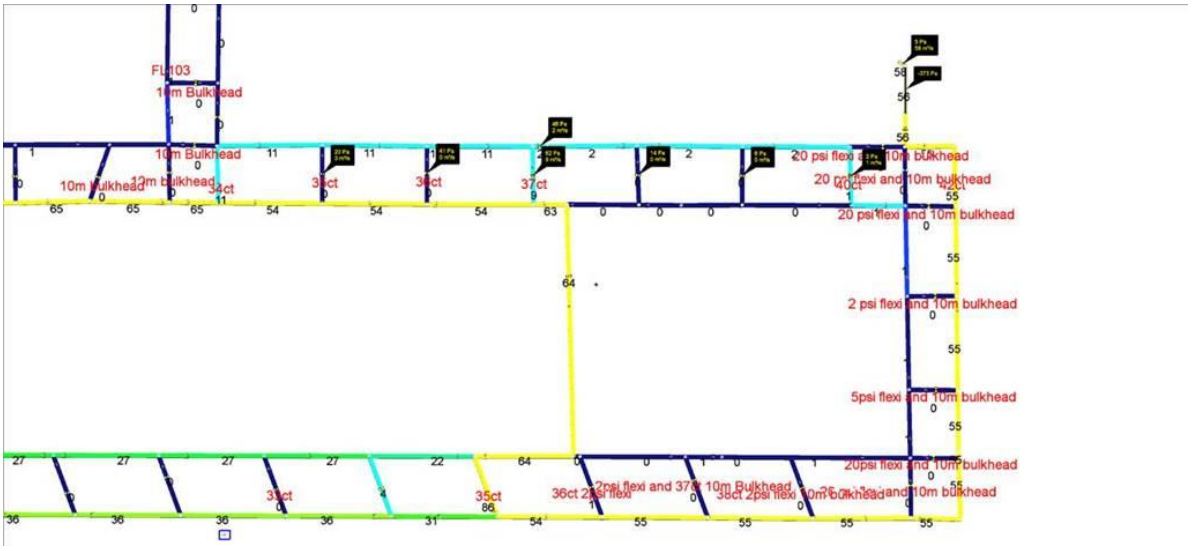


Figure 11: Ventsim Model simultated as of 2nd June 2020

This data challenges whether the impact of the damage / deterioration in one (at least) of the VCD's in the inbye cut throughs in the TG was adequately assessed and controlled accordingly. Given the original SOP was reliant on at least 14kPa rated VCDs in the cut throughs to be maintained, the use of a substantial brattice stopping in C heading was a change from the intent of the LW104 TG ventilation system

The above considered, it is recommended that in future, a higher level of control be applied when designing the ventilation system with dual returns within a Longwall Tailgate roadway, to prepare for extenuating circumstances such as that experienced at Grosvenor. That is, to install standard seals around the perimeter of the longwall, with passive support provided to ensure they maintain integrity as the longwall retreats.

3. TARPs

GRO-6953-TARP Active Goaf Spontaneous Combustion does not contemplate response levels for monitoring at the goaf stream or localized heating indicators. For example, there was no response level required when the #96 shield Graham's ratio exceeded 0.5 on the 21st May 2020 or for the goaf stream once the Graham's ratio exceeded 0.5 on 25th May 2020. It cannot be concluded that use of an IMT at this time would have led to a different response, as other Spontaneous Combustion indicators, such as CO make in the longwall return, had not escalated. However, it may have created a heightened sense of awareness and potentially better preparation of tube bundle monitoring points and emergency preparation seals in the event this did escalate.

Even if the recommendations from the report provided by Darren Brady in January 2020 had been implemented prior to the incident, it is important to note that while a goaf stream trigger would have been in place, it would not have escalated to Level 2 any sooner than 2nd June 2020 when the IMT at Grosvenor was first convened. The report recommended a Trigger 2 value for Graham's ratio between 0.6 and 1.2 for the goaf stream, which would have first been triggered on 3rd June 2020. However, the recommendations from the report would have triggered a withdrawal of the mine on 6th June 2020. The SSE at Grosvenor made an executive decision to proactively withdraw non-essential personnel from the mine on 6th June night shift despite Level 3 TARP not being reached. While this is to be commended, having a clear and conservative level of withdrawal would in future provide greater assurance that this decision would be repeated and not reliant on individual judgement.

It is further noted that with respect to the Spontaneous Combustion TARPs, that there is limited prescription of minimum actions and considerations to be taken in response to an event by the IMT. While it is important that the IMT have the ability to manage each event based on the dataset available and specific environmental conditions, a series of actions and considerations would aid in prompting the team to undertake that are most likely to control the event.

4. Intertisation Strategy

With the U ventilation system of the LW104 panel and companion road ventilated by the MG103 C41 shaft, the differential pressure induced by this downcast shaft arrangement results in highest pressure across the seal in closest proximity to the downcast shaft, that is, the MG103 C40-C41 and 41c/t seals. It must be noted however that from analysing the data provided from the ERZ Controller bag sampling tags (when taking bag samples from the goaf seals), maximum pressure differentials across the LW104 companion road seals were around 300Pa, which is well below the maximum permitted differential pressure of 500Pa in ***GRO-15-PHMP-Ventilation.***

A	B	C	D	E	F	
ID	Location	Emp Name	Date	Baro	Seal Press	Total F
12800	MG103 40-41ct C seal	Lawrence	31-Mar-20	986	0	
12833	MG103 40-41ct C seal	Sharpe	03-Apr-20	986	0	
12837	MG103 40-41ct C seal	Sharpe	04-Apr-20	986	0	
12847	MG103 40-41ct C seal	Sharpe	05-Apr-20	984	0	
12860	MG103 40-41ct C seal	Sharpe	06-Apr-20	986	0	
12932	MG103 40-41ct C seal	Priest	13-Apr-20	986	0	
12998	MG103 40-41ct C seal	Dando	19-Apr-20	984	0	
13006	MG103 40-41ct C seal	Dando	21-Apr-20	989	-280	
13018	MG103 40-41ct C seal	Hart	22-Apr-20	989	300	
13083	MG103 40-41ct C seal	Bishop	30-Apr-20	986	0	

It is noted that the differential pressure readings on file are sparse and that there is opportunity for improvement to ensure a more robust collation, validation and interpretation process.

The pressure then reduces outbye around the goaf edge and companion road accordingly so the lowest differential pressure at the time of the incident would therefore be the MG104 36c/t VCD. Whilst attempts

were made to construct intertisation chambers via installation of 14kPa stoppings on the goaf side of the Type C (140kPa) seals around the LW104 companion road and inertisation injection, to aid in minimising oxygen ingress into the goaf from a pressure imbalance across the seal, it appears this was not as effective as first planned. For example, the following graph shows the oxygen levels monitored in the goaf behind each seal (on the goaf side of the inertisation chamber 14kPa stopping), for each of the LW104 companion road seals.

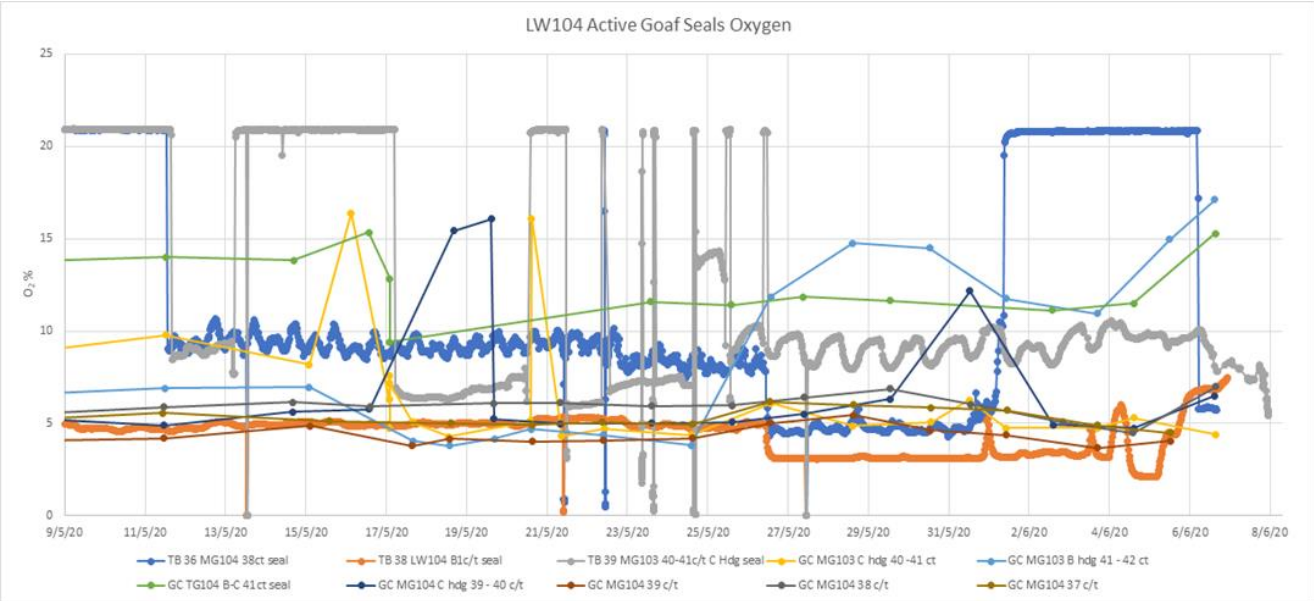


Figure 12: LW104 Active Goaf Seals Oxygen

Note that despite inertisation being injected into the majority of these seals, the oxygen levels at the inbye seals (closest proximity to the downcast shaft and highest differential pressure and risk of oxygen ingress), shows that the impacts of Nitrogen injection appear limited. For example, MG103 41c/t B-C heading seal had around 14% oxygen up to around the 17th of May before then being maintained at around 11% oxygen thereafter.

Likewise, the MG103 C40-C41 seal appears to have 8-10% oxygen consistently and fluctuating with the barometric pressure (movements of +- 2% oxygen accordingly).

Then when interrogating the nitrogen levels in these samples (for example in the MG103 C40-C41 data set below), shows Nitrogen levels ranging between 54% and 74%, yet 98% Nitrogen was supposedly being injected into this area.

A	B	C	D	E	F	G	H	I	J	K	L
ID	Location	Emp Name	Date	Baro	Seal Press	Total Fan Press	rflow M3 Per Se	Wet Bulb	Dry Bulb	Sample O2 %	Sample N2 %
12800	MG103 40-41ct C seal	Lawrence	31-Mar-20	986	0	0	0.5	0	0	16.2232	68.8068
12833	MG103 40-41ct C seal	Sharpe	03-Apr-20	985	0	0	0.5	0	0	14.9079	68.8271
12837	MG103 40-41ct C seal	Sharpe	04-Apr-20	985	0	0	0.5	17	21	13.4553	67.7634
12847	MG103 40-41ct C seal	Sharpe	05-Apr-20	984	0	0	0.5	15	23.5	12.8992	64.8596
12860	MG103 40-41ct C seal	Sharpe	06-Apr-20	986	0	0	0.5	25.6	23.6	14.0967	70.064
12932	MG103 40-41ct C seal	Priest	13-Apr-20	986	0	0	0.5	18	19	14.9743	72.7609
12998	MG103 40-41ct C seal	Dando	19-Apr-20	984	0	0	0.5	0	0	9.9371	73.9307
13006	MG103 40-41ct C seal	Dando	21-Apr-20	989	-280	0	0.5	0	0	10.6206	71.8077
13018	MG103 40-41ct C seal	Hart	22-Apr-20	989	300	0	0.5	13	15	8.8489	67.0814
13083	MG103 40-41ct C seal	Bishop	30-Apr-20	985	0	0	0.5	0	0	10.212	54.4443

The key observation here is that there appears to be little Nitrogen flow in the inbye seals toward the end of the Nitrogen pipeline (which had the highest differential pressure). The preferred end state would be to have greater Nitrogen flow available at the inbye seals closest to the downcast shaft. In the case at the time of

the incident however, with a single pipeline in MG104 “B” heading fed from the Mains, there is significant resistance in the network. However, there are no triggers / prompts for oxygen levels behinds seals in the Active Goaf TARP, therefore there was no formal process for reacting to conditions similar to those observed. In comparison, in the Sealed Goaf TARP, oxygen is triggered accordingly.

The inertisation pipework / layout as of 2nd of June in the LW104 perimeter (before any changes made during the Level 2 TARP trigger events from 2nd of June onwards as per IMT directions) was as per Figure 13 below.

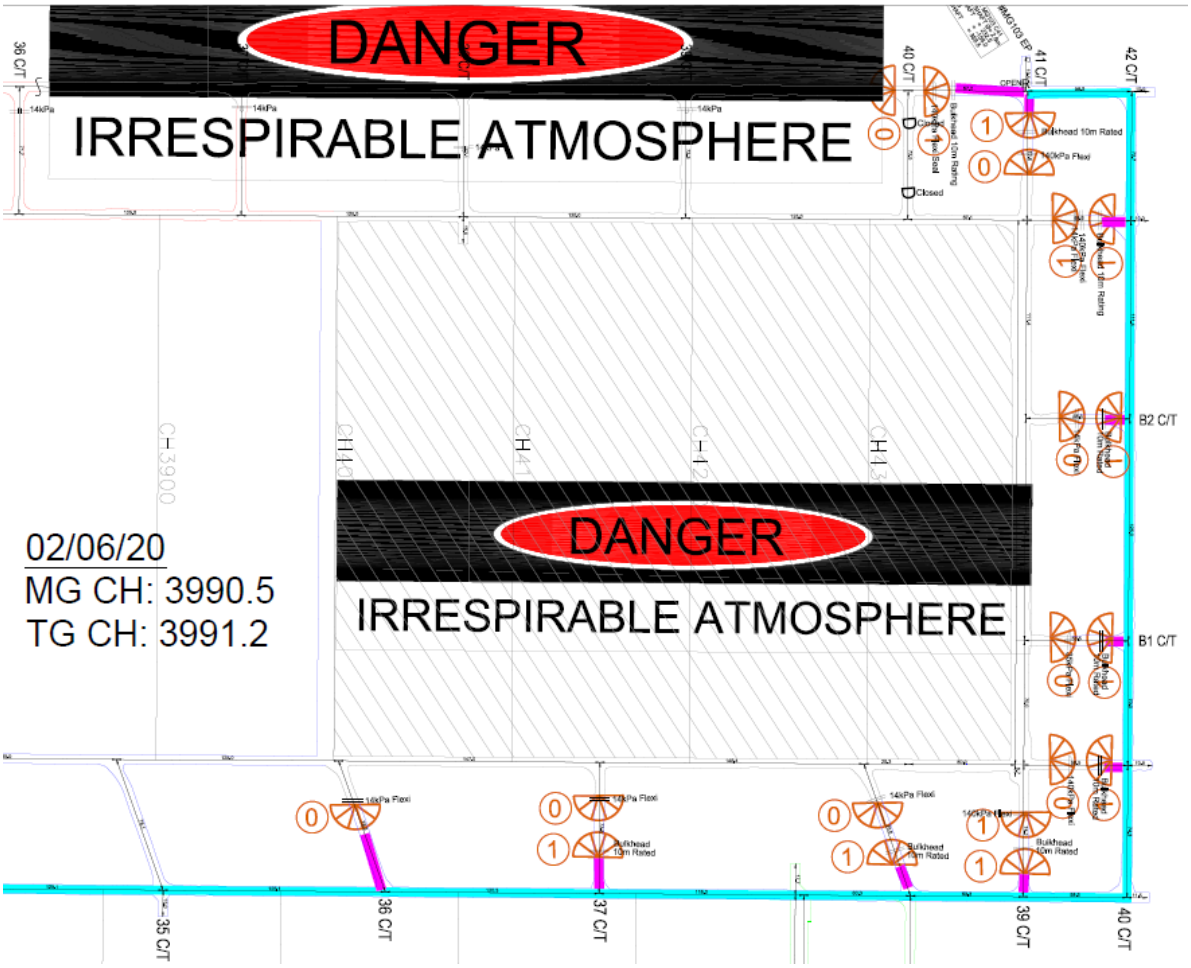


Figure 13: Inertisation Pipework / Layout as at 2nd June 2020

The inertisation pipework / layout as of 23rd of June in the LW104 perimeter (after implementing changes during the Level 2 TARP trigger events from 2nd of June onwards as per IMT directions) was as per Figure 14 below.

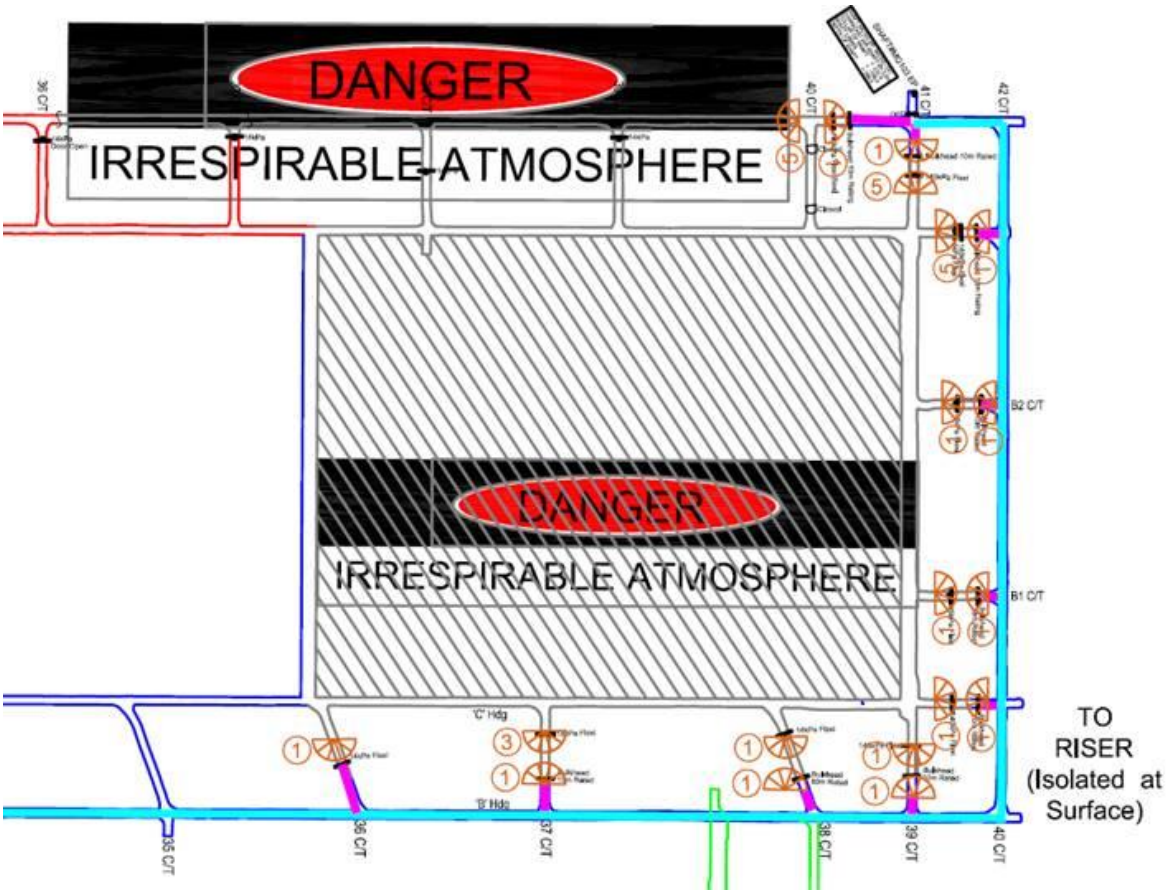


Figure 14: Inertisation Pipework / Layout as at 23rd June 2020

Despite two Floxal (Nitrogen) plants running at full capacity into the UG Workings it now appears that a large portion of this Nitrogen was being injected into the adjacent LW103 goaf, with little Nitrogen making it to the inbye end of the LW104 perimeter pipe range and in turn into the goaf through the seals closer to shaft 9 (with the highest differential pressure across them).

It appears that the UG Nitrogen injection reticulation system did not provide adequate flow to the inbye seals of the LW panels in the current configuration. Further investigation highlights lack of flow meters installed to identify the flow into each gateroad / LW panel. It is recommended to develop a Nitrogen (inertisation) strategy / procedure that adequately captures the required design and monitoring parameters so sufficient flow is available to meet the intended purpose of the inertisation chambers behind the goaf seals and in turn, reduce the oxygen ingress and spontaneous combustion risk.

It is also recommended to including seal differential pressures in the active goaf TARP to aid in managing pressure differential impacted oxygen ingress paths. This will require careful consideration based on statistical data of the four previous extracted panels for inbye the airwash zone.

A further recommendation is to consider whether measuring of oxygen levels at the inertisation chambers should be captured by the mine's critical control monitoring process.

5.2 Contributing Factors – Gas Ignition

The below factors are likely to have contributed to the over pressure event and gas ignition, on 8th June 2020 at approximately 2:45am:

- Accelerated oxidation occurring within the goaf environment.
- Reversal of pressure driver (MG becoming the low-pressure side of the face instead of the TG), amending airflow pathways and in turn oxygen / methane levels within the goaf environment.
- >5% methane being drawn across the location of the accelerated oxidation event site.

The above are not discussed in further detail in this report, as ultimately, the ignition was a secondary impact as a result of the spontaneous combustion event at the mine. The recommendations provided above to manage the spontaneous combustion event would in turn significantly reduce the likelihood of the ignition having occurred. It is again noted that the decision to withdraw personnel in advance of TARP triggers and as part of the ventilation change risk management process, was undertaken to ensure that no personnel were present in the underground workings when the ignition occurred.

5.3 Additional Opportunities

Additional opportunities were identified during the course of the investigation. While these may not be contributing factors to the event, they are provided for the consideration of mine management to ensure continual improvement of the mine's systems and processes.

1. It was identified during the investigation that the ventilation quantity across the LW 104 face was around 72m^3/s to assist in managing TG methane levels during LW104 production, coupled with an extensive post goaf drainage system drawing up to 7,000l/s of goaf gas from the waste working – albeit a rather small volume (LW had only retreated just over 400 metres). There is evidence to suggest that once the remaining post goaf drainage system was turned off on the 6th of June, the ventilation system wasn't capable of dealing with the additional methane liberating into the TG roadway (which resulted in a rise from 1.0% to up to 3.0% methane). At that point, the post goaf drainage system had been reduced over time (after the incident on the 6th of May) to around 1,800l/s of goaf gas on the morning of the 6th of June.

   It is recommended to further identify the pre-drainage opportunities (both underlying and overlying methane bearing coal seams) through detailed gas reservoir analysis to reduce reliance on ventilation quantities and post goaf drainage measures. This in turn will reduce differential pressures across the face and goaf, and in turn spontaneous combustion risk.

2. During the review of data collected by ERZ Controllers using Personal Gas Detectors, it was identified that there are some minor inconsistencies in the naming of sample locations. Furthermore, it was discussed with ERZ Controllers who were sampling in the lead up to 2nd June, that there was not a consistent understanding regarding the location to take bag samples / temperatures where no clear sampling point had been established. Thirdly, the use of different measuring equipment for temperature readings was noted during the investigation. All three of these factors can impact the integrity of data analysis. The following recommendations are provided to address this matter:
   a. UG Tablets should be configured to mandate additional minimum fields for naming of sample sites (e.g. whether sample is in the MG or TG)
   b. The Spontaneous Combustion TARP should include an action for the ERZ Controller to immediately demarcate sampling locations determined by the IMT
   c. All ERZ Controllers should be familiarised with the preferred temperature monitoring device and the Spontaneous Combustion TARP should mandate that the same device is used across shifts

3. Consideration was given to the level and course of action taken following the formation of the IMT on 2nd June 2020. During this event, the direction from the IMT lead (UMM) was to ensure progressive action was taken and that each management strategy applied could be effectively monitored before trialling another. Strategies included inertisation, injection of void fill foam behind the maingate roof supports to reduce oxygen ingress into the goaf and reducing goaf drainage to push the goaf fringe back toward the longwall face. When these did not control the escalation of the event, the ventilation change was completed.

   There is an opportunity to conduct a full review of the effectiveness of the inertisation strategy at Grosvenor. The focus of the intertisation strategy for this event was to inject at 36c/t however it remains unclear how effective this was in managing the Spontaneous Combustion or if it was just diluting the gases and therefore giving a false sense of progress.

   The decisions made by the IMT to mobilise additional inertisation units from external sources was somewhat delayed. It is recommended that the Spontaneous Combustion TARP could include a trigger at Level 1 to check for resourcing availability and Level 2 to mobilise to site immediately, well before any further escalation.

4. The tube bundle locations at Grosvenor required relocation to enable data collection from key areas however this took longer than expected and ultimately, monitoring of other locations was lost. It is recommended that additional tube bundle points be available in the maingate in line with the panel face that can be used for monitoring seals on retreat that would then be available as additional monitoring during response to an event of this nature.

5. Given spontaneous combustion was a known risk with a longwall being stood for an extended period, strategies to enact emergency sealing from underground were considered and discussed with DNRME. However limited progress was made to prepare (e.g. sourcing inflatable stoppings and increasing intertisation capacity) prior to the withdrawal of personnel from the mine.

   It is recommended at Grosvenor that the Level 1 TARP for Spontaneous Combustion include a check that preparation seals are available in each entrance to the district, including supply of all necessary materials such that these can be erected at short notice. There is also opportunity to further understand panel emergency sealing from the surface.

6. It was identified during the investigation that on several occasions, ERZ Controllers had noted General Body TARP levels on statutory reports, which were not reflected on the Undermanager report. On discussion with personnel, this related to a difference of interpretation regarding whether the atmosphere outbye of the substantial stopping in TG104 C Heading was Goaf Stream or General Body, and whether inbye was General Body or Active Goaf. While it is acknowledged that inbye was later clarified to be Active Goaf, it did raise the question of how the mine reports TARP levels and more importantly, the tracking of decisions to reduce TARP levels. It is recommended that a process be implemented whereby the Undermanager must record all TARP levels reported and sign a record of any decisions made around the increase or decrease of TARP level.

7. The daily gas data review emails, received by a third party, were sent to a large distribution list which included Control Room Operators, Undermanager's, UMM, Ventilation and Gas Team etc. During the investigation, it was evident that many on the distribution list were assuming the review and action of the emails was the accountability of someone else. Furthermore, there were several emails where data was highlighted in red, however there was no clear consensus on how this was then interpreted or acted upon. It is recommended that given the content of these emails, they added as an agenda item to the fortnightly Ventilation and Gas meeting, and in the event of an IMT situation, these be included in the daily meeting review.

6 RECOMMENDATIONS

6.1 Actions to address Contributing Factors

Action	Responsibility	Date	Enablon #
Conduct full review of all Spontaneous Combustion TARPs with consideration for: • Darren Brady report (Jan 2020), including goaf stream triggers, retreat rate trigger, evacuation triggers • Data analysis from 2020 Grosvenor SC event • Any opportunity to include investigation triggers for SC indicators detected at a localised source not specifically defined by the TARP • Seal pressure differential triggers in the active goaf TARP to aid in managing pressure differential impacted oxygen ingress paths. The TARP should also capture the following opportunities for improvement: • A series of actions and considerations that would aid in prompting the IMT to undertake that are most likely to control the event. • Action prompting the ERZ Controller to immediately demarcate sampling locations determined by the IMT • Action to ensure the same environmental monitoring device (i.e. Flir) is to be used across shifts • Level 1 to check for inertisation and emergency sealing resourcing availability and Level 2 to mobilise to site immediately, well before any further escalation. • Action to ensure preparation seals are available in each entrance to the district, including supply of all necessary materials such that these can be erected at short notice	Ventilation Officer	15/6/2021	TS.01504172
Ensure relevant sections of SHMS (e.g. Ventilation PHMP) capture that for a dual return airway in a Longwall Tailgate, seals must be constructed and have passive support in place to protect them accordingly.	Ventilation Officer	15/7/2021	TS.01504174
Develop a Nitrogen (inertisation) strategy / procedure that adequately captures the required design and monitoring parameters so sufficient flow is available to meet the intended purpose of the inertisation chambers behind the goaf seals and in turn, reduce the oxygen ingress and spontaneous combustion risk. And include an effectiveness review process.	Ventilation Officer	12/4/2021	TS.01504175

6.2 Actions to address Opportunities for Improvement

Action	Responsibility	Date	Enablon #
Further identify the pre drainage opportunities (both underlying and overlying methane bearing coal seams) through detailed gas reservoir analysis to reduce the reliance on increased ventilation quantities and post goaf drainage measures.	Technical Services Manager	30/3/2021	TS.01504176
A learning from this investigation is that the differential pressure readings on file are sparse and there would be benefit in a more robust collation, validation and interpretation process.	Ventilation Officer	30/3/2021	TS.01504177
Investigate benefits and capability of potential to use real time pressure differential monitoring. Provide feedback at Underground Operations meeting.	Ventilation Officer	30/4/2021	TS.01504178
Consider whether measuring of oxygen levels at the inertisation chambers should be captured by the mine's critical control monitoring process.	Vent and Gas Superintendent	15/6/2021	TS.01504179
Investigate if UG Tablets can be configured to mandate additional minimum fields for naming of sample sites (e.g. whether sample is in the MG or TG)	Sord Systems Officer	31/5/2021	TS.01504180
Ensure all longwall ERZCs are familiarised with use of Flir guns for environment monitoring	LW Superintendent	31/7/2021	TS.01504181
Ensure Flir guns are approved and available for use for environment monitoring on the longwall (that is, permitted as UPEE with appropriate levels of controls)	Electrical Engineering Manager	31/5/2021	TS.01504182
Conduct full review of availability of additional tube bundle points in the maingate that can be used for monitoring seals on retreat that would then be available as additional monitoring during response to an event of this nature.	Ventilation Officer	10/5/2021	TS.01504183
Purchase / implement and document additional monitoring based on review from prior action. Ensure this is validated / reviewed by workforce cross section and third-party technical experts.	Ventilation Officer	30/6/2021	TS.01504184
Investigate opportunity to enable panel emergency sealing from the surface	Ventilation Officer	10/5/2021	TS.01504185
Investigate system/process whereby the Undermanager must record all TARP levels reported and sign a record of any decisions made around the increase or decrease of TARP level	Underground Mine Manager	31/5/2021	TS.01504186
Investigate if we have capability to select TARP level on tablets (rather than just in notes section)	Sord Systems Officer	30/4/2021	TS.01504187

Amend fortnightly Ventilation and Gas Meeting agenda to include review of third party analysis of gas and ventilation data	Vent and Gas Superintendent	28/2/2021	TS.01504188
Amend SCMT template to include review of third party analysis of gas and ventilation data.	Vent and Gas Superintendent	28/2/2021	TS.01504189

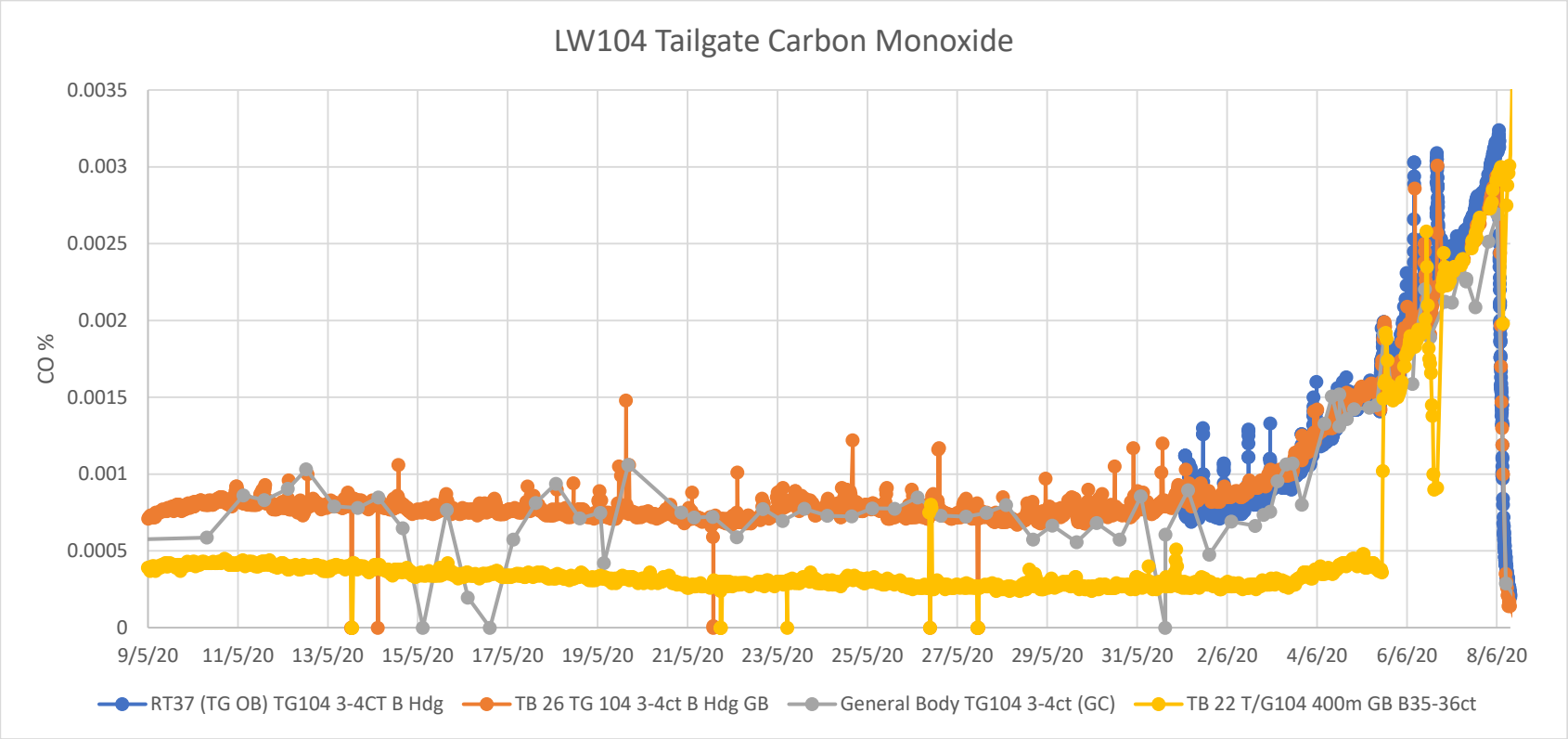
7 INVESTIGATION REPORT SIGN-OFF

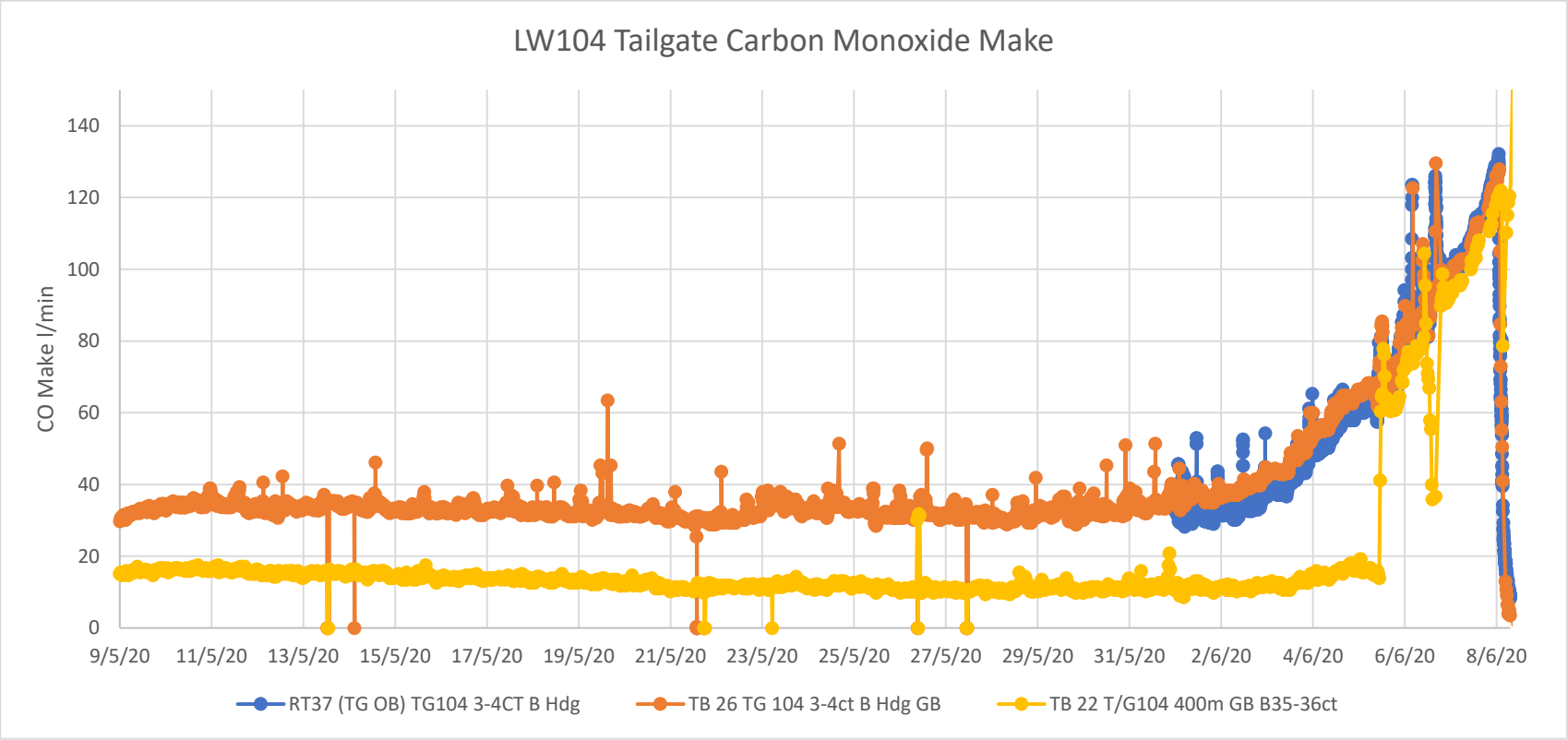
Report Submission		
Name	**Signature**	**Date**
Kate Bachmann – Safety, Health and Environment Manager		01.02.2021

Report Sign Off		
Name	**Signature**	**Date**
Logan Mohr – Technical Services Manager		1/2/2021
Rob Nowell – Operations Manager		2/2/2021.
Wouter Niehaus – Underground Mine Manager		2/2/21
Trent Griffiths – Site Senior Executive		2/2/2021

8 SUPPORTING INFORMATION (APPENDIX)

8.1 Data Summary




LW104 Tailgate Carbon Monoxide Make
CO Make l/min
140
120
100
80
60
40
20
0
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
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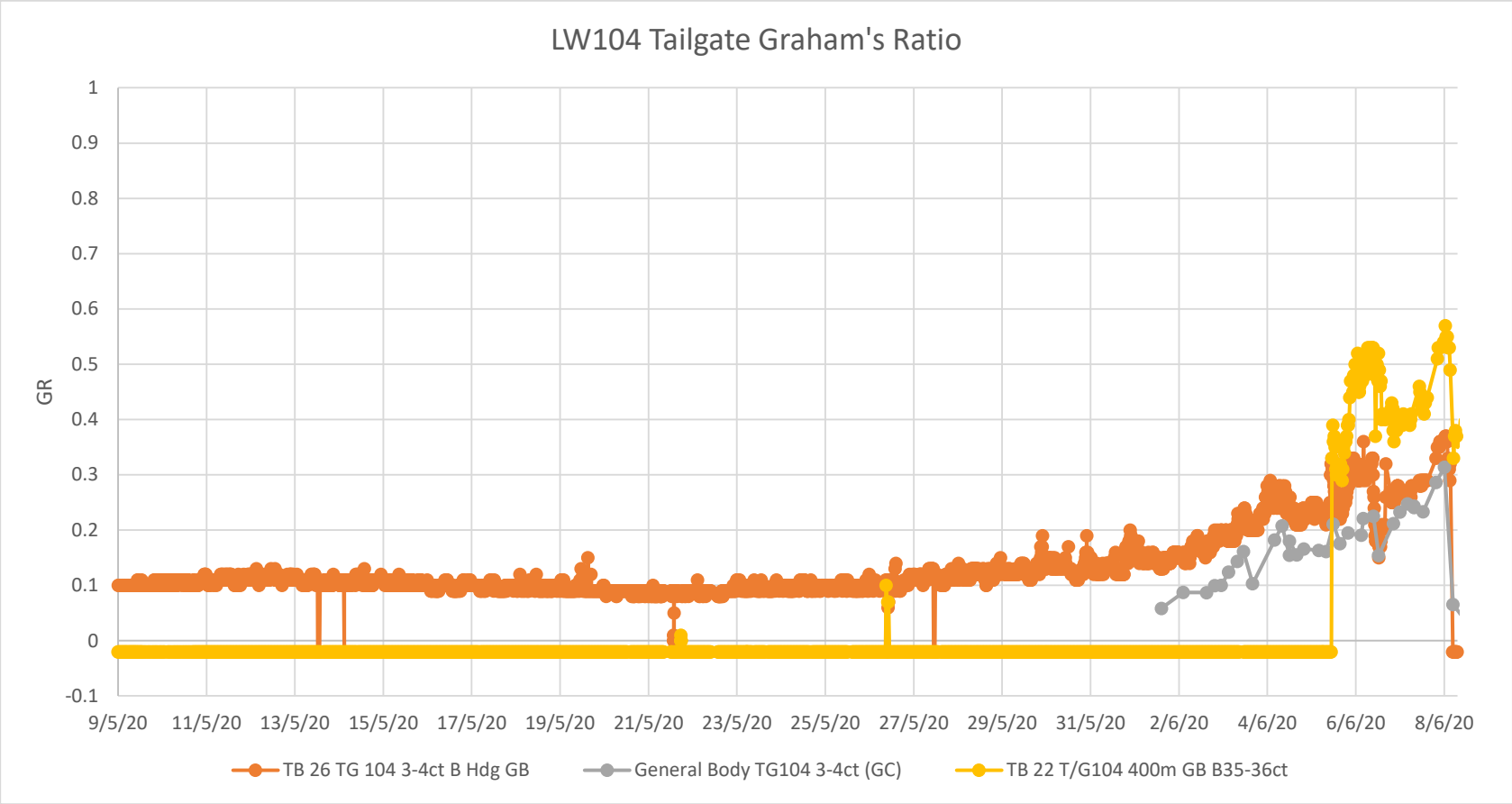
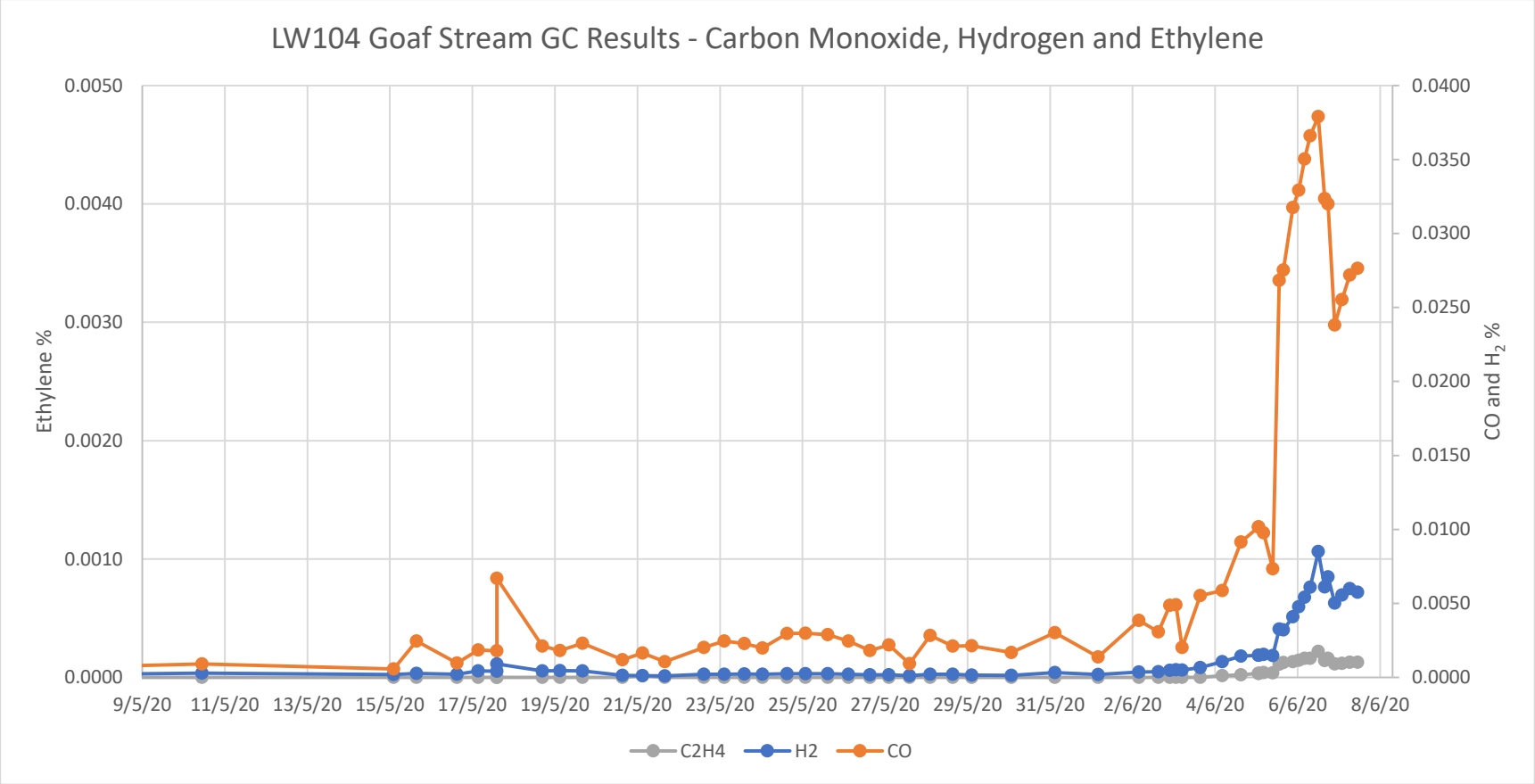
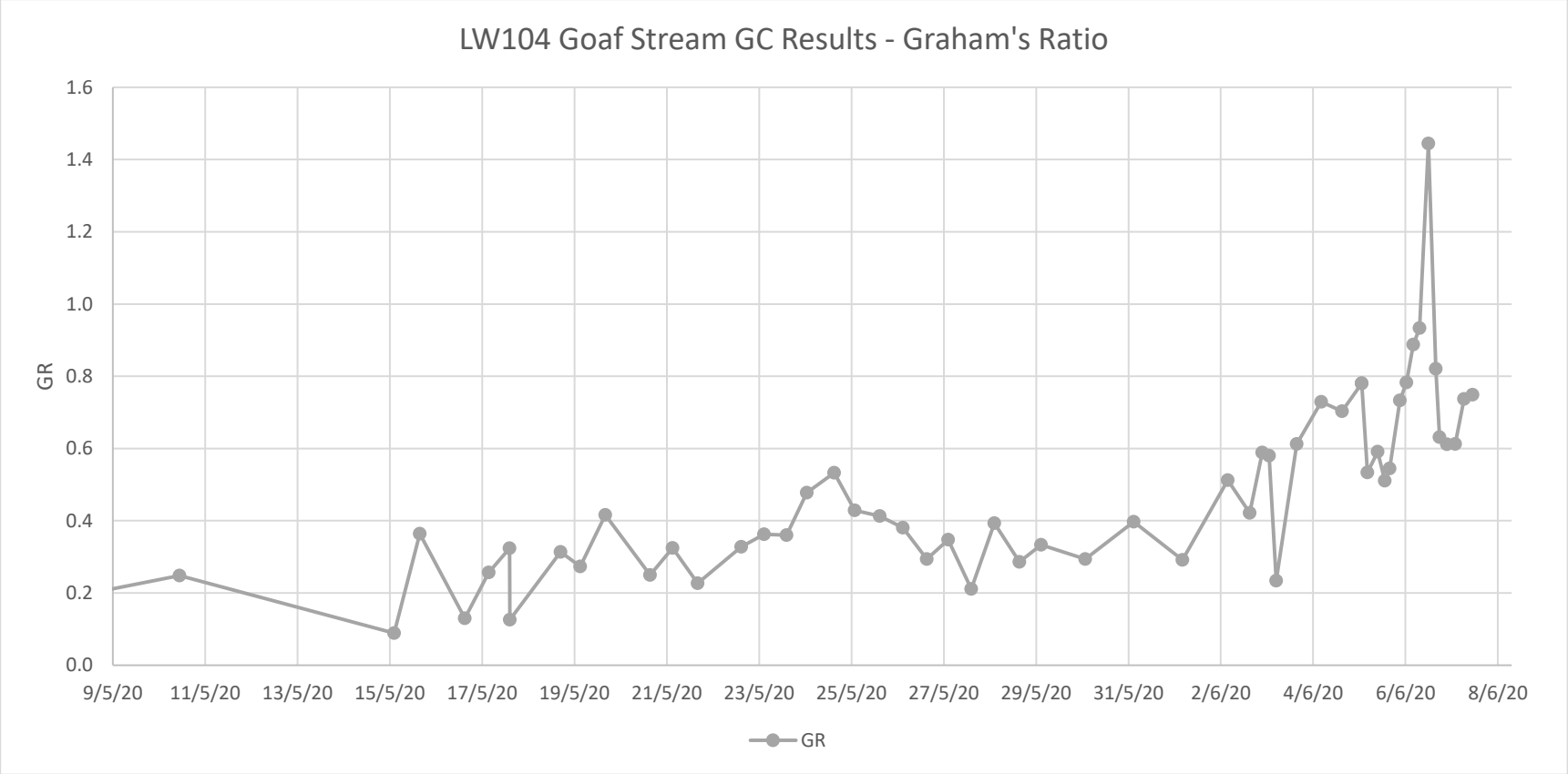
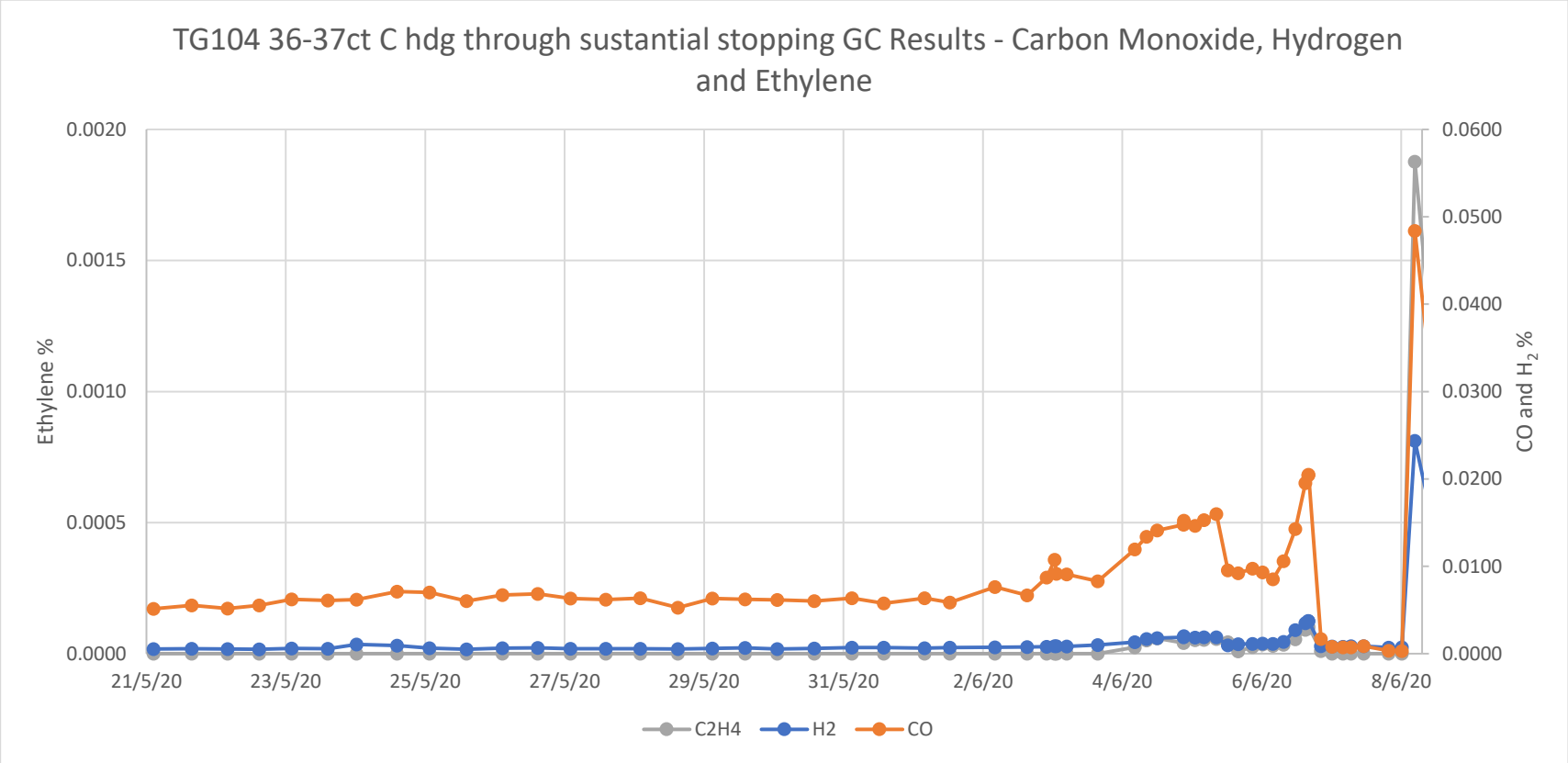
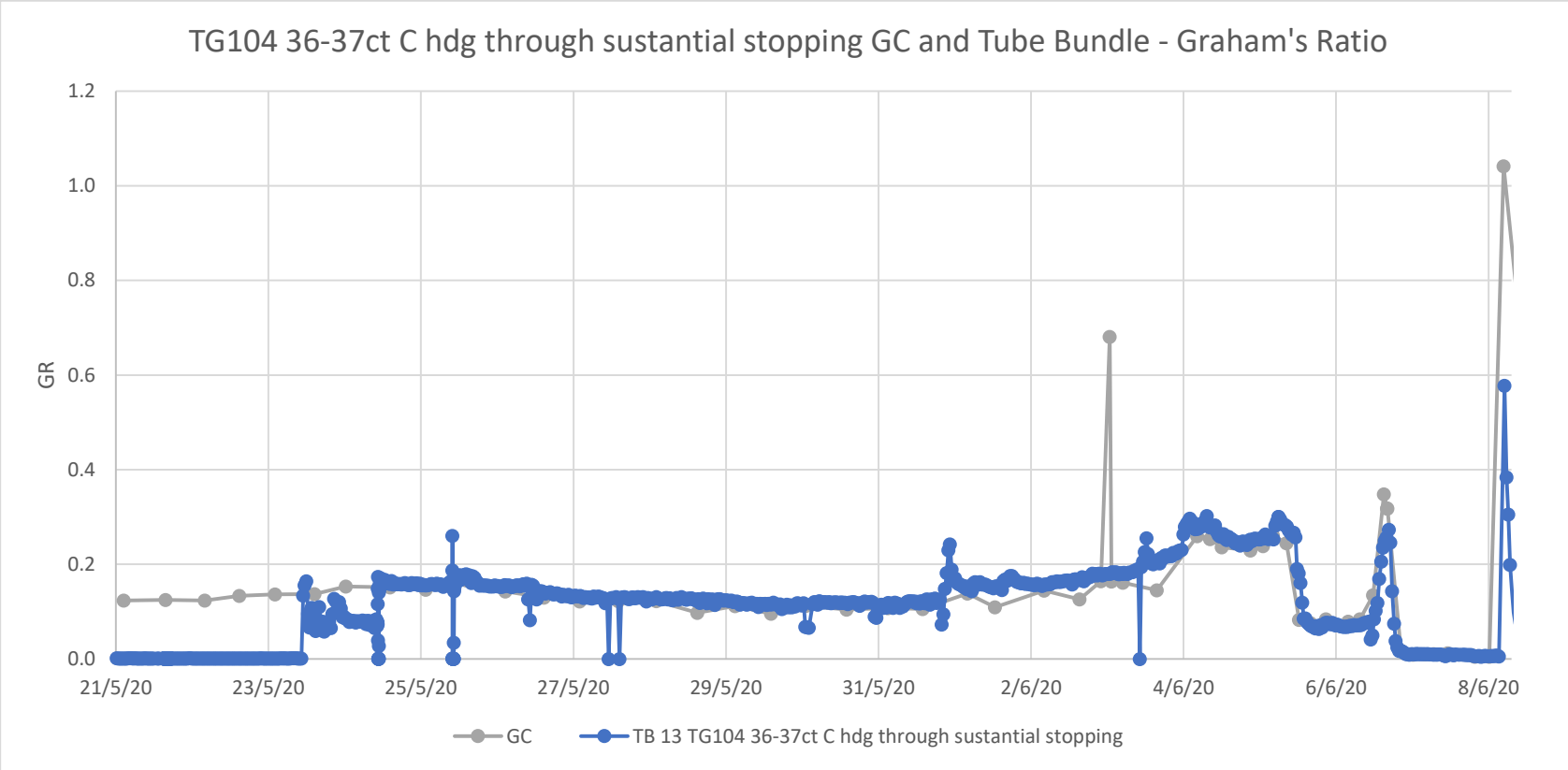

LW104 Tailgate Graham's Ratio
GR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
TB 26 TG 104 3-4ct B Hdg GB
General Body TG104 3-4ct (GC)
TB 22 T/G104 400m GB B35-36ct

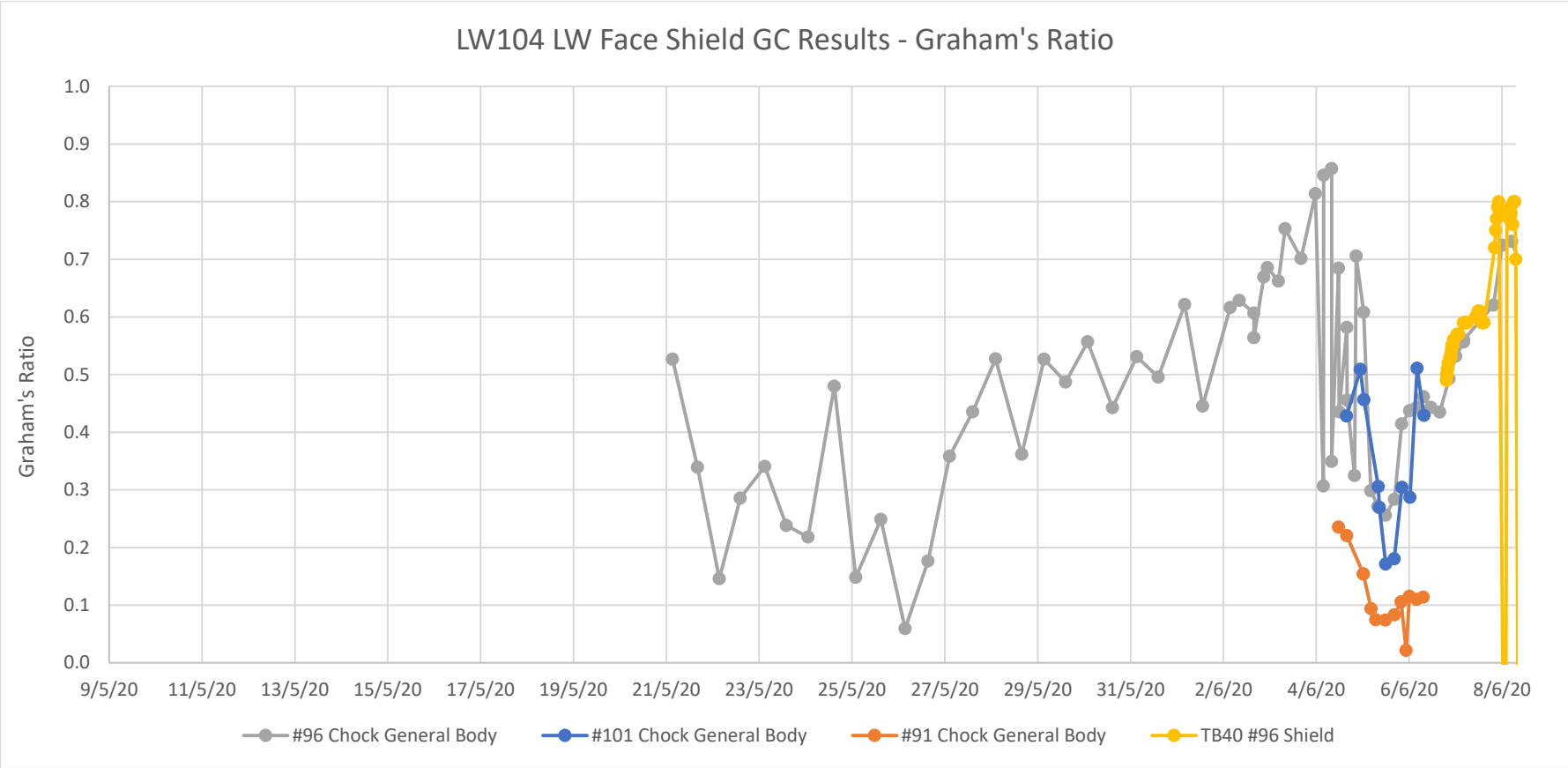
Goaf Stream

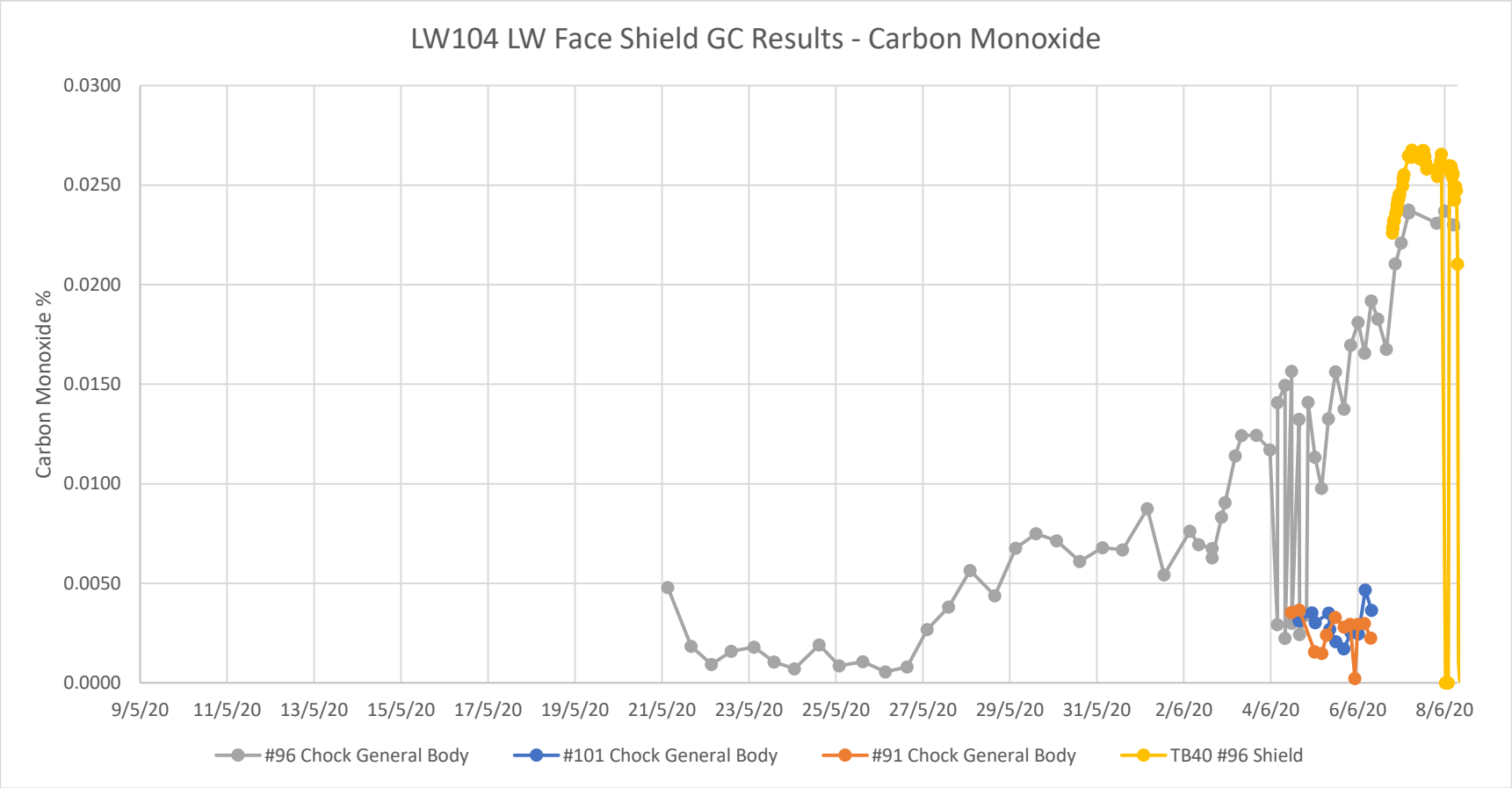

LW104 Goaf Stream GC Results - Carbon Monoxide, Hydrogen and Ethylene
Ethylene %
CO and H_2 %
0.0050
0.0040
0.0030
0.0020
0.0010
0.0000
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
C2H4
H2
CO


LW104 Goaf Stream GC Results - Graham's Ratio
GR
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
GR


TG104 36-37ct C hdg through sustantial stopping GC Results - Carbon Monoxide, Hydrogen and Ethylene
Ethylene %
CO and H_2 %
0.0020
0.0015
0.0010
0.0005
0.0000
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
C2H4
H2
CO


TG104 36-37ct C hdg through sustantial stopping GC and Tube Bundle - Graham's Ratio
GR
1.2
1.0
0.8
0.6
0.4
0.2
0.0
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
GC
TB 13 TG104 36-37ct C hdg through sustantial stopping


LW104 LW Face Shield GC Results - Graham's Ratio
Graham's Ratio
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
#96 Chock General Body
#101 Chock General Body
#91 Chock General Body
TB40 #96 Shield


LW104 LW Face Shield GC Results - Carbon Monoxide
Carbon Monoxide %
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
9/5/20
11/5/20
13/5/20
15/5/20
17/5/20
19/5/20
21/5/20
23/5/20
25/5/20
27/5/20
29/5/20
31/5/20
2/6/20
4/6/20
6/6/20
8/6/20
#96 Chock General Body
#101 Chock General Body
#91 Chock General Body
TB40 #96 Shield

8.2 References

- *Coal Mine Safety and Health Regulation 2017*
- Grosvenor Mine gas monitoring data 6th May 2020 – 8th June 2020
- ERZ Controller Longwall Production Shift Reports 6th May 2020 – 8th June 2020
- SCMT Meeting Minutes 2nd June – 8th June 2020
- Completed VC0091 Permit To change Ventilation
- JSEA To Complete VC0091
- LW104 Temperature Monitoring results
- Preliminary Report 'Spontaneous Combustion TARP Trigger Review' prepared by Darren Brady of Serinus Pty Ltd – 5th January 2020
- ***GRO-10671-RA-LW104 Secondary Extraction***
- ***GRO-10684-SOP-LW104 Second Workings***
- ***GRO-6953-TARP Active Goaf Spontaneous Combustion***
- ***GRO-10758-RA-Ventilation Changes to Mitigate Accelerated Oxidation***
- ***GRO-15-PHMP-Ventilation***
- Fortnightly Vent Gas Meeting_200528
- Fortnightly Vent Gas Meeting_200515
- Completed VCD Permit MG103 38 ct B-C Hdg stopping
- Completed VCD Permit MG103 39 ct B-C Hdg stopping
- Completed VCD Permit MG103 40ct Flexi
- Completed VCD Permit MG103 41ct B-C Hdg 140kPa flexi stopping
- Completed VCD Permit MG103 36-37ct C Hdg Substantial
- Completed VCD Permit MG103 37-38ct C Hdg Substantial
- Mine Record Entries and Directive issued by DNRME between 6th May 2020 and 8th June 2020
- IMT Meeting Minutes for TG104 CH4 – 7th April 2020
- Learning from Incident Report – CH4 Exceedances 6th & 7th April 2020
- Install Sherwood Curtain JSEA – 20th May 2020
- Relocate TB#13 from TG104 24ct seal to TG104 36ct-37ct – 18th May 2020
- Emails as noted throughout report