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Innovative Approach to Maintaining Mine Ventilation During Fan Upgrade at Carborough Downs Mine, June 2008

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INNOVATIVE APPROACH TO MAINTAINING MINE VENTILATION DURING FAN UPGRADE AT CARBOROUGH DOWNS MINE, JUNE 2008

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ABSTRACT: Carborough Downs Coal Mine was developed from a box cut using three entries, one for men and materials, one for the conveyor and one return portal. The initial drivage was conducted by drill and blast and each access was ventilated by a Flaktwoods 27 m^3/s 1058 50 kW fan. The box cut fan installation was transferred from the sister mine in NSW and installed on the portal. After 18 months the shock losses in the fan to adit adaptor were severely affecting the ability to increase the number of development units operating in the mine. It was decided to perform a fan upgrade prior to the installation of the main fans and fan shaft in March 2009. The fan housing adaptor was modified to reduce the shock losses and the motors and gearboxes were upgraded at the same time. The planning processes, minor ventilation changes and supervision which were conducted to maintain mine ventilation during the overhaul period are discussed. The three Flaktwoods1058 fans were bolted into a shipping container and monitored for flow, pressure and vibration to suit the requirements of the Queensland legislation and the ventilation maintained with in the mine at 75 m^3/s down from 145 m^3/s with the original fans. The upgraded ventilation capacity achieved was 245 m^3/s. Two of these fans are currently being used in series to ventilate the new conveyor drift with a design capacity of 28 m^3/s at 1200 m through 1218 mm ducting.

INTRODUCTION

Carborough Downs coal mine is situated approximately 140 km south west of Mackay and 35 km east of the township of Moranbah in central Queensland.

Development of the mine commenced in 2006 by the excavation of a box cut to simplify the seam access. Seam access was by three stone drifts: conveyor access, men and materials and return. Each of these roadways was driven by drill and blast to access the seam and ventilated by a Flaktwoods 27 m^3/s 1058 50 kW fan through 1218 mm steel ducting exhausting to atmosphere. Once the coal seam was accessed and ventilation connections made the surface fan arrangement comprising two Richardson 1965 CY and a plenum chamber attached the fans to the portal in parallel. These fans and portal adaptor had been lying idle at the sister mine of the Integra Coal Mine (Glennies Creek) in New South Wales(NSW) and had been fully overhauled with new Toshiba 250kW motors and Hansen 3.11:1 gearboxes rotating the impellers at 473 rpm. Once installed they supplied a total of 145 m^3/s to the pit, 40 m^3/s below the original modelling predictions that had been carried out during the feasibility study stages prior to the development of Carborough Downs Mine. The original planning was to have only two bord and pillar sections with a nominal total ventilation requirement at around 120 m^3/s, so the initial modelling showed ample quantities to be able to cope with the expected conditions. Approval of the expansion plan to include longwall mining required the working of four development panels to achieve the desired schedule. This requirement necessitated the upgrade of the mine fans in the box cut until the main fans could be installed in the planned return shaft. The approach used to maintain mine ventilation during the change out of the fan adaptor and fan upgrade is the subject of discussion in this paper.

DEFINITION OF THE PROBLEM

In 2007 the mine expansion plan was approved which required the operation of up to four working panels to achieve longwall start-up in June 2009. Ventilation investigations carried out by John Rowland of Dallas Mining Services, Wollongong, revealed that the existing fan installation had unacceptable shock losses, around 500 Pa in the adaptor, and ventilation modelling also revealed that a fan upgrade would also be required to increase available ventilation quantities to achieve

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longwall start-up of June 2009. The upgrade required an increase in the size of the motors from 250-280 kW and the installation of new gearboxes with a ratio of 2.5:1 giving a projected impeller speed of 595 rpm and capacity of 245 m^3/s. The long-term plan was to install a return shaft and fan installation to provide life of mine ventilation. The location of the fan shaft is adjacent to the first longwall block shown in Figure 1.

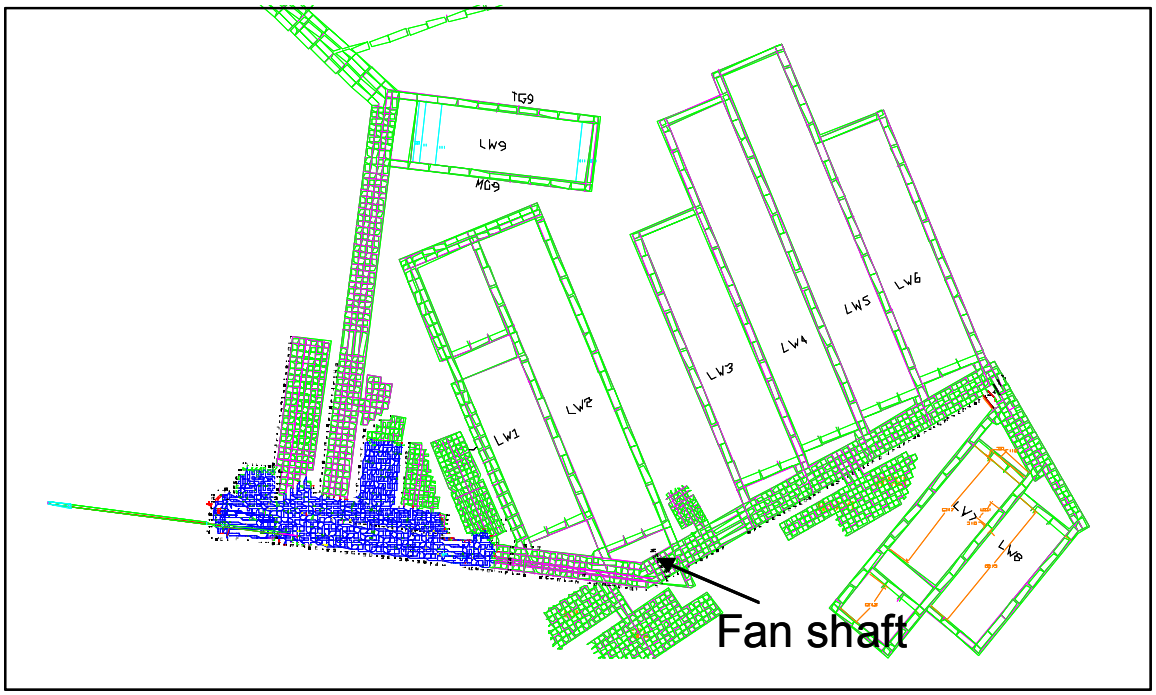

Figure 1 - Longwall layout plan for the first 9 Panels

Once it was identified that the adaptor change out and fan upgrade was required the search commenced for suitable temporary fan to maintain the mine ventilation. The mine was driving longwall access roads with typical insitu gas content over 5 m^3/t and up to 6.2 m^3/t post drainage, therefore maintaining mine ventilation was critical.

The work on the fan upgrade and adaptor modification was planned to coincide with a required statutory annual high voltage switch testing and the opportunity was also going to be taken to install the conveyor belts for maingate 1 development.

PLANNING FOR MINE FAN UPGRADE

It was not possible to obtain a suitable fan for maintaining the temporary ventilation of the mine for the three day period required (12th to 14th June 2008). At this time attention was paid to the three Flaktwoods fans that had been "mothballed". Whilst on there own they could not produce sufficient ventilation, but modelling analysis indicated that in parallel they could produce up to 90 m^3/s.

A quick and effective solution was now sourced to fabricate suitable temporary fan housing. It was decided to simply bolt the three Flaktwoods fans in parallel in a steel shipping container. The shipping container was then adapted to fit the mine using mesh and brattice at the conveyor portal. Each of the fans was monitored for vibration and pressure in the mines Citect monitoring system to comply with the Queensland coal mining act and regulations. Full ventilation modelling was undertaken using Ventsim to predict the anticipated mine ventilation during the change over process.

Detailed work lists were prepared to site temporary ventilation structures which could be quickly commissioned on 12th June 2008. Work included the preparation of temporary stoppings and the installation of brattice rolls which could be quickly deployed and removed during the ventilation changeovers. Another working procedure was prepared for the sequence of events required to

establish the temporary ventilation circuit on ceasing the operation of the main fans. Maintaining the mine ventilation enabled the tailgate to complete its panel extension, the installation of the maingate conveyor belt in preparation for panel production and the continuation of inseam methane drainage operations.

ESTABLISHING TEMPORARY VENTILATION

The stages of the ventilation change over were:

1. Ensure all appliances are pre-erected as required before commencing change and ensure any air leaking through or past the tubes at the road-header fan site has been sealed.
2. No road the E heading road header district.
3. Shut down main fans and ensure underground power is tripped.
4. Enter the mine via fan drift and close stopping appliance at bottom of fan drift. (See Figure 2 for appliance locations and steps)
5. Move the four gas tree at 3 line D heading to ensure the it is in the ventilation stream from the northern return.
6. Open D heading 3 to 4 cut-through double doors and chain back. Information tag must be attached with reason for doors being open recorded.
7. Close both brattice stoppings in B to C heading 4 and 5 cut-through.
8. Drop bag around temporary coffin seal D 5 to 6 line.
9. Start the three temporary portal fans (Flactwoods 50 kW fans) and check airflow is established.
10. Close the regulator in 6 line E-F heading to allow 25 m^3/s to return along F heading 6-12 cut-through. (The target regulator pressure drop is around 60 Pa)
11. Proceed to 11 cut-through and open the doors at 11 C to D to get air flowing inbye in the belt road.
12. Check ventilation status on travelling inbye into the mine.
13. Adjust the brattice stopping outbye of the overcast in 53 cut-through B heading to allow 10 m^3/s to ventilate the drill stub at 54 cut-through
14. Measure the return quantity at tailgate 01 regulator and the last open line (6A) and note general body gas levels.
15. Measure return quantity for the East Mains panel at the last line and note general body gas level.
16. Notify the control room officer that the pit is open and designated work areas are safe.
17. Conduct full ventilation survey sufficient to update the Ventsim model.

Conducting these ventilation changes meant the mine return roadways connected to the conveyor drift which then became the temporary return drift. All other ventilation circuitry remained the same in the mine and therefore only minor changes were required to maintain the gas monitoring system, consisting of a 4 gas tree (CO, CO_2, O_2 and CH_4) at the shipping container and the minor relocation of the 3 cut-through gas tree (around 5 m). .

A sensor change from Explosion Risk Zone/Non-Explosion Risk Zone (ERZ/NERZ) status to environmental status was carried out at 16 cut-through as the return for the outbye drift drivage was closed off during the fan shut down and the face area no-roaded. This negated the requirement to have the ERZ/NERZ boundary in place and re-directed the ventilation that was normally sent to this return further into the mine to the critical face areas. As the drift area was being driven in stone and the face area was only 20 m in, the no-roading of the area was predicted not to cause any concerns with gas accumulations

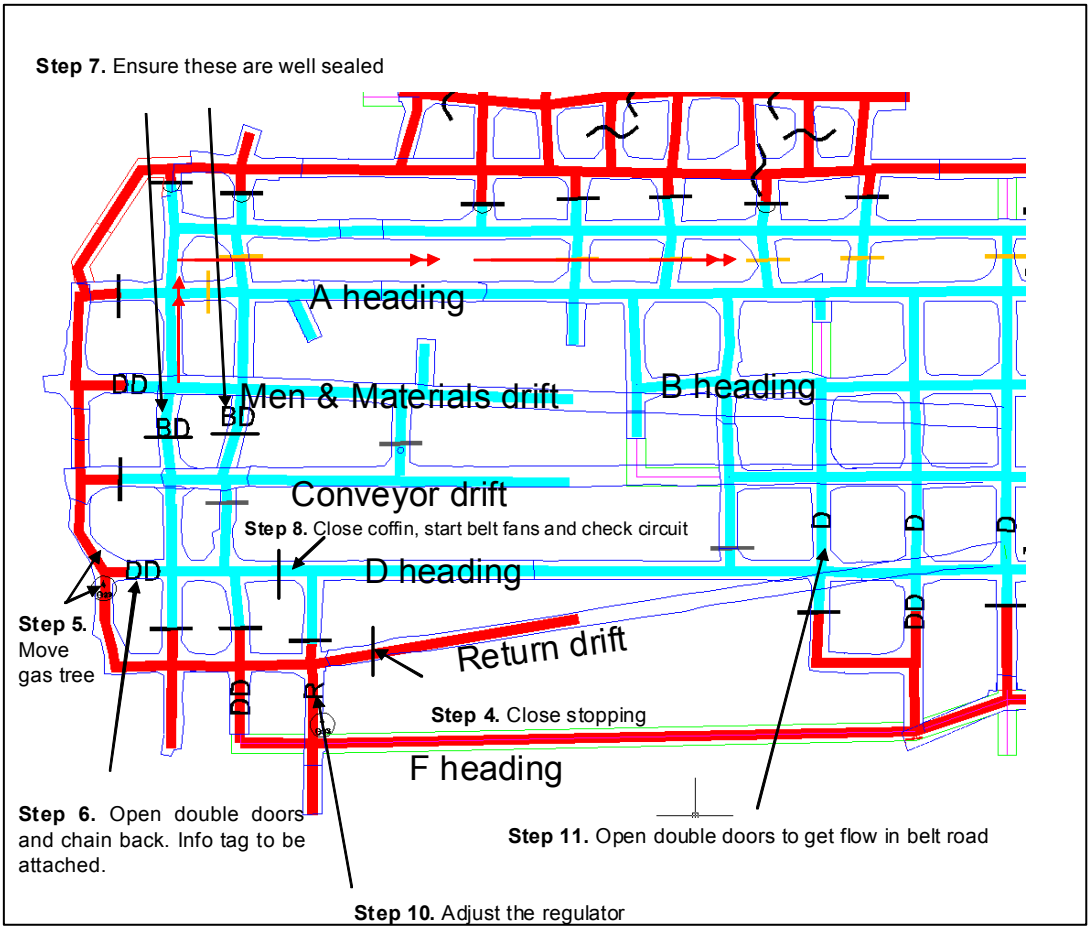

Figure 2 - Plan detailing ventilation changes on stopping of the main fans

The mine ventilation officer carried out the ventilation changes, conducted ventilation surveys and inspected the underground districts to monitor methane levels and make minor adjustments to the district ventilation quantities. The maximum methane percentage found during the temporary ventilation arrangements was 1.2 % in the tailgate return and was as per the predictive modelling had shown. Full details of the methane percentages and ventilation quantities pre-restarting the upgraded fans are provided in Table 1.

Table 1 - Ventilation Quantities and methane percentages before main fan start-up after re-commissioning

Panel	Heading or C/T	Intake / Return	Quantity m3/s	CH4 %
Belt Drift	**Vent station**	**Return**	**93**	**0.9**
East Mains Return	**F 57 to 58**	**Return**	**21**	**1.1**
TG return	**A 0 to 1 line**	**Return**	**20**	**1.2**
Drill rig site	**B52 to 53 line**	**Return**	**10**	**1.0**
Return	**F Hdg 6-12 line**	**Return**	**5**	**1.0**

One hiccup in the system was realised when a loader that was being used to install a quickseal at 60 c/t shut down in the return with a methane trip. The problem arose when the crew installing the quickseal dropped the sheet to the ground and the ventilation was travelling from further inbye carrying general body concentrations of 1.2 % CH_4. The ventilation officer was present in the east

mains panel at the time and steps were taken to recover the loader using a temporary ventilation change. In order to recover the loader the tailgate panel was closed off to increase the quantities to the east mains return and therefore reduce the general body concentrations in the return where the loader was located to below 1%. This change worked well although it created another problem as by the time the loader had been removed from the return and the tailgate ventilation was being restored it had given the methane (0.25%) in a stub located 5 m inbye of the ERZ/NERZ boundary sensor in the tailgate time to reach the sensor location with the lack of ventilation in the area. This tripped underground power. The fans that were being used to ventilate the mine during this shutdown were being powered from the 1050 volt tramming outlet on the side of the main fan switch room. This was connected to underground power and therefore tripped off the fans. The ventilation in the mine was only lost for twenty minutes but the delay was then in re powering the mine. The whole loader recovery, that had only interrupted the tailgate ventilation for a period of 15 minutes, caused nearly two hours delay to the power in the panels. The upgraded mine fans were re-started as detailed in the procedure below and identified in Figure 3.

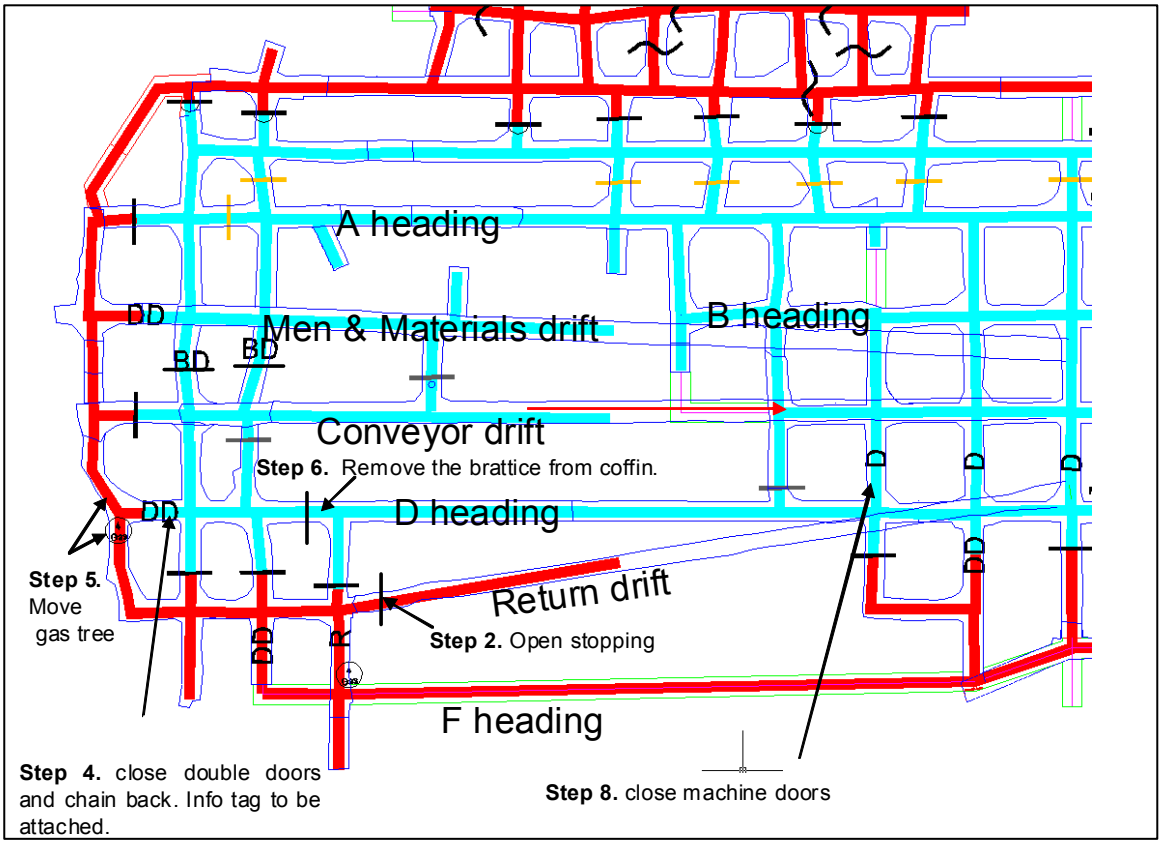

Figure 3 - Plan showing changes for recommissioning of the upgraded fans

RE-ESTABLISHING MINE VENTILATION

The main fan upgrade and ducting change out was actually completed four hours before the schedule and the ventilation circuit was then returned to its original state. Steps in Ventilation change to re-establish the normal mine ventilation were:

1. Ensure that the air lock doors, explosion doors and the damper doors on the main fan installation are closed
2. Enter the mine via the ventilation drift, dismantle the substantial brattice stopping at the bottom of the drift and store the material in 6 cut-through D-E heading to recover later.
3. Shut down the three temporary fans, open all doors and the flap on the Belt Portal and remove brattice
4. Close the machine doors at 3-4 line D heading and remove the information tags
5. Move the 4 gas tree in 3 line D heading back into the original position in the ventilation stream
6. remove the brattice from the temporary stopping in D heading 5-6 cut-through
7. Start the main fans
8. Close the machine doors at 11 cut-through C-D heading

9. Reopen the man door at 14 cut-through E-F to establish ventilation back in the E heading drift district
10. Reset the ERZ/NERZ sensor at 16 cut-through E heading
11. Change the ERZ/NERZ sensor at 16 cut-through E heading back over from environmental to ERZ/NERZ
12. Adjust the brattice stopping out-bye of the overcast in 53 cut-through B heading to allow 10-15 m^3/s to ventilate the drill stub 54 cut-through B heading.
13. Measure quantities and pressures sufficient to update the mine model and record the panel quantities for the ventilation change report.
14. Update the alarm set points on Citect to reflect the relative quantities.

Subsequent to the upgrade a ventilation capacity of 245 m^3/s was achieved and the mine operated with 5 working panels during October 2008:

- maingate 01
- tailgate 01
- one bord and pillar section
- mains drivage
- back drivage of the new conveyor drift.

Two of the Flaktwoods fans were used in series to ventilate the new conveyor drift from the surface with a design capacity of 28 m^3/s at 1200 m through 1218 mm ducting. After the upgrade the mine collar pressure increased to 1055 Pa which increased localised leakage at the 3 and 4 cut-through location where there were a number of machine doors. Any ventilation structure which had a pressure differential of more than 500 Pa was inspected and an inspection regime implemented in line with the mines spontaneous combustion hazard management plan

CONCLUSIONS

- Mine ventilation planning needs to cater for possible increases in ventilation requirements during the life of the mine. That is catering for possible additional requirements by having contingency in the available quantities/pressure available. ie the initial modelling for Moranbah North indicated that there was a requirement for two fans with a mine requirement of 250 m^3/s; three fans were installed at the fan shaft to cater for modifications to the mining plan.
- Fan in-situ tests to BS848 give a true fan curve for the fan(s) as connected to the mine and enable reliable ventilation network analysis to be conducted.
- A practical approach utilising on site equipment enabled the fan upgrade to be completed whilst maintaining mine ventilation.
- Detailed planning and dedicated supervision enabled the upgrade to be completed with minimum interference to mine operations and no hazardous accumulations of methane to occur.

REFERENCES

Queensland Coal Mining Safety and Health Regulation 2001
Queensland Coal Mining Safety and Health Act 1999