Narrabri Coal Operations
NARRABRI COALFIELDS CHARACTERISTICS

NARRABRI, AUSTRALIA
JUNE 2018

WHITEHAVEN COAL
Introduction

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- Bachelor of Mining Engineer (UQ)
- 3 Years at Narrabri Coal Operations
- Gas drainage Coordinator Since May 2017
- Graduate Program
  - SIS Gas Drainage
  - Development
  - Mine Optimization
Agenda

- Background Information
- Coal Seam Characteristics
- What sets us apart
- UIS Gas Drainage
- SIS Gas drainage
- Goaf Drainage
Narrabri Coal Operations

- Located 28km south of Narrabri
- 550 km North west of Sydney
- Producing:
  - High energy export thermal coal
  - A low ash, low sulphur, low phosphorus, mid volatile PCI coal
- First development coal was produced in FY2011
- Full commercial production from the longwall achieved in October 2012.
Narrabri Mine Plan

- Seam thickness ~ 9m
- 20 longwall panels planned
- Panel length up to 4,000 m
- Longwall 7 commenced April 2017. First 400 m face.
- 7 Heading Mains
- 3 Heading Gateroad
- MG106 First 3 heading gateroad
- Cut and flit operation on southern side – Commenced January 2018
Production Equipment

Longwall

- 400 metre wide face
- The face is 196 shields wide and is operated at a mining height of 4.30m

Development:

- 4 x Joy 12CM12 continuous miners
- 1 x Joy 12CM30 continuous miner
- Joy 12SC32 shuttle cars
- 2 Super panels run
- FY2017 = 22’000 m

Cut & Flit Project:

- Joy 12CM12 continuous miner
- Joy Multi-bolter – RT137
Coal Seam Characteristics
Hoskissons Seam

- Raw Ash 11 %
- Volatiles 28 – 30 %
- Sulphur 0.37 %
- Calorific Value (gad) of 6,950 kcal/kg
- Full Seam Thickness 9m
- Development Mining Section
  - Mains = 3.50 m
  - Gateroad = 3.70 m
- Longwall mining section = 4.3 m
Geology

Major fault runs almost perpendicular to normal fault plane
Outburst Prone Structure – Fault

LW107

- Predicted fault mapped in blue
- Actual fault mapping from LW face in black
Dyke – LW108

Development

- 7 Headings driven through it so far

Longwall

- Stepping around in LW108
Dyke – MG108

Conditions extremely variable

Shotfired in places

Concreted the floor in other spots
Gas Contents

- The Hoskisson’s Seam is potentially outburst prone.
- The seam gas content is predominantly carbon dioxide (CO2) (approximately 90%).
- Insitu gas contents in current mining areas range from 5 m$^3$/t to 10m$^3$/t
- Future mining areas have insitu contents >10m$^3$/t
- Seam is liable to spontaneous combustion
- Permeability is 3 to 30 milliDarcy
- Issues;
  - Outburst risk
  - Gas emissions in LW return
Gas Contents

- The Hoskisson Seam is potentially outburst prone. The seam gas content is predominantly carbon dioxide (CO2) (approximately 90%).
- In-situ gas contents in current mining areas range from 5m³/t CO2 to 9m³/t.
- Future mining areas have in-situ contents >10m³/t.
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- Permeability is 3 to 7 mD.
- Issues:
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  - Gas emissions in LW return
Gas Composition

Predominantly CO2

After drainage has occurred CH4 is typically 3-5%

Southern side of mine increases to 30+ % as move SE

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Outburst Thresholds

- DTV = 6.20 m³/t
- Level 1 TLV = 7.05 m³/t
- Level 2 TLV = 8.0 m³/t

Restrictions above Level 1 include:
- Restrictions on mining rate
- maximum borehole spacing in flanking or cross block pre drainage patterns
- exploration drilling to identify presence of outburst prone structure or to disprove projected or predicted structures
- additional sampling to confirm gas content and the extents of the outburst control conditions area
What Makes Narrabri Different?
We Are The Unknown

- All outburst benchmark data is from seams other than ours.

- No gas drainage experience in the Hoskisson seam.

- The big question is:
  
  *Are the outburst levels we are working to correct?*

- History says yes as we have not had an outburst incident.
Narrabri Coal Operations
GAS DRAINAGE CASE STUDY
UIS Gas Drainage
Mine Plan
UIS Gas Drainage
## UIS Drilling – ADS Drilling

<table>
<thead>
<tr>
<th>Project Commencement 2012</th>
<th>Current Situation 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ 2 rigs</td>
<td>➢ 3 rigs 24x7</td>
</tr>
<tr>
<td>➢ 1 Rig 24/7 &amp; 1 x Rig 12/7</td>
<td>➢ 250,000m per year</td>
</tr>
<tr>
<td>➢ Contracted for 30,000m per year</td>
<td>➢ Hole spacing ranges from 5 to 20 metres depending on gas levels</td>
</tr>
<tr>
<td>➢ Holes spacing 20-40m</td>
<td>➢ Standardised setups and infrastructure at each drill site</td>
</tr>
<tr>
<td>➢ Minimal gas infrastructure running 2” hose from drill sites to nearest SIS holes for gas drainage</td>
<td>➢ Gas from each site now vented through pipe system to designated surface risers</td>
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</table>
UIS Drilling

EQUIPMENT

- DGS survey system
- Fibreglass composite standpipes
- Gas / water separators
- Fish tanks / Fines bins
- Air Pumps
- Drilling 17 to 22km per month total
  (250 km in past 12 months)
Underground Infrastructure

MG107 & Earlier:
- Service bore shared between 2 – 3 patterns
- 6” Pipework
- Small expansion chambers
- Non standard site setups

MG108 & Future:
- Service bore for every significant pattern
- 10” Pipework
- Standardised pipework setup for every pattern
Gas Drainage Design

- **UIS Gateroad drainage**
- **UIS LW drainage**
- **UIS compliance**
- **SIS Drainage**
UIS Gas Drainage Design

- Initial design done by gas drainage coordinator
- It covers requirements of developing roadways and LW block drainage
- Any known geological features
- Design includes location to be drilled from and services available etc
- Favourable drainage hole direction
- Management plan

- This is reviewed by the outburst committee for any comments

- Cores taken initially to determine pattern design and hole spacing
- Core is taken and analysed.
- Gas cores confirm predicted virgin gas content
- Design modified as necessary
Gas Drainage Design – Initial

- Long holes
- Drilling down dip
- Dewatering issue
Gas Drainage Design – Initial

Not enough information gathered

Tight spots in the mains
Gas Drainage Design – Intermediate

Holes drilled from the maingate (Drilled up dip)
Drainage efficiency increased – Time restrain too great
Gas Drainage Design – Now

Structure Identification

Gas Drainage

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Issues – Non-Draining Areas

MG105

- Very localised
- Multiple holes in face
- No gas make from boreholes
- Mined through with no issues
Issues – Non-Draining Areas

LW108 Bleeder road

- Face road drained to below 4 m³/t
- No gas from open holes in face
- Realigned roadway
- ROS pod
- Mined through with no issues
Issues – Non-Draining Areas

TG201
- 100 metre core spacing initially
- Drainage in place for 6 months
- 3 “hot” spots
- Washouts & faulted ground in the area
- Large differences between upper and lower cores
 Issues – Spontaneous Combustion

- UIS drill patterns drilled from the gateroad both side of a longwall block.
- Lead to CO form a pattern.
- Pattern repeatedly flooded with water until problem subsided.
Issues – Spontaneous Combustion

CO found in several UIS drainage patterns

Several Possible Reasons

- UIS & SIS drilled perpendicular to patterns
- Many development intersection points on the MG108 faceroad
- Stop / Start drainage
Core Sampling

Position In Seam

- Where the virgin gas content is greater than 8.0m3/t then an additional compliance core will be taken in the upper portion of the seam (Hsk 3)

Density Correction

- Standard:
  - CO2 > 65%
  - Ash = 9%
  - Relative Density (RD) = 1.41g/cc.
- Coal samples that do not meet this criteria have their gas content corrected.
- Majority of upper cores are corrected
Hole Maintenance

- Monitoring requirements have increased proportionally with the drilling regime
  - Started with 12 Hour coverage – Operators
  - Now 24 Hour coverage – Deputies
- Following the completion of a hole it is connected to the gas drainage reticulation system.
- Each hole is then measured for gas flow on a regular basis
  - Pattern – Daily
  - Individual hole – Weekly to Monthly
- Gas range gas composition is constantly monitored by tube bundle system and flow measurements are taken
- Regular gas bags taken for gas ranges to verify tube readings
- Pressure monitoring of gas range – Suction location and strength
- Maintaining
  - Inspections of gas drainage sites, gas drainage ranges for any damages
  - Empty water along gas ranges regularly
UIS Drilling – Future Challenges

Coring / Drilling Distance
- Currently restricted to 650 metres for compliance
- Up to 1’100 metres for exploration

Time constraints
- Getting Deeper in the pit – Running fines bins in and out

Higher gas contents
- Longer standpipes
- Increased size of infrastructure
- Improving pressure grouting of ribs

More vigilance on safety
- Resampling in a higher density to provide a more comprehensive view of how the gas drainage has performed & in an attempt to not miss any tight spots
- Reviewing the data more in depth to identify problem drainage areas
Surface Infrastructure
Gas Drainage Plant

- 3 Liquid Ring Pumps

- Capacity of 3 \(m^3/s\)

- Currently running only one pump due to demand

- Gas plant will be fully utilised when drilling on the southern side of the mains (LW201 – LW206)
Surface Gas Lines

Current Setup
- Running 5 mobile extraction units
- Due to the fact that the distance to the plant is too great (> 10km)
- Each gateroad is segregated

Future
- 1 Big network
- Provides flexibility for maintenance
- Provides the ability to manipulate pressure where required
Mobile Extraction Unit (MEU)

HOWDEN CD10 1100 PADDLE BLADED FAN

- Capacity = 2000 L/s
- Pressure = -30 kpa
- Remote monitoring

Generator  “Blower”  Monitoring Skid
Future Plan

8 Mobile Units

- 5 For Goaf extraction
  - 4 Active
  - 1 Leap frogged onto next hole

- 3 For UIS Drainage
  - 1 For each gateroad on active drainage
SIS Drainage
SIS Drainage – Overview

Have performed LW block drainage in earlier blocks

All gateroads have SIS drainage

**Issues:**

- Drilling distance
  Laterals in excess of 2’200 m

- Development intersection

- Drilling accuracy:
  Tolerance is now 200 mm
SIS Drainage – MG109
SIS Drainage – Surface VPW

Issues:

- Remote monitoring issues in dense bushland

  This requires labour to go and check each station regularly and download information

- Disposal of water – extensive surface pipework
Goaf Drainage
Goaf Drainage

- 50 Metres Spacing
- 100 Metres Spacing
- 200 Metres Spacing
Goaf Drainage – Infrastructure

Venturi

Goaf Trailer
Finding a balance with underground ventilation setups

Back over bleed ventilation setup to keep the gas away form the tailgate drive and off the face

This limits the efficiency of goaf drainage near the face

As underground ventilation and mining practices change goaf drainage will adapt to follow

Use of sliders

Goaf holes moved closer to the middle of the block
THANK YOU

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Questions???