Operators Perspective on Managing Outbursts

Presented By
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West Cliff Colliery
What Is An Outburst?

Violent ejection of gas and/or coal or rock with the potential to cause injury or death through physical harm or irrespirable atmosphere.
## Outbursts

<table>
<thead>
<tr>
<th>Colliery</th>
<th>No. of Outbursts</th>
<th>Size in tonnes</th>
<th>Gas</th>
<th>Geological Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appin</td>
<td>22</td>
<td>2 - 88</td>
<td>mainly CH$_4$ &amp; CO$_2$ on dykes.</td>
<td>Predominantly strike slip faults; mylonite zones.</td>
</tr>
<tr>
<td>Brimstone</td>
<td>2</td>
<td>30</td>
<td>CO$_2$</td>
<td>Mainly dyke related structures with strike slip movement.</td>
</tr>
<tr>
<td>Corrimal (closed)</td>
<td>4</td>
<td>12</td>
<td>CH$_4$ &amp; CO$_2$</td>
<td>Sheer zone associated with minor faulting &amp; dykes.</td>
</tr>
<tr>
<td>Kemira (closed)</td>
<td>2</td>
<td>60 - 100</td>
<td>CO$_2$</td>
<td>normal fault with mylonite.</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>37</td>
<td>1 - 150</td>
<td>mainly CO$_2$ with minor amounts of CH$_4$</td>
<td>Predominantly with dykes &amp; faults that exhibit sicken sides &amp; mylonite.</td>
</tr>
<tr>
<td>South Bulli</td>
<td>7</td>
<td>1 - 300</td>
<td>mainly CO$_2$</td>
<td>Strike slip faults with mylonite; dyke zones &amp; thrust faults.</td>
</tr>
<tr>
<td>Tahmoor</td>
<td>88</td>
<td>5 - 400</td>
<td>mainly CO$_2$</td>
<td>Mainly strike slip faults; with dykes (110° - 135°) &amp; thrust faults: mylonite usually present.</td>
</tr>
<tr>
<td>Tower</td>
<td>19</td>
<td>1 - 80</td>
<td>mainly CH$_4$</td>
<td>Mainly strike slip faults with dykes.</td>
</tr>
<tr>
<td>West Cliff</td>
<td>250</td>
<td>4 - 350</td>
<td>mainly CH$_4$ with CO$_2$ to the NE development</td>
<td>Predominantly strike slip faults (100° - 110°) with sicken sides &amp; mylonite; dykes and thrust faults have been associated with outbursts.</td>
</tr>
</tbody>
</table>
# Fatal Outbursts

<table>
<thead>
<tr>
<th>COLLIERY</th>
<th>DATE</th>
<th>No. KILLED</th>
<th>SIZE (tonnes)</th>
<th>GAS</th>
<th>STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan</td>
<td>10 June 1896</td>
<td>3</td>
<td>Unknown</td>
<td>CO₂</td>
<td>Dyke and soft fault zone</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>27 July 1926</td>
<td>2</td>
<td>140</td>
<td>CO₂</td>
<td>Fault with 5m throw</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>2 December 1954</td>
<td>2</td>
<td>90</td>
<td>CO₂</td>
<td>Normal fault with 0.3m throw</td>
</tr>
<tr>
<td>Tahmoor</td>
<td>24 June 1985</td>
<td>1</td>
<td>400</td>
<td>CO₂</td>
<td>Behind a dyke associated with strike slip movement</td>
</tr>
<tr>
<td>South Bulli</td>
<td>25 July 1991</td>
<td>3</td>
<td>300</td>
<td>CO₂ &amp; CH₄</td>
<td>Thrust fault with 35 cm of mylonitic coal; very high gas pressure.</td>
</tr>
<tr>
<td>West Cliff</td>
<td>25 January 1994</td>
<td>1</td>
<td>350</td>
<td>CO₂</td>
<td>Intersection of 2 strike slip structures; 30 cm of mylonitic coal.</td>
</tr>
</tbody>
</table>
Ejection of Coal or Rock
Ejection of Coal or Rock

Tahmoor 85
Ejection of Coal or Rock

Tahmoor Remote Mining
Cone Shaped Cavity
Cone Shaped Cavity
Mechanics of Outbursts

Factors Associated With Outbursts

• Gas
  – Pressure (mPa)
  – Content (m³/tonne)
  – Composition (%CH₄ - %CO₂)

• Structure
• Stress
• Coal Strength
Outburst Warning Signs

Describe the warning signs in two words:

UNEXPECTED CHANGE!
Outburst Warning Signs

- More cutters than usual
- Change in direction of cutters
- Greasy backs
- Reddish brown tinge
- Poor roof or ribs
- Good roof or ribs
- Sudden seam dip
- Abnormally hard or soft face
- Chemicals being blown out from rib holes
Outburst Warning Signs

- Conical Cavity in the face or ribs. (small outburst)
- Mylonite zones
- Other geological features such as faults or dykes
- Calcite bands
- Marked increase or decrease in noise from the strata
- Gas
- Coal spitting from face or face bulging
- Wet ribs or face
Faults & Dykes
What to do if Warning Signs Are Noticed?
Outburst Warning Signs

• Unexpected changes in the mining environment may indicate the potential for an outburst to occur.
• If these warning signs are unexpected:

Stop Mining and Inform The Supervisor
What happens when we “STOP and REPORT” outburst warning signs to the Section Supervisor?
Procedure When Mining Has Ceased Due To Warning Signs

• Inspection by Mining Supervisor.
• Inspection by Undermanager if warranted.
• UMIC & Geologist investigate if warranted.
• Authority To Mine is revoked if Geologist is required.
• Outburst Risk Review Team considers Geologists findings.
• Outburst Risk Review Team may authorise normal mining or other requirements such as further drilling.
What else will we find in the Outburst Management Plan?
The Outburst Management Plan

1. Prediction

2. Prevention

3. Protection
The Outburst Management Plan - Prediction

Prediction

• Drill hole logs (from survey) used to identify and map structures.
• Core samples.
• Geological mapping.
• Surface 2D & 3D seismic.
• Outburst Risk Review Team meetings.
The Outburst Management Plan - Prevention

Prevention

• Drilling and Gas Drainage.
• Reduce gas content below Outburst Threshold Limits.

(Insufficient gas pressure left to generate an outburst.)
The Outburst Management Plan: Prevention - Threshold Chart

West Cliff Outburst Threshold Chart

![Graph showing total gas content vs. methane/(methane + carbon dioxide) for different mining scenarios.]

- Normal Mining under current OMP conditions and drill
- Normal Mining with increased drilling and coring regime
- No Mining
- Outburst Threshold Level 1
- Outburst Threshold Level 2

100% CO2
100% CH4

Total Gas Content (m³/t) vs. Methane / (Methane + Carbon Dioxide)
Gas Drilling - Design Basis

- When mining areas above Outburst Threshold level 1 but below Outburst Threshold Level 2, in a CO2 environment, the boreholes are spaced to a maximum of 20m and cover the entire area within that zone - with only one branch per hole.
### Coring Design

<table>
<thead>
<tr>
<th></th>
<th><strong>BELOW THRESHOLD LEVEL 1</strong></th>
<th><strong>BETWEEN THRESHOLD LEVEL 1 &amp; 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Structure</td>
<td>150m spacing in a CH$_4$ environment and 100m spacing in a CO$_2$ environment on the basis of worst case sampling</td>
<td>75m spacing in a CH$_4$ environment and 50m spacing in a CO$_2$ environment on the basis of worst case sampling</td>
</tr>
<tr>
<td>Projected Structure (by geologist) not confirmed by drilling</td>
<td>Routine closely spaced samples as determined by the Outburst Risk Review Team</td>
<td>Within 10m either side of structure on both sides of the roadway in all roadways at 10m intervals, starting 10m before predicted zone.</td>
</tr>
<tr>
<td>Confirmed Structure</td>
<td>Maximum 10m either side of structure for each road to be driven.</td>
<td>Within 10m either side of structure on both sides of the roadway in all roadways.</td>
</tr>
</tbody>
</table>
Core Locations – No Structures
(Above Threshold Level 1 & Below Level 2)
Core Locations – **With Structures**
(Threshold Above Level 1 & Below Level 2)
Typical drilling plans – drainage patterns
Prevention
The Outburst Management Plan - Protection

- Routine training in Outburst Awareness
- The identification of outburst warning signs
- Use of First Response Rescue and Escape equipment
- The ability to suspend mining and initiate an inspection of the face area at any time should outburst warning signs be observed
What To Do If An Outburst Occurs

- **Self Escape**
  - Familiarity with equipment (SCSR)
  - Speed is critical
  - CO2 toxic to breathe @ 5-10%

- **Consider Rescue Options**
  - No one is required to perform a rescue
  - Risks must be considered
  - Leadership
  - Confidence
  - Have a plan
  - Where is a place of safety
  - Back up people required
  - Equipment required
  - Restore ventilation
  - Recovery of situation