Standpipe Rupture

17/11/2016

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## Metropolitan Overview

<table>
<thead>
<tr>
<th>Location</th>
<th>Helensburgh, New South Wales</th>
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</thead>
<tbody>
<tr>
<td>Product</td>
<td>Coking coal (~ 70% LV HCC &amp; ~ 30% Other Metallurgical coal)</td>
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<tr>
<td>Volume</td>
<td>1.8Mt (2015)</td>
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<tr>
<td>Overview</td>
<td>One of the oldest continually operating coal mining operations in Australia</td>
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<td></td>
<td>Underground mine utilizing longwall mining techniques</td>
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<td></td>
<td>Residential Workforce of ~360 residing in the greater Illawarra region of NSW</td>
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<tr>
<td>Transportation</td>
<td>Railed to Port Kembla Coal Terminal</td>
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<tr>
<td>Employment</td>
<td>260, plus contractors</td>
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</tbody>
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Background Information

- SIS drilling not possible due to surface constraints
- Contract project to drill:
  - 11 x 2000m; and
  - UIS bores in new mining area
- Bulli Seam – predominant seam gas CO2 at average 15m$^3$/tonne virgin content
- Seam height in area ranges from 2.8 - 3.2m.
- VLI successful contractor
  - Modular drill rig selected, with bolt down feed frame due to site access constraints
Location Plot finished bores
Risk Management Standard

AS/NZS 4360
Risk Assessment Process

- Workplace Risk Assessment & Control (WRAC) risk assessment model
- Combination of mine management, check inspectors, industry experts and site and contract drill operators used in RA
- Key risks identified
  - Standpipe design and loading
  - Removing survey tool and DHM in high gas environments
  - Gas emission from rib line
  - Standpipe blockages
  - Excessive bore hole back pressure.
  - Gas Range capacity
Risk controls were implemented:

- 150mm Kevlar composite standpipes
  - Reduced wear on standpipe wall due to less contact
- 12 metre long standpipes
- Dual 100mm off-takes from each standpipe
- Closed circuit drill set up to allow tools to be removed without gas leakage
- Drill rig bolted to floor using 6 x AX grade bolts
- 300mm gas range to each drill site and daily monitoring of gas range for blockages
Standpipe set up

Figure 2: Standpipe configuration with 3 m enclosure
Location of Drill Sites

Drill site 1 - 4 bores

Drill site 2 - 7 bores
Ventilation Arrangement Drill Site 2
Seam Profile (Bore EX03)
Incident occurred day-shift 24 November 2015

- Release of gas from standpipe # 9

7 boreholes had been completed successfully at up to 2150m in length.

- 4 bores at first drill site

Previous shifts had started to experience issues with maintaining a water seal in the gas water separator due to back pressure in the range.

Boreholes were turned off to allow repositioning of equipment.

Separator had been installed at non-optimum height due to gas range location and equipment position.
Incident

- One of the drill crews had previously identified a small leak in the bottom of the standpipe and had sealed the leak with grout.
- Standpipe turned off at 11.30 am and grout patch fails under pressure.
- Subsequent examination showed a hole 30mm diameter worn in bottom of standpipe.
Incident Immediate actions

- Back pressure caused grout repair to fail, releasing seam gas under pressure
- Ventilation increased to stub – remaining bores turned back on.
- Incident reported to regulator – Clause 179 – uncontrolled escape of gas
- Site sterilized by regulator – drilling suspended until original standpipe integrity able to be re-established
- Review of procedures and processes carried out.
So what went wrong?
Contributing Factors

- Boreholes were turned off to rectify gas water separator problem
- Rib line was under-cut where standpipe was installed – increasing length of exposed standpipe
- Standpipes had only single layer of Kevlar wear protection – no prior knowledge of wear associated with this length bore
- Gas range and drill rig location compromised separator set up
- Back pressure in gas range from first drill site bore holes
Contributing Factors

- Bolt down feed frame holes were of greater diameter than bolts – rig was able to move slightly under load

- Increasing curvature on boreholes with greater deflection on drill string

- Closed circuit set up
  - Placed rig six metres from standpipe allowed for further deflection

- Leakage from standpipe not identified as issue by drillers
Incident Recovery

- Consultation with standpipe OEM
  - OEM supplied composite adhesive – additional layers glued on and covered with steel pipe bandage.
- A test standpipe was set up to test and pressure tested to OEM specification before repairs to damaged standpipe carried out
- All standpipes were examined for damage
- External sleeves bonded to all standpipes
- Procedure to inspect drill rig hold down bolts each shift and chain blocks used to lock rig alignment
Incident Recovery

- Gas separator – separate gas line - run into return – not into gas range
- Training of crews in procedure to bond sleeves to standpipes
- Retraining of crews in procedures to set up each standpipe and monitoring requirements of rig position each shift
Key learnings from incident

- Risk assessment process focused on engineering controls
- Success of first four bores led to some complacency with second set of boreholes
- Audit and assessment of each standpipe and set-up following incident
- Highlights James Reason’s model –
  - Series of small un-related events coincide and led to an incident
    1. Compromised water separator set-up
    2. Gas range back pressure
    3. Undercut rib and known hole in standpipe
    4. Drill rig –feed bed movement
    5. Greater than predicted wear on standpipes.
Questions

Thank You