EMERGENCY SEALING & SURFACE FAN PROTECTION

PETER WYNNE
MINING CONSULTANT
PIKE RIVER DISASTER, 2010
**PIKE RIVER - ISSUES RELEVANT TO N.S.W. MINES**

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<td>RESCUE STRATEGIES, eg SELF ESCAPE</td>
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<td>EMERGENCY MANAGEMENT, eg I.M.T.</td>
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<td>INFRASTRUCTURE/EQUIPMENT, eg INERTISATION</td>
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PIKE RIVER - IMPROVISED SEAL AT PORTAL
PIKE RIVER
– INEFFECTIVE EXPLOSION PROTECTION

STANDBY FAN

BEFORE

AFTER
EMERGENCY SEALING – OBJECTIVES

• NOT TO SAVE LIVES

• TOOL FOR I.M.T. TO CONTROL SITUATION

• TO AVOID COMPLETE LOSS OF MINE

• TO ENABLE SAFE RE-ENTRY

• TO AVOID ONGOING NEGATIVE PUBLIC RELATIONS
Coal Mine Health and Safety Regulation 2006, Clause 45(b):
- mine has to have facilities for:

“(x) the rapid and effective sealing of the mine (while at the same time allowing for re-entry to the mine),”

THIS WAS ONLY RIGOROUSLY COMPLIED WITH AT MINES LIABLE TO SPON COMBUSTION, eg ULAN, WAMBO, BLAKEFIELD SOUTH.
EMERGENCY SEALING - QUEENSLAND REGULATIONS

• 70kPa RATING
• WHEN DEPLOYING, NO PERSONNEL EXPOSURE TO “LINE-OF-FIRE”
• PROVISION TO ATTACH AN INERTISATION SYSTEM
• PROVISION FOR MONITORING BEHIND SEALS
• AIRLOCK FOR RE-ENTRY
• ANNUAL TESTING OF OPERABILITY
• FOR SHAFTS, SEALS CAN BE AT SEAM INSETS

MOST QLD MINES APPEAR TO (GENERALLY) COMPLY, ALTHOUGH WITH SOME SHORTCOMINGS.
WHS (MINES) REGULATION, 2014: CLAUSE 68

- NO kPa RATING SPECIFIED
- RISKS OF SEALING ACTIVITIES TO BE MANAGED
- ANNUAL TEST OF AIRLOCKS & INERTISATION CONNECTIONS
- ANNUAL MODELLING - SUITABILITY OF INERTISATION LOCATIONS

RECOMMENDATION: USE QUEENSLAND’S AS THE STANDARD!
EMERGENCY SEAL
– BARE DOWNCAST SHAFT “LID”
EMERGENCY SEAL
- STEEL DOORS AT PORTAL
EMERGENCY SEAL
- STEEL DOOR IN DRIFT
EMERGENCY SEAL
– DRIFT AIRLOCK FOR RE-ENTRY
EMERGENCY SEAL
- INERTISATION CONNECTION
EMERGENCY SEAL
- “AIRBAG” FOR ROADWAY
EMERGENCY SEAL – INFRASTRUCTURE IN DRIFT

EXAMPLE – “PROFILED” DOORS
EXAMPLE: PRE-INSTALLED FRAME FOR FREE-FLOWING MATERIAL
EMERGENCY SEAL
- INFRASTRUCTURE IN DRIFT

EXAMPLE: PRE-INSTALLED FRAME FOR FREE-FLOWING MATERIAL

CONCRETE PIPE
QLD EXAMPLE: PRE-INSTALLED FRAME FOR FREE-FLOWING MATERIAL
INTAKE SHAFT WITH WINDER, etc
- SEAL OPTIONS

1. CLAD HEADFRAME
   - EXPENSIVE (70 kPa RATING)
   - MAJOR VENTILATION RESTRICTION
   - ENABLES RE-ENTRY USE (WITH AIRLOCK)

2. AIRBAG SEAL
   - THEORETICALLY POSSIBLE, BUT UNLIKELY IN REALITY
   - PREVENTS USE OF SHAFT FOR RE-ENTRY

3. AT SEAM ENTRY (STEEL DOORS, AIRBAGS, etc)
   - CHEAPEST OPTION
   - ENABLES USE OF WINDER FOR RE-ENTRY (WITH AIRLOCK)
   - RECOMMENDED OPTION
INTAKE SHAFT WITH WINDER, etc
- AIRBAG OPTION

Plan View (not to scale)
UPCAST/FAN SEAL EXAMPLE – REPLACE ELBOW WITH “LID”
UPCAST/FAN SEAL - “GUILLOTINE” DOOR IN FAN DUCT (CHINA)
CURRENTLY, NO AUST. REGS OR STANDARDS FOR RATINGS:

- EXISTING PRACTICE DEPENDS ON WHAT INCLUDED IN FAN APPROVALS (CONSISTENCY?), BASED ON RISK ASSESSMENT.

- DERIVED FROM EXPERIENCE(?) &/OR PRACTICE.

BEST “STANDARD” APPEARS TO U.S.B.M. GUIDELINE:

- STILL LACKING SPECIFIC NUMERICAL DESIGN CRITERIA, eg:
  “Each main mine fan shall be protected by one or more ‘weak’ walls or explosion doors.”

- HOWEVER, THE DESIGN GEOMETRY SEEMS RATIONAL:

SCOPE FOR DETERMINATION OF RIGOROUS STANDARD ! PhD TOPIC?
FAN EXPLOSION PROTECTION
- USBM LAYOUT GUIDELINES

- AREA OF EXPLOSION PANEL(S) ≥ PROJECTED AREA OF APPROACH SHAFT/DUCT/ROADWAY
- FAN ≥ 15ft FROM PANELS
FAN EXPLOSION PROTECTION
- EXAMPLE OF “BLOW OUT” PANELS

ABOVE UPCAST SHAFT, 10kPa “TRIGGER” PRESSURE
FAN EXPLOSION PROTECTION
- IMPROVED “SURVIVABLE” DESIGN

Advantages:
- Panels will react quicker than a single larger steel door.
- Panels will self close after being relieved under their own weight.
- Reaction loads spread over numerous hinges and door stops.
- Smaller doors inherently stronger than a larger door.
- Fabrication relatively simple and cost effective.
- % open area greater than rubber option.
- Can be used for forced venting applications with a retaining mechanism added.

Disadvantages:
- Steel panels more rigid than the rubber option. More susceptible to damage.
- Reaction time slower than rubber panels due to increased mass.

Primary Vent Fan
Explosion Relief Solution #2
Utilising a series of small doors

Use an off the shelf docking rubber as the door stop.
Risk to better resist tension loads from impact.

Sealing Detail
Rubber attached to door
Negative pressure holds rubber to seal

Rubber flaps to be added around door perimeter to assist with sealing.
Light weight construction of door to minimize door mass.
INTERACTION OF SEALS & EXPLOSION PROTECTION

THIS LAYOUT NOT RECOMMENDED!
INTERACTION OF SEALS & EXPLOSION PROTECTION

RECOMMENDED LAYOUTS
FAN EXPLOSION PROTECTION
-SIMPLE, EFFECTIVE DESIGN (XUANDONG MINE, CHINA)
FAN EXPLOSION PROTECTION
-SIMPLE, EFFECTIVE DESIGN (XUANDONG MINE, CHINA)
SEALS

• 70 kPa RATING FOR SEALS

• NO “LINE-OF-FIRE” EXPOSURE DURING SEAL IMPLEMENTATION

• ALLOW FOR RE-ENTRY & INERTISATION AT SEAL(S)

• ANNUAL TESTING OF OPERABILITY

EXPLOSION PROTECTION

• INTERACTION OF SEALS & FAN EXPLOSION PROTECTION MUST BE CONSIDERED, SO THAT EXPLOSION PROTECTION DOESN’T NEGATE SEALING

• “SURVIVABLE” EXPLOSION PROTECTION RECOMMENDED

KEEP IT AS SIMPLE AS POSSIBLE