MINE ESCAPE PLANNING & EMERGENCY SHELTER WORKSHOP

National Academy of Sciences
Washington, DC
April 2006

F.J. van Zyl
CSIR
South Africa
Overview

- South African Approach
- Three main focus areas
  - Underground fresh air
  - Getting to it
  - Getting to surface
- Current Practices
- Research
- Potential Needs
- Conclusions
South African Approach

- Mine Health and Safety Act
  - Hazard Identification and Risk Assessment based (HIRA)

- Emergency Preparedness & Response – Risk Based
South African Approach in HIRA Practice

Get Miners to 
U/G Fresh Air

Get Miners to 
Underground 
Fresh Air

Get Miners to 
Surface 
Fresh Air

Get Miners 
to 

Fresh Air
Underground Fresh Air – Current Practice

Get Miners to Fresh Air – Rescue Bays

• Hard Rock Mines
  • 30 minutes from work area – based on SCSR duration
  • Rescue Bay requirements
    • Compressed air
    • Water
    • Communications
    • First-aid
  • Sufficient size for deployed workforce
Underground Fresh Air – Current Practice

- Coal mines
  - 1 400 m maximum from work area – DME guideline, based on belt worn SCSR duration
  - Fixed and Portable
  - Fixed
    - Access from surface for rescue – air from surface, communication, water, first-aid and rescue access.
    - If no surface access 24 hours life support - oxygen candles, first aid, water, communications.
  - Portable
    - 24 hours duration, oxygen candles, first aid
    - OEM design (Survive-Air, MARS, etc)
- Focus on Collieries

Get Miners to Fresh Air – Rescue Bays
Underground Fresh Air – Research

- Most rescue bays designs and layouts in-house based on DME guidelines (fixed and portable)
- Mine Health and Safety Council (MHSC) – Public funding
  - Assessment of the design of refuge bays in coal mines – COL 115
  - Feasibility of using radio-assisted location of refuge bays (REBLE) – COL 224 (cancelled)
  - Manual of best practice for emergency response procedures – COL 605
Underground Fresh Air – Needs

- Guidelines on maintenance of rescue bays
- Clear guidelines on location of rescue bays
- Sealing off of rescue bays
- Use of oxygen candles – fire risk, duration
- Flameproof and intrinsically safe issues – portable units
- Minimum design criteria for portable rescue bays
- Multiple entries into portable rescue bays
Get Miners to Underground Fresh Air – Current Practice

Assistance to ‘section waiting’ place:

• Belt worn SCSR based
• All miners in U/G coal mines issued with belt worn SCSR
  • Each miner issued with dedicated unit
  • Provide assistance to rescue bays or long duration caches

• SCSR durability
  • Annual testing program – 1 % of all deployed SCSR tested annually (1 200/annum)
  • CSIR select and test with use of breathing simulator
    • Test criteria O₂, CO₂ and breathing resistance
  • Tripartheid Technical Committee oversee testing – state, OEMs & labor
  • Guidance on technical issues and testing specifications
Get Miners to Underground Fresh Air – Current Practice

Assistance from ‘section waiting’ place:
- Use of long duration units - chemical or compressed air
- Guidance systems
  - Guide rope with directional cones most common
  - Audio systems
- Rescue bays marked – audio, visual and physical
- Issue with enough air to reach 2nd rescue bay (some mines)
Get Miners to Underground Fresh Air – Research

Assistance to ‘section waiting’ place:
• Mine Health and Safety Council (MHSC) – Public funding
  • Use of ULF for communication and control following an explosion – COL108
  • Procedures to overcome disorientation and visibility after explosions – GEN 101

Assistance from ‘waiting’ place:
• In-house and OEM developments
Get Miners to Underground Fresh Air – Needs

**Assistance to ‘section waiting’ place:**
- Biggest current concern – unofficial statistics on quarterly escape training indicate that up 60% **do not** make it
- Early warning system – Personal Safety Device (guidance and location purposes)
  - EWAC
  - Belts
  - Aromatic gasses
  - Etc.
- Non-visual guidance vs ‘visual’ guidance
- Preparedness training – surviving teams usually have brigades men with them
- Use of goggles with SCSR
Get Miners to Underground Fresh Air – Needs

Assistance from ‘section waiting’ place:
- Effective system – engage more than one sense
- Reliability of systems after fire or explosion
Get Miners to Surface Fresh Air – Current Practice

**Mines Rescue Service (MRS)**

- **Brigade system**
  - Volunteer based
  - Region and country wide
- **MRS independent organization**
  - Rescue co-ordination centralized
  - Brigades men training done by MRS - intense
  - Annual assessment training of brigades men
- **Very successful**
  - Good track record
Get Miners to Surface Fresh Air – Research

Mines Rescue Service

- Continued improvement
- Focus on human physiological response
Get Miners to Surface Fresh Air – Needs (Challenges)

- Advancement rather than needs
- Physiological response – heat
- Declining numbers of brigades men
Conclusions

- **Getting the miner to the ‘section waiting’ place biggest issue**
  - Guidance in high stress no-visibility situation
    - Human response
    - Technology assistance
- **Guidelines on ‘Best Practice’**
  - Rescue bases
  - Withdrawal practices – early warning & guidance systems
- **Evaluation of ‘Best Practices’ after incidents**
  - Humans
  - Technology
THANK YOU