Practical guidelines for strain burst hazard awareness for development miners

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Outline

- Common Safety Values
- The Challenge
  - Strain burst defined
  - Contractor perspective
  - Relevance to the IRS
  - Objectives
- Risk-Based Approach to Guidelines
- Conclusions
- Feedback / Discussion
  - Draft Strain Burst Safety Card
Common Safety Values

Ontario Value:

“Every worker, home safe and healthy”

Cementation Value:

Our belief in working safely and eliminating injuries must pervade everything we do. We are committed to safety because it is the “RIGHT WAY TO WORK”
The Challenge

Rock bursting is a well recognized hazard with **significant** consequences that is **difficult to predict.**
Rock Burst - Defined

• An explosive failure of rock which occurs when very high stress concentrations are induced around underground openings

  (Evert Hoek)

• Damage to an excavation that occurs in a sudden or violent manner and is associated with a seismic event

  (Canadian Rockburst Support Handbook)
Rockbursts can be divided into three categories:

• Fault Slip Burst
• Pillar Burst
• Strain Burst
Pillar Burst

Photo from Rockburst by Blake and Hedley
Strain Burst
Contractor’s Challenge

As a contractor, we develop mines; therefore we employ many development miners in:

– Mine development headings
– Shaft sinking
– Mine rehab
Contractor's Challenge

Contractors bring experience from other projects but may not have the site-specific technical expertise for rock burst hazard planning at a given minesite.

But it is our workers, our guys, at the face; we have the responsibility for the safety of our employees.

We are helped when Operators (Clients) share their site specific knowledge.
What Contractors Can Do

Contractors can implement strategies with workers to raise the awareness of strain burst hazard using general guidelines.

Can continually update the guidelines with experience gained on multiple sites.

Can share the development with our clients.

(safety synergy)
Practical Guidelines

Objectives

• Promote worker awareness of the strain burst hazard
• Coach underground workers to recognize factors that are commonly associated with strain burst occurrence
• Provide guidance on what they can do to reduce the consequences of strain bursts
• Reduce the number of strain burst related incidents → ‘zero harm’
Internal Responsibility System

• Everyone in the workplace has a role to play and duty to actively ensure everyone (from the face to the boardroom) is safe

• Rockbursting is not a simple subject matter and awareness training is essential to the IRS to improve understanding of the hazard
Guidelines - Products

• Guidelines available throughout the company
• One page summary card for all workers
• Presentations for project personnel

• All will be shared with our clients and the industry in general
Approach

Taken from E. Hoek’s Practical Rock Engineering
Approach

RISK = Probability × Consequence
Risk Approach

Probability

• What factors increase the likelihood of strain burst occurrence?
  – Recognize indicators
    • What indicators can be recognized?
    • What training is required so the indicators are recognized

• What can we do to reduce the probability of occurrence?
Risk Approach

Consequence
If a strain burst is going to occur, what can we do to reduce the consequence of the event?

– How can we avoid the hazard and minimize potential for harm? or

– How can we control the hazardous consequences of strain bursting?
Causal Factors

Strain bursting occurs where stress exceeds rockmass strength in brittle rock.

Look for increased stress or decreased strength (and brittle rock).
Causal Factors

- High stress
  - deep mining
  - locked in stress
  - stress changes near faults / structures
  - mine-induced stress
    - over extraction, poor pillar layout, sudden changes in excavation shape/size
Causal Factors

- Hard, brittle rock types
- Contrasting rock types
  - Geological structures
    - dykes are often stronger, more brittle
    - weak zones may allow slips or shed stress to nearby brittle rocks
Indicators

Observable indicators of burst-prone ground include:

• Mining depth
• Mechanical properties and behaviour of the intact rock
  – strong, hard, brittle rock
  – ground noise associated with brittle failure
• Size, spacing, orientation, and mechanical properties of pre-existing geologic structures (e.g. faults, joints)
  – geological changes/contacts
  – dykes
• Shape, size, and proximity of excavations
  – Change in excavation shape
Indicators

While drilling:
- Lower drilling speeds
- Drill rods jamming
- Jerking of drill rods
- Pinching/Caving of holes

Other observations:
- Face “spitting”
- Rock Noise
- Formation or opening of a crack

Measurements/Instrumentation (ground control):
- Increased levels of mine seismicity
- Swarms of regional seismicity
Reduce Probability

We can reduce the probability of strain bursting by:

• Minimizing the effect of rock stress
  — Geometry, sequence and rate of mining
    — avoid sill mining, proper backfill, cross structure/dykes at favorable angles, use seismic data in planning etc.
    — De-stressing (drilling/blasting to drive high stress away from excavation boundary)

Generally the mine owner controls these variables
Reduce the Consequence

• Remove the worker from the hazard zone
  ─ Retreat during active seismicity
  ─ Barricade; re-entry protocols
  ─ Remote automated vs. mechanized vs. handheld equipment

• Induce strain burst activity - such as cold water to induce bursting from a safe distance

• Reduce the extent of damage
  ─ Energy absorbing ground support
Communication & Reporting

To communicate face workers observations of indicators of strain bursting

- Example for reporting “rock noise”
- Use Hazard Awareness Card to communicate conditions to supervisors/ management or guide notes on 5 point card

Guidelines

• A draft hazard awareness card is available in this room.
• Plan to provide such a card to all underground workers.
• Foster better communication between underground workers, site safety personnel, planning and ground engineering staff management.
• May be instances of “crying wolf” but worthwhile if prevents any incidents.
Conclusions

• Common Safety Values

• Strain bursts are a significant safety hazard but nearly impossible to predict.

• There are indicators that assist with hazard identification

• Using a risk approach, Cementation is developing a “practical guideline” to improve workplace safety – this will include hazard awareness training and the introduction of a strain burst hazard awareness card
Conclusions

- The approach is to empower the worker, through awareness and knowledge, to report and act on areas of concern (the IRS).
- The guideline will be generic and we plan to use it across our project sites. Site specific input for each mine project is always required.
- We would appreciate any comments/suggestions that you may have.
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Questions / Discussion

• Guidelines are always a work in progress, feedback is essential and welcomed.

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