SAFETY IMPROVEMENTS IN THE MINING INDUSTRY OVER THE LAST 30 YEARS - THROUGH THE LENS OF GLENCORE COAL

Mick Buffier, Glencore
29 October 2019
Important notice concerning this document including forward looking statements

This document contains statements that are, or may be deemed to be, “forward looking statements” which are prospective in nature. These forward looking statements may be identified by the use of forward looking terminology, or the negative thereof such as “outlook”, “plans”, “expects” or “does not expect”, “is expected”, “continues”, “assumes”, “is subject to”, “budget”, “scheduled”, “estimates”, “aims”, “forecasts”, “risks”, “intends”, “positioned”, “predicts”, “anticipates” or “does not anticipate”, or “believes”, or variations of such words or comparable terminology and phrases or statements that certain actions, events or results “may”, “could”, “should”, “shall”, “would”, “might” or “will” be taken, occur or be achieved. Forward-looking statements are not based on historical facts, but rather on current predictions, expectations, beliefs, opinions, plans, objectives, goals, intentions and projections about future events, results of operations, prospects, financial condition and discussions of strategy. By their nature, forward-looking statements involve known and unknown risks and uncertainties, many of which are beyond Glencore’s control. Forward-looking statements are not guarantees of future performance and may and often do differ materially from actual results. Important factors that could cause these uncertainties include, but are not limited to, those disclosed in Glencore’s 2018 Annual Report published in early March 2019. For example, our future revenues from our assets, projects or mines will be based, in part, on the market price of the commodity products produced, which may vary significantly from current levels. These may materially affect the timing and feasibility of particular developments. Other factors include (without limitation) the ability to produce and transport products profitably, demand for our products, changes to the assumptions regarding the recoverable value of our tangible and intangible assets, the effect of foreign currency exchange rates on market prices and operating costs, and actions by governmental authorities, such as changes in taxation or regulation, and political uncertainty. Neither Glencore nor any of its associates or directors, officers or advisers, provides any representation, assurance or guarantee that the occurrence of the events expressed or implied in any forward-looking statements in this document will actually occur. You are cautioned not to place undue reliance on these forward-looking statements which only speak as of the date of this document. Except as required by applicable regulations or by law, Glencore is not under any obligation and Glencore and its affiliates expressly disclaim any intention, obligation or undertaking, to update or revise any forward looking statements, whether as a result of new information, future events or otherwise. This document shall not, under any circumstances, create any implication that there has been no change in the business or affairs of Glencore since the date of this document or that the information contained herein is correct as at any time subsequent to its date. No statement in this document is intended as a profit forecast or a profit estimate and past performance cannot be relied on as a guide to future performance. This document does not constitute or form part of any offer or invitation to sell or issue, or any solicitation of any offer to purchase or subscribe for any securities. The companies in which Glencore plc directly and indirectly has an interest are separate and distinct legal entities. In this document, “Glencore”, “Glencore group” and “Group” are used for convenience only where references are made to Glencore plc and its subsidiaries in general. These collective expressions are used for ease of reference only and do not imply any other relationship between the companies. Likewise, the words “we”, “us” and “our” are also used to refer collectively to members of the Group or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies.
Presentation Overview

- About Glencore
- What drives safety excellence
- Changes in safety over 30 years, including legislation
- Risk Management
- Catastrophic Hazard (MUEs) and critical controls
- Glencore’s coal business safety improvement journey
Glencore at a Glance

Who We Are

Glencore is a global diversified natural resource company and a major producer and marketer of commodities worldwide.
Glencore in Australia

Australia is an important part of our global business and we have operated here for 20 years.

In 2018, Glencore contributed $15.6 billion to regional, state and national economies in Australia.*

**18,000**
Employees and contractors

**$2.0b**
Wages and salaries

**$10.1b**
Spent on goods and services

**$2.2b**
Taxes and royalties paid to state and federal governments**

**$1.3b**
Capital and sustaining investment

**$9m**
Regional community investment initiatives

---

*The tax and royalties figures represents Glencore’s share of every operation we operate and manage in Australia. All other figures represent 100% of the operations that Glencore manages in Australia and include our joint venture partners’ interests in Glencore Agriculture, Ernest Henry Mining (Copper); our joint venture partners’ interests in a number of coal operations and our 49% interest in Hunter Valley Operations.

** Glencore’s estimated corporate tax liability for 2018 is about $1 billion.
The history of our business in Australia
Our view - what drives Safety Excellence

• Committed senior leadership
• Risk-based approach
• Safety management systems
• Effective standards and procedures
• Technical expertise and competence (mechanical, electrical, geotechnical, hydrogeological, structural etc)
• Right safety tools (JSA’s, bowties, hierarchy of controls, PTO’s, SO’s)
• Visible leadership at all management/supervisor levels
• Assurance
• Everyone owns and is committed to safety
## Changes in mining industry safety performance

Through a Glencore coal lens

<table>
<thead>
<tr>
<th><strong>1980s</strong></th>
<th><strong>2000s</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive legislation</td>
<td>Change in legislative approach to risk management</td>
</tr>
<tr>
<td>Mine Manager responsible – “full charge and control”</td>
<td>Focus on organisational responsibility and leadership</td>
</tr>
<tr>
<td>High injury rates</td>
<td>H&amp;S Management Systems</td>
</tr>
<tr>
<td>Confrontation between management and workforce</td>
<td>Behavioural safety focus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>1990s</strong></th>
<th><strong>2010s</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of Risk Management principles</td>
<td>Quality control of risk management, standards and systems</td>
</tr>
<tr>
<td>ISO Standards and focus on Quality Assurance</td>
<td>ICAM incident investigation</td>
</tr>
<tr>
<td>Early discussion on H&amp;S Management Systems</td>
<td>Fatal Hazard Protocols and assurance</td>
</tr>
<tr>
<td>Injury rates start reducing</td>
<td>Catastrophic Hazard Management and critical controls</td>
</tr>
<tr>
<td>Consultation with workforce</td>
<td></td>
</tr>
</tbody>
</table>

---

UNSW | Kenneth Finlay Memorial Lecture | Oct 2019
37 Functions of managers

(1) Subject to any instructions given to the manager of a mine or to another person employed at the mine by:
   (a) the owner of the mine,
   (b) a superintendent of the mine, or
   (c) an assistant superintendent of the mine,

(excluding instructions which are required under section 52 or 54 to be confirmed in writing and which have not been so confirmed), the manager of a mine:

   (d) shall have full charge and control of:
       (i) all persons employed at the mine, and
       (ii) all operations at the mine,

   (e) shall enforce the observance, by all persons employed at the mine, of this Act, the regulations, the rules and any schemes and any directions, or conditions of exemptions or approvals, given thereunder, and

   (f) shall have such other functions as may be conferred or imposed on the manager by this Act, the regulations, the rules and any schemes and any directions, or conditions of exemptions or approvals, given thereunder.

(2) Without limiting the generality of subsection (1), the manager of a mine shall:

   (a) appoint the requisite number of officials of the mine required by this Act or the regulations (other than officials who are senior to the manager) to exercise the functions conferred or imposed on those officials by this Act, the regulations, the rules and any schemes and any directions, or conditions of exemptions or approvals, given thereunder,

   (b) ensure that the machinery, apparatus and equipment in use at the mine is maintained in a safe working condition,
NSW Coal Mine Regulation Act 1982 (repealed 2004)

Prescriptive – rule based

101 Transport rules

(1) The manager of a mine shall make rules (to be known as transport rules), not inconsistent with this Act, with respect to the use of vehicles at the mine.

(2) Without limiting the generality of subsection (1), the manager of a mine shall, under that subsection:

(a) if the mine is an underground mine—make transport rules with respect to such matters as are prescribed for the purposes of this paragraph, and

(b) if the mine is an open cut mine—make transport rules with respect to such matters as are prescribed for the purposes of this paragraph.

102 Support rules

(1) The manager of an underground mine shall make rules (to be known as support rules), not inconsistent with this Act, with respect to the support of the roof and sides of working places and roadways in the mine.

(2) Where support of the roof and sides of working places and roadways in an underground mine is to be removed under the system of mining in use at the mine, the manager of the mine shall include in the rules made under subsection (1) rules, not inconsistent with this Act, for the removal of that support.

(3) Without limiting the generality of subsections (1) and (2), the manager of a mine shall:

(a) under subsection (1)—make support rules with respect to such matters as are prescribed for the purposes of this paragraph, and

(b) under subsection (2)—make support rules with respect to such matters as are prescribed for the purposes of this paragraph.
114 Manager of mine to ensure that employees undertake training

The manager of a mine shall ensure that persons employed or to be employed at the mine undertake training in accordance with the provisions of:

(a) any training scheme approved by the approved company in respect of the mine pursuant to any order made or given by the approved company, and

(b) any training rules made pursuant to section 115.

115 Making of training rules

Where the Minister is of the opinion that further provisions should be made for the training and instruction of persons employed or to be employed at a mine in addition to the provisions of any training scheme approved by the approved company in respect of the mine pursuant to an order made or given by the approved company, the Minister may direct the manager of the mine to make training rules to include those further provisions.
Early 1990’s introduction of Risk Management

Hazards

- A hazard is a source of potential harm
- To identify hazards look for sources of energy
- Incidents are due to unplanned energy releases

**Types of Energy**

- **Gravity**: falling or things falling
- **Electrical**: contact or arcing
- **Mechanical**: moving vehicles or parts
- **Chemical**: inhale, touch, ingest, etc
- **Pressure**: air, spring, etc
- **Noise**: level and duration
- **Thermal**: hot/cold surfaces
- **Radiant**: light, radiation
- **Body mechanics**: lifting, position etc
Risk - the effect of uncertainty on objective

- It is a deviation from the expected – either positive and/or negative

- It is referred to in terms of consequence and likelihood (AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines)

Consequences are usually considered to be the “Maximum Reasonable Consequence”

(cf Professor Jim Joy on WRAC – in early 90’s first RA done with senior management on using a lawn mower)

- Lion - same hazard, however low and high Risk due to effectiveness of controls
12 Step Risk Assessment Process

1. Establish the Context
2. Select the Risk Assessment type
3. Identify the risks, causes and consequence
4. Identify the existing controls
5. Determine Risk Control Effectiveness (RCE)
6. Determine the Expected Consequence
7. Determine the Likelihood
8. Determine the current level of risk
9. Determine Authority for Continued Toleration of Risk
10. Determine Potential Maximum Consequence
11. Treat the Risks
12. Monitor & Review
4 Obligations to control risk

(1) For the purposes of this Regulation, an obligation to control a risk to health or safety (in any case in which the elimination of the risk is not reasonably practicable) is an obligation to take the following measures (in the order specified) to minimise the risk to the lowest level reasonably practicable:

(a) firstly, substituting the hazard giving rise to the risk with a hazard that gives rise to a lesser risk;
(b) secondly, isolating the hazard from the person put at risk;
(c) thirdly, minimising the risk by engineering means,
(d) fourthly, minimising the risk by administrative means (for example, by adopting safe working practices or providing appropriate training, instruction or information),
(e) fifthly, using personal protective equipment.

(2) A combination of the above measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.
Coal Mine Health and Safety Regulation 2006

Overall responsibility with Operator who appoints manager, electrical engineer and mechanical engineer

7 Nomination of operator by colliery holder

(1) For the purposes of section 17 (5) of the Act, if there is only one coal operation within a colliery holding, the nomination of the operator of a coal operation by the colliery holder must be in a form that contains at least the following information and signature:

(a) the name of the coal operation,
(b) a description of the area covered by the coal operation,

(a) people with appropriate engineering expertise, and
(b) the manager of mining engineering for the coal operation, and
(c) in the case of an underground mine:
   (i) the manager of electrical engineering for the coal operation, and
   (ii) the manager of mechanical engineering for the coal operation.
Subdivision 1  Health and safety management systems generally

Note. Section 23 (3) of the Act specifies what must be included in a health and safety management system, namely system elements, any major hazard management plans that are required, the management structure and any contractor management plan required. Section 23 (3) (e) permits the regulations to prescribe additional matter that must be included in a health and safety management system, and section 23 (4) permits the regulations to require such a system to be consistent with any management system standard specified in the regulations.

(c) *supervision arrangements* that assist in meeting the requirements of the regulations under the *Occupational Health and Safety Act 2000* in relation to the supervision of employees,

(e) *an electrical engineering management plan* covering the life cycle of electrical plant and installations, and electrical engineering practices, at the coal operation, that is developed, implemented and periodically reviewed through consultation with a qualified electrical engineer, to control risks as follows:

(f) *a mechanical engineering management plan* covering the life cycle of mechanical plant and installations, and mechanical engineering practices, at the coal operation, that is developed, implemented and periodically reviewed through consultation with a qualified mechanical engineer, to control risks as follows:
Coal Mine Health and Safety Regulation 2006
Requirement to identify major hazards and have major hazard management plans

Division 3  Major hazards and major hazard management plans

29  Contents of major hazard management plan: slope stability management plan

For the purposes of section 36 of the Act, a major hazard management plan in relation to a major hazard arising from slope instability must make provision for the monitoring of the control and stability of high walls, low walls, stock piles and overburden dumps in so far as the safety of people at the operation may be affected.

30  Contents of major hazard management plan: surface transport management plan

(1)  For the purposes of section 36 of the Act, a major hazard management plan in relation to hazards arising from the use and operating environment of plant used for the transport of people or materials on the surface part of the operation (transport) must make provision for the following matters:

(a)  the conditions under which the transport may be used,
(b)  transport being used only within its design parameters,
(c)  the design (including appropriate signage and provision of adequate windrows) of roadways on which the transport may operate,
2010s - Critical Control Management

Glencore Coal view – the most comprehensive change to the management of Fatal and Catastrophic hazards since introduction of Risk Management

Underlying assumptions of the critical control management process

The CCM process is built upon a number of assumptions.

Assumption 1
The majority of MUEs within the mining and metals industry are known, as are the controls.

Assumption 2
Most serious events including MUEs are associated with failures to effectively implement known controls rather than not knowing what the risks and controls should be.

Assumption 3
More can be less. A hazard management plan of 50 pages will often contain a large number of controls, which can be complex to understand, implement and monitor. This can lead to less robust management of critical controls. Less can be more. The fewer number of controls, the more robustly they can be monitored.

Assumption 4
Some controls are more important than others. Those critical controls should be monitored more regularly.
Developing a bowtie and identify controls and critical controls

**Actions to identify controls**

- Action 1: Identify controls
- Action 2: Develop a bowtie
- Action 3: Assess the bowties and controls

**Figure 2: A simple bowtie diagram**

**CRITICAL CONTROL MANAGEMENT**

**STEP 4: Select the critical controls**

*Figure 4: CIP Dillon critical control decision tree*

- Identified control
  - Does control prevent, detect or mitigate a potential risk? [YES/NO]
    - If YES, does control prevent repeat violation? [YES/NO]
    - If YES, is control the only barrier? [YES/NO]
    - If YES, is control effective for multiple risks? [YES/NO]
    - If YES, is control implemented? [YES/NO]
  - If NO, is it a critical control?

Net a critical control

Critical control
Safety Bowtie Analysis example

Threats/Causes

- Compromised visibility at intersections, curves and corners
- Operator error leading to loss of control of mobile equipment
- Personnel exceeding mobile equipment operating limits
- Mechanical or electrical component failure while in operation
- Poor road conditions such as grade, camber, surface conditions, etc.

Controls

- Intersections, curves and corners designed for good visibility
- Supervisor inspects road conditions daily
- Truck operators drive equipment to rules
- Shovel operators load trucks to defined levels
- Supervisors observe operator acts
- Equipment selected to minimise errors due to poor human factors design
- Equipment is maintained to defined standards
- Operators report issues with equipment function
- Mine design includes road specifications
- Supervisor monitors new and existing road design
- Mine design includes road specifications
- Operators report control design issues
- Operator acts are consistent with training
- Equipment is selected to minimise errors due to poor human factors design
- Equipment is selected to minimise errors due to poor human factors design

Consequences

- Injury or fatality of personnel operating mobile equipment
- Injury or fatality of personnel operating heavy mining equipment
- Injury or fatality of personnel operating heavy mining equipment
- Collision with ancillary plant carrying hazardous substance or explosives
- Collision with fixed structures such as conveyors, electrical structures, buildings, etc.
- Key assets located away from HME routes
- Key assets protected by berms and bollards
- Vehicles transporting hazardous materials do not travel on operating haul roads
- Windrows and berms on roads
- Cab design to prevent intrusions
- Other vehicle operators follow 50 meter authorisation requirement
- Other vehicle operators follow 50 meter authorisation requirement
- Other vehicle operators follow 50 meter authorisation requirement
- Other vehicle operators follow 50 meter authorisation requirement

Heavy vehicle operating unsafely

Heavy mining equipment collisions
## Critical Control example – specification and verification requirements

1. **What is the name of the critical control for underground fire and coal dust explosions?**
   - Sharp picks on shearer

2. **What are its specific objectives related to the MUE?**
   - To reduce the risk of ignition of flammable mixture by reducing the friction between the shearer and rock

3. **What are the critical control performance requirements to meet the objectives?**
   - Picks are sufficiently sharp to reduce the risk to prevent sparking

4. **What are the activities that support or enable the critical control?**
   - A template of acceptable pick profile is developed
   - Shearer picks are visually inspected pre-shift to assess their condition
   - Regular maintenance is carried out on shearsers

5. **What activities can be checked to verify the critical control performance?**
   - Picks inspected against the template
   - Review of inspection records weekly
   - Review of maintenance and replacement records monthly

6. **What is the target performance for critical control?**
   - Picks meet the acceptable pick profile template, between markers 3 and 5. Picks outside this range are replaced.

6. **What is the critical control performance trigger for shutdown, critical control review or investigation?**
   - 5 per cent of inspections indicate that the picks are beyond threshold condition for use.
SafeWork Australia – fatality statistics
(Note: any workplace fatality is unacceptable)
Causal safety investigation - example

Video #1 Ravensworth Open Cut - Worker injured by pin ejecting under pressure

https://www.youtube.com/watch?v=aKY3VnqZRKo&feature=youtu.be

It is recommended that mine operators and contractors review their safety management systems, focusing on:

- Hot work risk assessments including thermal lancing
- The potential for steam expansion or hydrocarbon combustion events
- The potential for confinement and piling of molten slag
- Safe standing zones
- Hot work permit systems and procedures
- The appointment of workers permitted to perform thermal lancing activities
- The availability and suitability of appropriate tools and procedures for the mechanical removal of pins
Glencore’s coal business - safety improvement journey
Reduction in Glencore global coal fatalities – across a workforce of 21,000 - 30,000

2002 – 2019

Leadership driven Standards and Systems High risk verification

Unacceptable Fatal Hazard Protocols Visible Field Leadership

Start Cat Haz critical controls Resilience through “do what we say” & assurance Constant state of unease

All Fatalities by Fatal Risk

No. of Fatalities


Australia Colombia South Africa

Leadership driven Standards and Systems High risk verification

Unacceptable Fatal Hazard Protocols Visible Field Leadership

Start Cat Haz critical controls Resilience through “do what we say” & assurance Constant state of unease

No. of Fatalities


Australia Colombia South Africa

All Fatalities by Fatal Risk
What turned South Africa around

- INSIKA, 10 cardinal rules, initial focus on core hazards
- Training managers, supervisors and workforce in risk management
- A weekly high risk verification process involving senior managers
- Visible safety leadership in the field
- Leadership training for managers and supervisors plus holding each accountable for safety outcomes
- SafeCoal implementation followed by SAFEWORK
- Key initiatives that made a difference:
  - Fall of Ground (Strata Control) laboratory training for all underground employees
  - Underground mobile equipment – separation distances, no go zones and Collision Avoidance
  - Contractor’s Academy and training centre – working at heights; electrical isolation
  - GCOM – structured pre-shift safety communications
Key objectives of SafeCoal:
- Eliminate fatalities by focusing on Fatal Hazards
- Reduce injuries by 50%
- Streamline systems and documentation
- Communicate SafeCoal

All employees had to be able to identify the FHP’s and controls in their workplace.

Managers and supervisors are to have the control of fatal hazards as part of their job description.

A Field Visible Safety Leadership checklist had to be established at each site.
SafeCoal Tools: South Africa - High Risk Verification Process

3.1 Identify Activities/Tasks
   - Rate activities/tasks
   - Prepared Weekly High Risk Work Report
   - Discuss Weekly High Risk Work Report at Site Planning Meeting
   - Identify activities/tasks to be verified
   - Submit "Site" HRW Report to Table A Meeting for approval
   - Identify HO/D’s to act as verifier/auditors
   - Submit "Complex" HRW Report to Group Health and Safety

4.3 Report findings to weekly Planning Meeting
   - Verifiers to verify activities/tasks
   - Safe?
     - Yes
       - Report to ECSA, HRW, and Ministry
     - No
       - Stop Task and Correct

3.2 Compile ECSA HRW Report and distribute

End
Contractors Academy and Training Centre

- Established due to the number of fatalities involving contractors – often poorly trained in both job skills and safety
- Contractors often not committed to the same safety level
- In excess of 40,000 trained since 2008

Contractors Academy
- established to train (1 day) the senior management of Contract Cos in SA Coal requirements - SafeCoal, FHPs, permits, performance expectations
- undertake written competency test and receive certificate
- Glencore Contractor ‘Owner’ who manages the contractor on site also undertakes same training

Training Centre
- utilised to train both Glencore and contractor employees
- Includes both safety inductions and specialised training where required – working at heights; strata control; electrical safety; mobile equipment and confined space training
Fatal Hazard Protocols - across the global coal business from 2009

1. STRATA FAILURE
2. FIRES AND EXPLOSION
3. MOBILE EQUIPMENT
4. INAPPROPRIATE EMERGENCY RESPONSE
5. INRUSH AND OUTBURST
6. EXPLOSIVES AND SHOTFIRING

7. INADEQUATE ENERGY ISOLATION
8. WORKING AT HEIGHTS
9. LIFTING AND CRANAGE
10. CONFINED SPACE AND IRRESPIRABLE/NOXIOUS ATMOSPHERE
11. TYRE AND RIM MANAGEMENT
12. ELECTRICAL SAFETY
Clear communication of Fatal Hazard Protocols critical

- A strata failure risk assessment must be undertaken and a Strata Failure Management Plan developed, implemented and maintained

- The Strata Failure Management Plan must include:
  - the appropriate factors of safety in the mine and pillar design; and
  - the support rules or surface slope stability rules

- No person shall enter under unsupported roof

- Assets must develop, implement and maintain an energy isolation procedure and relevant permits for all of the relevant energy sources

- The energy isolation procedure must, as a minimum, contain the 12 step process flowchart for all isolations

- Particular emphasis must be placed on:
  - identification and dissipation of all relevant energy sources
  - isolating and securing; and
  - verification of the isolation, i.e. test for dead.
A key initiative taken in the 2000s was to map to Patrick Hudson’s maturity model – goal “Resilient.”

Based on Professor Patrick Hudson’s safety culture ladder (2007)
Strategic planning – responsibility rests with senior management

Glencore Corporate HSEC Strategy

Coal Department

Coal Department HSEC Strategic Planning Paper
Strategy & Annual Plan

Regional HSEC Strategies & Annual Plans

Asset HSEC Annual Plans

Budget presentations & reporting
Budget presentations & quarterly reviews
Budget presentations, reporting & quarterly reviews

Assurance, support & interventions
Assurance, support & interventions

- HSEC Risk Register
- Performance and audit results
- Emerging trends
- Stakeholder feedback

UNSW | Kenneth Finlay Memorial Lecture | Oct 2019
HSEC Management Framework: Coal Australia example
Glencore Coal – Safety Governance

**Monthly**
- HPRI meeting
- HSEC monthly reporting
- Project progress as applicable (e.g. catastrophic hazards project)

**Quarterly**
- SD Leadership visits
- HSEC quarterly reporting and reviews
- HPRI PMC 5 and Corporate Audit corrective actions
- Critical control verification results

**Annually**
- HSEC risk assessment review
- SD strategy planning
- Budget presentations
- Assurance and verification
- Annual Sustainability Report
## 2019 Coal Department HSEC Assurance Plan

### Australia

- **Glencore Corporate HSEC Assurance**
  - UG Multidisciplinary Verification - Oaky Creek
  - Multidisciplinary Verification - Integra UG
  - OC Multidisciplinary Verification

- **Catastrophic Hazards**
  - Catastrophic Hazard Topic TBC - if UG, 4 assets
  - Note: This program may be impacted by the Glencore Multidisciplinary 2019 schedule

- **Safe work Fatal Hazard Protocols**
  - Self-assessment of FHP’s
  - 2nd/3rd party verification – 4 assets (SafeCoal Fatal Hazard Protocols)

- **HSEC Policies**
  - Self-assessment – 4 assets
  - Verification Blasting Protocol – All OC assets
  - Risk-based verification Geochemical Protocol – All assets
  - Stakeholder Engagement Plans

- **Health and Safety Legal Compliance Audit**
  - Verification: 14 assets
  - Self-assessment: 7 assets

- **Permitting and Legal Environmental and Community Compliance Audit**
  - Verification of community development and investment plans – All assets
  - Internal E&C compliance review – 5 assets
  - Inspections / GDPs (leading & lagging indicator) reviews – All
  - Land Rehabilitation – All OC assets
  - Annual Site EC Plans – All assets

- **HSEC Data**
  - HST program design and trial – TBC
  - GCP Data Reviews (Q1,2 & 3) – All assets
  - NGERs data by Deloitte – All assets

- **Independent verification**
  - Mick Buffier, Lucy Roberts and Rosie Davey - Nov/Dec 2019

### South Africa

- **Glencore Corporate HSEC Assurance**
  - TSF Verification
  - TUGO-ER & Brush verification

- **Catastrophic Hazards**
  - Catastrophic Hazards – All assets
  - UG Strata – TFN
  - Surface slope failure - All assets
  - UG Fires, Explosions - TFN
  - UG Inrush & Outburst – TFN
  - Mobile Equipment & Pedestrian interaction – All Assets
  - Structural failure/Integrity - All assets
  - Cat. Hazards Quarterly Self Assessments – All assets

- **Safe work Fatal Hazard Protocols**
  - Safe work Fatal Hazard Protocols – All assets
  - GGV – Apr 2019
  - Izimbiwa – Apr 2020
  - TFN – Oct 2019
  - IMPunzi – Oct 2020
  - SafeWork FHP Self assessments – All assets
  - Strata Management and Slope Failure – IMP

- **HSEC Policies**
  - HSEC Policy Audits : Izimbiwa and IMPunzi
  - HSEC Policies Self-Assessment – All assets

- **Health and Safety Legal Compliance Audit**
  - Verification: 14 assets
  - Self-assessment: 7 assets

- **Permitting and Legal Environmental and Community Compliance Audit**
  - Verification of community development and investment plans – All assets
  - Internal E&C compliance review – 5 assets
  - Inspections / GDPs (leading & lagging indicator) reviews – All
  - Land Rehabilitation – All OC assets
  - Annual Site EC Plans – All assets

- **HSEC Data**
  - HST program design and trial – TBC
  - GCP Data Reviews (Q1,2 & 3) – All assets
  - NGERs data by Deloitte – All assets

- **Independent verification**
  - Mick Buffier, Lucy Roberts and Rosie Davey - Nov 2019

### Colombia

- **Glencore Corporate HSEC Assurance**
  - 1st party/self assessment
  - 2nd party
  - 3rd party (external to the business)

- **Catastrophic Hazards**
  - Catastrophic Hazards – All assets
  - UG Strata – TFN
  - Surface slope failure - All assets
  - UG Fires, Explosions - TFN
  - UG Inrush & Outburst – TFN
  - Mobile Equipment & Pedestrian interaction – All Assets
  - Structural failure/Integrity - All assets
  - Cat. Hazards Quarterly Self Assessments – All assets

- **Safe work Fatal Hazard Protocols**
  - Safe work Fatal Hazard Protocols – All assets
  - GGV – Apr 2019
  - Izimbiwa – Apr 2020
  - TFN – Oct 2019
  - IMPunzi – Oct 2020
  - SafeWork FHP Self assessments – All assets
  - Strata Management and Slope Failure – IMP

- **HSEC Policies**
  - HSEC Policy Audits : Izimbiwa and IMPunzi
  - HSEC Policies Self-Assessment – All assets

- **Health and Safety Legal Compliance Audit**
  - Verification: 14 assets
  - Self-assessment: 7 assets

- **Permitting and Legal Environmental and Community Compliance Audit**
  - Verification of community development and investment plans – All assets
  - Internal E&C compliance review – 5 assets
  - Inspections / GDPs (leading & lagging indicator) reviews – All
  - Land Rehabilitation – All OC assets
  - Annual Site EC Plans – All assets

- **HSEC Data**
  - HST program design and trial – TBC
  - GCP Data Reviews (Q1,2 & 3) – All assets
  - NGERs data by Deloitte – All assets

- **Independent verification**
  - Mick Buffier, Lucy Roberts and Rosie Davey - Feb 2020

Note: This program may be impacted by the Glencore Multidisciplinary 2019 schedule.
High Potential Risk Incident (HPR) reporting and investigation

One of the most important Coal initiatives – all senior management attend monthly global teleconference

- Coal conducts a rigorous HPRI review process which is held monthly and chaired by the Industrial Lead.
  - review all HPRIIs that occur within Coal
  - each presentation is given by General Manager displaying leadership
  - actions are discussed and how they will prevent a repeat HPRI
  - actions may be delegated to regions and/or across Coal
  - track strategic projects – collision avoidance and fatigue technologies
- Across Glencore all PMC 4 & 5 consequence incidents are reported and investigated

- weekly global Glencore HPRI reports are provided to each region. Regions review the incidents and create actions as appropriate.

- HPRIIs are also reported in the monthly and quarterly HSEC report with a focus on repeat incidents.
Repeat HPRI’s – an important focus area
Indicates not in control or learning from mistakes; a leading indicator

<table>
<thead>
<tr>
<th>Repeat HPRI</th>
<th>Main Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strata Failure</strong></td>
<td>• Poor surface water and groundwater management</td>
</tr>
<tr>
<td></td>
<td>• Piezometer installation and monitoring inadequate</td>
</tr>
<tr>
<td></td>
<td>• Insufficient focus on CC’s</td>
</tr>
<tr>
<td></td>
<td>• Insufficient slope monitoring</td>
</tr>
<tr>
<td><strong>Mobile Equipment – vehicle collisions/loss of control</strong></td>
<td>• Roads not to/ maintained to design standard</td>
</tr>
<tr>
<td></td>
<td>• Fatigue – micro sleeps</td>
</tr>
<tr>
<td></td>
<td>• Distraction</td>
</tr>
<tr>
<td></td>
<td>• Poor positive communication</td>
</tr>
<tr>
<td></td>
<td>• Over-watered road surface</td>
</tr>
<tr>
<td></td>
<td>• No collision warning</td>
</tr>
<tr>
<td></td>
<td>• Separation distance not maintained</td>
</tr>
<tr>
<td></td>
<td>• Speeding</td>
</tr>
<tr>
<td></td>
<td>• Poor supervision/inadequate intervention by Supervisor</td>
</tr>
</tbody>
</table>

![Image of mining site](image-url)
Repeat HPRI’s – an important focus area
Indicates not in control or learning from mistakes; a leading indicator

<table>
<thead>
<tr>
<th>Repeat HPRI</th>
<th>Main Causes</th>
</tr>
</thead>
</table>
| **Mobile Equipment – trucks over dumps or collision with other vehicles** | • Safety windrow not maintained to standard  
  • Poor reversing by driver  
  • Dump layout poor  
  • Poor positive communications |
| **Dozer into coal stockpile drawdown valve**     | • Poor shift pre-panning and communications  
  • Procedure inadequate/or not adhered to  
  • Lack of positive communication with control room |
| **Blasting incidents**                           | • Poor pre-blast planning meetings  
  • Procedure inadequate/or not adhered to  
  • FHP mandatory 2nd verification clearance not undertaken |
Senior Management – Critical Control Workshop

• Lead by the Industrial Lead
• Workshop objectives:
  o Do we have the correct critical controls?
  o Can we specify the control?
  o Can we verify the control?
  o Implementation challenges
• Regional representation: Industrial Leads, COOs, Directors of Operations and H&S Managers
• Expert facilitator (Dr. Maureen Hassall UQ)
Catastrophic Hazard Management
Critical control verification reporting - quality over quantity

- Regions review: monthly
- Department review: quarterly
- Review considers performance and trends
- Verification App. in development for Australia and Prodeco operations
- Further work required on sites’ interpretation/application of verification activities and findings
- Building maturity in operations to accurately self-assess systems and performance
- Verification vs inspection – ‘quality over quantity’ when it comes to verifications

### Q2 2019 Coal Department critical control verification results

<table>
<thead>
<tr>
<th>Catastrophic Hazard</th>
<th>Amber Findings</th>
<th>Red Findings</th>
<th>KPI - % CC verified to schedule</th>
<th>Total CCs Scheduled to be verified</th>
<th>Total CCs Verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Equipment (incl. pedestrians)</td>
<td>20</td>
<td>1</td>
<td>98%</td>
<td>369</td>
<td>361</td>
</tr>
<tr>
<td>Explosion - UG</td>
<td>5</td>
<td>1</td>
<td>98%</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td>Inrush - Gas or Liquid</td>
<td>2</td>
<td>0</td>
<td>100%</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Explosion - Surface</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aviation</td>
<td>0</td>
<td>0</td>
<td>100%</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Surface Ground or Slope Failure</td>
<td>13</td>
<td>6</td>
<td>97%</td>
<td>199</td>
<td>194</td>
</tr>
<tr>
<td>UG Strata Failure</td>
<td>2</td>
<td>0</td>
<td>100%</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Fire - UG</td>
<td>15</td>
<td>0</td>
<td>85%</td>
<td>73</td>
<td>62</td>
</tr>
<tr>
<td>Rail Incident (collision/ pedestrian)</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shipping Incident</td>
<td>0</td>
<td>0</td>
<td>100%</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Structural Failure</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Outburst (UG Coal)</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Toxic or Irrespirable Atmosphere</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tailings Dam Failure</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Significant Community Discontent</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Major Environmental Impact</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shafts, Winders and Lifts Incidents</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural Disasters</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loss of Control of Vehicles on Public Roads</td>
<td>2</td>
<td>0</td>
<td>100%</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>61</strong></td>
<td><strong>9</strong></td>
<td><strong>97%</strong></td>
<td><strong>848</strong></td>
<td><strong>823</strong></td>
</tr>
</tbody>
</table>
Two NSW mobile equipment mine incidents

Video #2 Bulga Open Cut - Dump truck collision – fatigue

https://www.youtube.com/watch?v=QkHvSdq1EuA&feature=youtu.be
Fatal incident Ravensworth Mine 2013

Incident and subsequent critical controls

**Critical Controls**

- **B1.1.** Only operate vehicles/equipment with functional brakes, steering and tyres
- **B1.2.** Workers maintain adequate vehicle clearances when travelling
- **B1.3.** Workers maintain adequate vehicle clearances when accessing equipment
- **B1.4.** Operators stop / give way to others at intersections
- **B1.5.** Operators drive at speed to meet site conditions
- **B1.6.** Workers maintain adequate vigilance
- **B1.7.** Workers are fit for work
- **B1.8.** Roads and intersections are designed and constructed to site standards
- **B1.9.** Physical barriers are installed
- **B1.10.** Workers take evasive action
- **B1.11.** Seatbelts/restraints are fitted and used by workers
- **B1.12.** Emergency Response activated and personnel respond
### Twelve HPRIs involving multiple vehicles in 2018

#### Level 7/8 - Awareness and Warning

**Australia:**
- Surface - pre-feasibility followed by implementation
  - 2019-2020
  - US$5: US70M

**South Africa:**
- Surface - Safemine collision warning on mobile equipment
  - Q4 2019
- UG diesel fleet
  - Complete
  - US$6m

**Prodeco:**
- Safe mine collision warning on all vehicles entering the Pit or surrounding haul roads will be fitted with collision warning, except shovels.
  - Q2/3 2019
  - US$13.3m

#### Level 9 – Collision Avoidance

**Australia:**
- Trial under way at Ulan West for longwall roof supports
  - In progress
- Oaky North shuttle car trial
  - Q3 2019

**South Africa:**
- Proximity detection interface installed in all in-by electric equipment (with the exception of roof bolters and feeder breakers)
  - Q3 2019
- Single machine test underway for diesel fleet to be followed by full implementation (eight LHDs)
  - US$0.5m

**Prodeco:** Watching brief
Fatigue Management
Shared responsibility, managed through controls, training, technology and decision making

<table>
<thead>
<tr>
<th>Management</th>
<th>Working hours, commute, breaks, overtime management, shift patterns, monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>Causes, impacts, drug and alcohol use, medical conditions, management strategies, sleep, reporting, available support and the benefits of a healthy lifestyle</td>
</tr>
</tbody>
</table>
| Technology | **Australia**: Fatigue management devices to be fitted to all haul and water trucks (US$6.5m), inward and outward cameras to be fitted in light vehicles and a standardised work hours monitoring system across all sites **Q2 2019**  
**South Africa**: Focus on fatigue detection systems for high speed mobile equipment  
Trialing options over next 12-18 months.  
Focus on the proper implementation and compliance to our fatigue management COP and practices **2019/ 2020**  
**Prodeco**: Implementation of Safemine (Hexagon Mining) fatigue monitoring system (vision monitoring and biological clock monitoring)  
Will be fitted to all truck fleet. Already on the buses **Q2/3 2019** |
<table>
<thead>
<tr>
<th>Tweefontein grader fatality - preventative actions, including seat belts</th>
</tr>
</thead>
</table>

### Coal Mandate (March 2018)
- Regions complete risk assessments
- Ensure that all new equipment is fitted with seat belt alarms
- Complete survey process

### Australia
- Now mandatory for UG to wear seatbelts
- All equipment without alarms for seatbelts will be retrofitted by December 2019
- Will be monitored through the targeted visible leadership program

### South Africa
- Installing high-vis seatbelts and seatbelt proximity switches
- Audio-visual alarms in cabs
- Visual LED on top of cab
- Two warning systems for implementation by 31 July 2019 (CAT and Ningi)

### Prodeco
- Employee survey - complete
- Verification of the existence of seat belts in all vehicles – complete
- Selection of appropriate warning system – in progress
- All new equipment purchased will be fitted with safety warning alarms and door alarms

---

**Engineering Standard approved and communicated for SA operations**
- Install High-Vis seatbelts (external observance)
- Install seatbelt proximity switches with ECM
- Audible/Visual warning in cab – 60s after start
- Visual indication (LED strobe) on top of cab – 60s after start
- System capable to accept inputs from door proximity switches to warn when cab door is open
Catastrophic slope failure – Prodeco, Colombia

- 00.45am 6 Oct 17 Eastern footwall of La Jagua collapsed
- Preceded by 290mm of rain in preceding 3 weeks
- 8 dump trucks, 1 dozer carried 300m down the slope; 80m vertical drop
- Hitachi excavator partially buried bottom of slope
- Fortunately no person suffered serious injuries, though post-trauma affects
- 4 million m3 or 10 million tonnes, NY Twin Towers 500,000 tonnes
Incident photo – mobile equipment post failure
Causes of Failure and new critical controls

Root Cause/s:
Attributed to excessive dump loading of the un-buttressed footwall in saturated hydrogeological conditions resulting in a sub-floor failure on a clay seam

- Back analysis (post failure) highlighted an oversight in the original Version 2 design assumptions
- Coal was removed as mining necessitated it, leaving the footwall un-buttressed, lowering the FOS
  - The FOS for **drained conditions was 1.16**
  - The FOS for **saturated conditions was 0.99 (equilibrium = 1)**

Hydrogeological
- Vertical drainage holes were installed in the slope to reduce groundwater pressure, however likely these became ineffective due to shearing off or covered by overburden
- Only one piezometer was installed - too far away to give an accurate reading

Monitoring
- No movement/failure had occurred in the previous blocks
- A radar monitoring unit was in use on the highwall, considered higher risk
Tailings Storage Facility - Catastrophic Incidents

- Catastrophic collapse of dams in Canada and Brazil(2) have driven immense focus on Tailings Storage Facilities

- Global Tailings Review
  - ICMM committed to global review with experts and establishing standards
  - Multinational companies requested by Church of England and others to provide a transparent review against questions

- Common Cause of Failures
  - Seismic Liquefaction – saturation of lower layers - Samarco
  - Static Liquefaction leading to catastrophic wall failure - Brumadinho
  - Wall Failure due to sliding on weak foundation - Mt Polley
  - Change in design – fundamental assumptions not considered
  - Storing excess water against dam wall
  - Inadequate drainage/pore pressure reduction
Glencore TSF critical controls:

1. Each Tailings Storage Facility (TSF) is to be scoped, designed by appropriately qualified personnel and constructed in accordance with the design.

2. The properties of the tailings produced and the rate the TSF is filled is to be in accordance with assumptions used in the design.

3. Monitoring to identify possible failure of the TSF, is carried out, reviewed and responded to.

4. Where contaminated water or tailings seepage / discharge from the facility, it is to be identified and controlled to minimise further impacts.

5. Assessments are to be conducted for mining activities that may impact within the TSF zone of influence e.g. blasting, mine subsidence.

6. Emergency Response Plans are in place. If there is a failure of the TSF, people are evacuated from TSF impact zone.

Video #4

https://www.youtube.com/watch?v=9qaVTqr_7l4

Brumadinho Brazil - 2019
Safety verification - good practices and areas for improvement
Safety verification - good practices and areas for improvement
Conclusion - what drives Safety Excellence?

- Committed senior leadership
- Risk-based approach
- Safety management systems
- Effective standards and procedures
- Technical expertise and competence (mechanical, electrical, geotechnical, hydrogeological, structural etc)
- Right safety tools (JSA’s, bowties, hierarchy of controls, PTO’s, SO’s)
- Visible leadership at all management/supervisor levels
- Assurance
- Everyone owns and is committed to safety
Thank You