Sharing Critical Controls

2018 Mining Law Summit

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Zero Harm Share
Failure of the Fundão Dam

- 17 people killed
- 60 million cubic meters of iron ore waste
- 3500 acres covered
- Bento Rodrigues destroyed
- Downstream water shortages

Goals

- Part of NIOSH grant
- Case Study
- Identify material unwanted events.
- Share Critical Controls
- Document and share
- Refine the process
Rio Tinto Kennecott – Bingham Pit Mine (2013)

IBIS radar Manefay data

Morning of April 10th
April 11\textsuperscript{th} 2013

**Unexpected Results**

“Bathtub Ring”
“Avalanche”

Before

After
NO INJURIES
NO FATALITIES

Disaster or Crisis?
What Are We Going To Do???

• How to Eat and Elephant

Available Assets
Value of Preparation

First Ore Barrier

Shovel Capacity Barrier
Critical Controls from the Manefay

1) 800+ trained eyes
2) Documented inspections
3) InSAR radars
4) GroundProbe radars
5) 300+ Fison network
6) Time Domain Reflectometry
7) Extensometers
8) Piezometers
9) Micro seism array

Monitor the Greatest Risk

Technology Race
Independent Review

3-D Numerical Modeling Required

Additional Geotechnical Resources Needed
Sharing Critical Controls

NIOSH Grant

Rare Extreme Impact Retrospective Outside the curve

Source: Health and Safety Critical Control Management - Shared Practice Guide, SME
If Only We Had Known

• Similar to Manefay
• Fast moving
• Covered pit bottom
• Destroyed equipment

Why Don’t We Share

• Liability
• Penalty
• Reputation

The Problem With Rock Bursts
Evert Hoek

Deep underground mines
Many miners killed
Embarrassment to companies
Began work in 1965
Not much written
Still not resolved
Questions for the Summit

How do we document?

When can we share?

How do we prevent being penalized?

How do we make safety more important than reputation?
GENERAL BACKGROUND 
HISTORY OF MINE SAFETY IN THE U.S.

- **Early History**
  - First statute in 1891
  - Ventilation requirements for coal mines
  - No children under the age of 12
  - 1900 – 1910 - Average of 2,000 coal mining deaths annually
  - 1910 - Bureau of Mines established (no inspection authority)
  - 1941 – Bureau of Mines empowered to enter and inspect coal mines
  - 1947 – Congress authorized the first Code of Federal Regulations for mine safety

GENERAL BACKGROUND 
HISTORY OF MINE SAFETY IN THE U.S.

- **Federal Coal Mine Safety Act of 1952**
  - Provided for annual inspections of certain coal mines
  - Bureau of Mines granted limited authority
  - Issuing violation notices
  - Withdrawing miners from imminent danger
  - Assessing civil penalties for non-compliance with withdrawal orders or for refusing to give inspectors access
  - 1952 Act amended in 1966 to extend coverage to all underground coal mines

GENERAL BACKGROUND 
HISTORY OF MINE SAFETY IN THE U.S.

- **Federal Metal and Nonmetallic Act of 1966**
  - First federal statute regulating non-coal mines
  - Provided for:
    - Promulgation of safety standards
    - Inspections of mines
    - Investigations of accidents
    - Enforcement authority minimal
GENERAL BACKGROUND
HISTORY OF MINE SAFETY IN THE U.S

Federal Coal Mine Health and Safety Act of 1969
- Most comprehensive and stringent of all previous Acts
- Covers both underground and surface coal
- Enforcement powers greatly enhanced
- Monetary penalties for ALL violations
- Criminal penalties for knowing and willful violations
- Safety standards strengthened and health standards adopted
- Provided compensation for miners disabled with “black lung”
- Created the Mining Enforcement and Safety Administration (MESA)
- Bureau of Mines relegated to research and mineral resource development

Federal Mine Safety and Health Act of 1977
- Current authorizing legislation that governs U.S. mine safety and health
- Consolidated all mines under one Act - coal and ALL non-coal mines
- Strengthened and expanded rights of miners and protections for exercising those rights
- Transferred responsibility from Interior to Labor and renamed agency to the Mine Safety and Health Administration
- Established an independent Commission to review MSHA enforcement actions
- Established training requirements for all miners
- Act amended in 2006 to include emergency response plans for coal mines and added regulations regarding emergency notifications, mine rescue teams, refuge chambers and sealing of abandoned mining areas

EXERCISE OF AUTHORITY
U.S. MINE SAFETY AND HEALTH

Federal Mine Safety and Health Act of 1977
- Congressional declaration
  - Priority: “the first priority and concern of all in the coal or other mining industry must be the health and safety of its most precious resource—the miner”
  - Need to improve working conditions and practices
  - Responsibility for safety - “operator . . . with assistance from miners . . .”
  - Cost of poor safety
- Mines subject to Act
  - “Each coal or other mine, the products of which enter commerce, or the operations or products of which affect commerce, and each operator of such mine, and every miner in such mine shall be subject to the provisions of this Act.”
EXERCISE OF AUTHORITY
U.S. MINE SAFETY AND HEALTH

• Federal Mine Safety and Health Act of 1977 Cont’d
  • Strict Liability Statute
  • Mine Safety and Health Administration
  • Nine program areas responsible for exercising MSHA authority
    • Office of the Assistant Secretary for MSHA
    • Coal Mine Safety and Health
    • Metal and Nonmetal Safety and Health
    • Program Evaluation and Information Resources
    • Administration and Management
    • Technical Support
    • Education Policy and Development
    • Standards, Regulations and Variances
    • Assessments

• Broad powers
• Primary duties
  • Inspections
  • Investigations
  • Recordkeeping
  • Education and Training
• Regulations (Safety and Health)
  • Development
  • Purpose
  • Public input
• Enforcement
  • Citations
  • Orders

• Penalties
  • Civil
    • Each violation for which a citation has been issued – up to $70,000
    • Failure to abate – up to $7,500 per day
    • Operator knowingly violates or fails or refuses to comply and upon 1st conviction – up to $25,000 and/or imprisonment up to one year
    • Any subsequent conviction up to $50,000 and/or imprisonment up to five years
    • Making a false statement – up to $10,000 and/or imprisonment up to five years
    • Giving advance notice of an inspection – up to $1000 and/or imprisonment up to six months
    • Smoking or carrying of smoking materials – up to $375

Penalties (Continued)

• Criminal
  • Each violation for which a citation has been issued – up to $70,000
  • Failure to abate – up to $7,500 per day
  • Operator knowingly violates or fails or refuses to comply and upon 1st conviction – up to $25,000 and/or imprisonment up to one year
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Penalties (Continued)
EXERCISE OF AUTHORITY
U.S. MINE SAFETY AND HEALTH

- Criminal
  - Individual convicted of a felony or misdemeanor as a result of death – up to $250,000 (organization up to $500,000)
  - Individual convicted of a misdemeanor not as a result of death – up to $100,000 (organization up to $200,000)
  - Subject to Alternate Sentencing Provisions found at 18 USC 3571
- Technical Assistance
  - Provide assistance to improve miner safety and health (internal and external)
  - Assist MSHA inspectorate in investigations and emergencies

TODAY’S MINING INDUSTRY

- 20,085 mines in 1978 vs. 13,015 at the end of 2017
- 544,165 miners in 1978 vs. 319,465 miners at end of 2017
- ±1940 MSHA employees in 1978 vs. 2,152 in 2017
- MSHA budget of ±$158,100,000 in 2017 of $375,172,000
- 242 mine related deaths in 1978 vs. 28 in 2017
- Fatal incident rate of 0.0515 in 1978 vs. 0.0104 in 2017
- All injury incident rate of 8.85 in 1978 vs. 2.15 in 2017
- 18 mining related deaths YTD 2018 (15 MNM – 3 Coal)

QUESTIONS

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Outline
- Why CRM?
- Layered system design
- Journey so far
- Learnings

A safety story in two parts
Reduction in injury rates
But cannot eliminate fatalities. Why?

CRM is a key element of fatality elimination in our safety strategy
Rio Tinto’s fatality risk management journey

1996
- Losing disaster: 10 fatalities

2007
- Introduce SQRA to better understand risk

2010
- Introduce critical control monitoring plans (CCMPs)

Now
- Embed these critical controls at the front line

CRM objective - a step towards zero fatalities

CRM provides a means to verify that critical controls are well designed, understood, in place and working at the front line – where the risk exists.

**CRM involves:**
- Every Rio Tinto operation
- Every critical risk
- Every operational person
  - General manager
  - Manager / supervisor
  - Supervisors / site leaders
  - Contractors / operators / maintainers

Standardised process and content, enables efficiencies and learning

CRM fundamentals - every person plays a role

Each layer is reinforcing and ultimately supports the frontline to stop work if the critical controls are not in place or working.
Layered verifications & accountabilities

- Critical Control verification standard (CCVS) - is used by the site leadership to verify the design, implementation and training aspects of a critical control are in place / effective.
- Critical Control Field Verification (CCFV) - is used on a shift-by-shift basis by the Supervisor to verify the correct implementation of the critical controls associated with the work.
- Critical Control Checklist (CCC) - is used on a task-by-task basis where a task incurs exposure to a credible fatality risk. The tool is designed as a self-assessment checklist to confirm the critical controls are in place.

CRM Portal – To capture, control content and enable real time data

Journey so far …

- Copper business discovered CRM model at Escondida
- Took what worked and adapted to Rio Tinto:
  - visual management
  - rigorous approach to verifications
  - ‘embrace the red’
  - frontline focus
- Group adoption
- 24 month rapid implementation
- Strong PG adoption and sharing
- No one site or PG can claim the benchmark of best practice
- All PGs playing a part in CRM’s evolution
CRM – Two years on …

- Standardised across all sites
- Over 1.2M control verifications YTD
- Identified thousands of gaps (“reds”)
- Over 6,500 participating leaders
- >85% of operational leaders above target
- >70% of gaps “fixed in field”
- Building the supporting culture to find and fix red and stop work and seek help
- Progressing integration
- Hundreds of Yammer conversations to “celebrate the red” and share learnings

Using the data

Example reports for a business

Find gaps in controls
Fix gaps in controls
Evolve to better controls

Simple is often best

CRM Feedback Wheel
Visual messaging, branding and communications - central to the approach.

Evolution cycle – Locking in the learning at the frontline

Integration – A key challenge
Learnings for others … based on our experience

We feel we have done well…

- Visible leader sponsorship (at all levels)
- Staying true to system design – but recognise the “tight vs loose”
- Road map and maturity model
- Fast tracking as appropriate
- Standardisation to drive efficiencies and effectiveness
- Treating technology as an enabler
- Collaboration

Our focus areas…

- Getting the context right and building the supporting culture
- Treat as cultural change - not just another system implementation
- Balance quantity with quality
- Integration – cannot be a “bolt on”
- Use the data to feedback and drive improvement

Comments! Questions?
Why is Information Not Shared?
Donna Pryor

How to Connect to the Polling Source Via Text

- Text HBEvent to 22333
- Text in answers to participate in polls
**POLL**

How do you share information about near miss accidents or other safety matters?

A. I share within the mine site only.
B. I share across the board within the company and communicate with other company mine sites.
C. I share within my company and among colleagues at other companies (via trade organizations or personal contacts within other companies).

**POLL**

If you are reluctant to share information, why is that?

A. It's a competitive industry. I’d rather not share.
B. I'm concerned about liability.
C. It's company policy to keep information confidential unless we have special permission to share the information.
D. I'm not a sharer.
If you are reluctant to share information, why is that?

- It's a competitive industry, I'd rather not share.
- I'm concerned about liability.
- It's company policy to keep information confidential unless we have special permission to share the information.
- I'm not a sharer.

Why is information not shared?

- You could waive the attorney-client privilege.
- Even internal sharing (near miss reports, accident investigation reports) can result in a MSHA citation.
- Concerns about potential litigation (plaintiff's lawyers).
- Information might be proprietary.

POLL
Do you share success stories?

A. Yes
B. No
Factual Situation

MSHA: Larry Corte
Safety Manager: Paul Yslas
External lawyer: Donna Pryor
Communications: Kyle Bennett
In-house lawyer: Matt Bingham
Engineering/Technical: Brad Ross
Environmental Manager: Kathy Arnold
Insurance Carrier/Risk Management: Denis Smith

Aftermath

Lessons
Voices React to Crisis
Third Annual Global Mining Law Summit
James E. Rogers College of Law, The University of Arizona:
“Mine Safety: Sharing Solutions”
November 9, 2018

Blue Moon Copper Mine

- Mining
  - Open pit copper mine in the western US.
  - The mine uses 240-ton haul trucks.
  - Heap leach operation using sulfuric acid.
  - Acid is brought to the mine in rail tank cars.
  - Each rail tank car has 100 tons of sulfuric acid and there are 36 tank cars per train.
Site conditions

Mountainous area.
Unusually wet spring resulted in thicker than usual growth of grasses and weeds.
Hot summer have created large fire hazard.
The Big Fish River runs through property which is source for community water.
Incident takes place at 3:00 am on July 5th.

Immediate Impacts:
- 13 tankers involved
- 4 tankers ruptured (500 tons sulfuric acid)
- 3 ruptured in the Big Fish River
- 2 tangled up with haul truck - 1 partially submerged
- Truck driver probably died at impact
Within 10 minutes
• Grass fire starts from accident, accelerated by hydrogen gas that is generated.
  • Mayday called by grader operator within 5 minutes of accident
  • Two employees (grader and water truck operator) die trying to rescue truck driver from acid burns and toxic fumes from fire.
  • Rear tires on truck ignite
  • Mine EMS arrive on scene

Within 30 minutes
• Haul truck is engulfed in flames – heating up full tankers.
  • Mine emergency start to spray water to try and put out fire. This actually causes first of three tanker explosions – severely injuring two emergency team members.
  • Remaining emergency team evacuates area for ½ mile.
  • Command center set up at office building
  • County EMS arrive on scene

Within 60 minutes
• Decision to let fire burn itself out.
  • First reports of employees at shop becoming ill. Shop and offices are down wind from fire.
  • Decision to evacuate shop & office complex (including command center.
Within 120 minutes:
- First reporters on scene asking what happened.
- News has reached families and many are worried that spouses, sons, or daughters have been hurt or injured.
- MSHA arrives on site and place the mine under 103K order.

Within 4 hours:
- First call from city water department.
- Big Fish River is primary water source for local town.
- Very low pH has been detected and all pumps shut down – entire town does not have water.
- EPA has been called.

Driver of Haul Truck:
- John Smith.
- 32 years old.
- 5 years with company.
- Good record, but late to work twice in past month. No other issues on record.
Short – Term Impact of Incident

- 3 Fatalities
- 2 Seriously injured
- 15 hospitalized from toxic smoke
- One haul truck and 10 tank cars destroyed
- 30 acres burned plus two small buildings

Immediate aftermath

• Resulting aftermath on ground
• Results of investigation
  • Driver
  • Truck

Long – Term Impact of Incident

- Mine shut down for 2 weeks for investigation
- City water system shut down for 2 weeks
Driver of Haul Truck

More Info

- John Smith
- Seen at 4th of July Celebration having a very “good time”.
- Supervisor did not see any issues at start of shift
- Fellow employee said he had bloodshot eyes and hung head down during meeting.
- Reports that John was recently separated and was depressed.

Truck Mechanical Issues

- Long term complaints about brakes on that truck
- Rebuild performed by 3rd party

Lessons that should be Shared

- Need for process safety approach
- Training on approaching incident scenes
- Training on fires involving sulfuric acid
- Reporting procedures for all agencies
- Importance of fitness for duty check
- Need for employee support programs
Different Industries

**Airline Industry**
- Lion Air Crash on 10/29
- Article 11/8
- “Boeing issues warning on potential instrument malfunction after Indonesia crash”

**Mining Industry**
- Highwall failure 10/30
- Article 11/7
- “The company released a statement Nov. 7 about the slide after a Facebook user posted a photo of the pit on a public page. The spokesperson said the mine is not releasing photos of that area of the pit.”

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**Mine Safety: Sharing Solutions**

The 21st Century Mining Research Organization

Mary Poulton

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**The 21st Century Mining Research Organization**

Dr. Mary Poulton

- First proposed by Senator William Morris Stewart of Nevada, Dec 12, 1860 to protect development of western mines.
- 6 Sep. 1869: Avondale coal mine disaster – 110 perished
- 11 Dec. 1865: Senator William Morris Stewart of Nevada's proposal was approved
- 1910: USGS established Technologic Branch focused on mine safety and testing coal that government bought
- Organic Act created US Bureau of Mines (USBM) – 298 employees and $0.5M budget
- 1913: Amendments expanded mission beyond safety
- 1915: 15 experiment stations
- 1920: Began mineral production stats
- 1941: Inspection authority in coal mines
- 1910: First proposed by Senator William Morris Stewart of Nevada, Dec 12, 1860 to protect development of western mines.

USBM – Growth Mode

- 1915: Expansion
  - 15 experiment stations
  - 718 staff
  - $1.3M budget
- 1920: Began mineral production stats
  - Minerals Yearbook began
- 1941: Inspection authority in coal mines
- Contributions to war effort
  - Albany, OR office developed Krall Process for titanium and contributed to construction of first nuclear submarine

USBM - Maturation

- 01: Coal Mine Safety Act, Metal/Nondurable Safety Act, 6000 employees in 1969
- 02: MESA – 3,000 USBM employees transferred
- 03: Office of Surface Mining Reclamation and Enforcement
- 04: Oil and Gas programs in WV, OK transferred to Energy Research and Development Association (became DOE in 1979) • $60M transferred out of budget
USBM - Demise

1990
National Academies report needed to improve competitiveness of US mining industry

1994
National Academies report evaluating USBM

1995
Contacted with America and changing priorities of executive branch

1996
Secretary of Interior and Congress agreed to defund USBM in 90 days, 1200 people lost jobs

Stopgap measures

- Minerals Yearbook to USGS
- Fossil energy already in DOE
- OIT created in 1993 for 7 industries with high energy and waste
- Mining added c. 1998, National Academies Road Map 2002
- Defunded around 2007?

- Need to save H&S functions and place in NIOSH Pittsburgh Lab and Spokane Lab
- NMA lobbied for mining program
- DOE initiatives of the Clinton program focused on energy use in mining

- Worked on Energy and Minerals section of Industry of the Future Act in Congress as way to allocate research support to mining programs
- Passed House in 2006, couldn't get through Senate

Pay as You Go Required
The Arizona approach

- US lacked a comprehensive, integrated approach to minerals research at federal level
- Science Foundation Arizona started in 2007 as public-private partnership for research and economic development
- Funding for Institute for Mineral Resources granted in 2008 – 2013
- Lowell endowment in 2009
- LIMR moving to advance AZ as the Silicon Valley of Mining

OUR MISSION
...is to advance responsible mining and use of minerals by catalyzing resources across the University of Arizona and around the globe.

OUR VISION
...will provide the framework for responsible mineral resource availability required to sustain generations to come.
A CATALYST FOR MINING INNOVATION

Developing Centers of Excellence in Areas of Key Risk

Centers elevate education and deliver innovation

Geotechnical
Safety
Law
Environment
Economic Geology
Mineral Processing
Mine Operations

A Track Record of Success

- Exploration: Our ore deposit concepts have led to discoveries worldwide.
- Environment: UA NIEHS Superfund Research program focusing on mine tailings.
- Law: We established the first mining law program in North America.
- Safety: Our virtual reality software improves training and evaluation.
- Technology: Created start-ups.
- Collaboration: 250+ faculty, students, staff involved in 100+ research projects.
AZ as the Silicon Valley of Mining

- Components of innovation ecosystem
  - Policy
    - Innovation ecosystem, entrepreneurial environment, engagement triple helix (education/government/industry)
  - Research to Development (R&D) funding
  - Human Capital
  - Clusters/networking
  - Regional attractiveness and infrastructure
  - Smart specialization

Technology Readiness Levels

21st Century Approach

- Federal support for centers of excellence for mineral resource readiness embedded in regional innovation ecosystems
  - 5-10 year emphasis areas for basic research
  - Responsive to multiple agencies
- State support for the innovation ecosystem
  - Fund knowledge and technology transfer
- University minerals program as the technopole
  - Interdisciplinary approach
- Industry as part of the triple helix
- Accountable for results and impact
Be a Champion

Let’s begin the conversation