

*FOG – PAST,
PRESENT
AND THE
FUTURE*

George Hattingh
(SACMA President)



AGENDA

1. Fall of Ground Statistics
 - a) FoG Fatalities
 - b) FoG Serious Injuries
 - c) Safety Milestones
2. Innovations
 - a) Equipment development
 - b) Monitoring devices & support consumables
3. Current Challenges
4. Call to Action

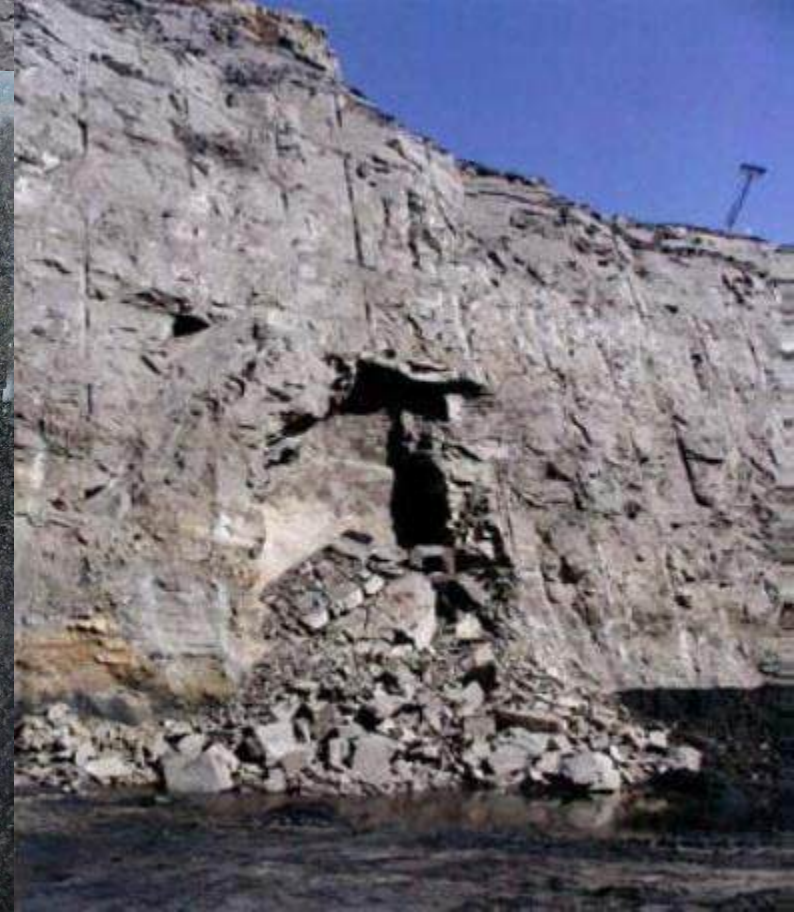


Coalbrook Mining Disaster

January 21, 1960 shall forever be embedded in the minds of many South Africans as one of the saddest days when the catastrophic disaster of a mine collapse occurred on site. Four hundred and thirty seven (437) miners were trapped some one hundred and eighty meters (180m) underground and it was on this day that they subsequently met their fate.

Our hearts go out to the victims of the Coalbrook Mining Disaster tragedy and their families. This disaster will go down in the history of books as one of the largest mine disasters in South Africa.
(Ellen Tauscher)

Siyanikhumbula - Re Ya Le Hopola - Lembrome de você - We remember you

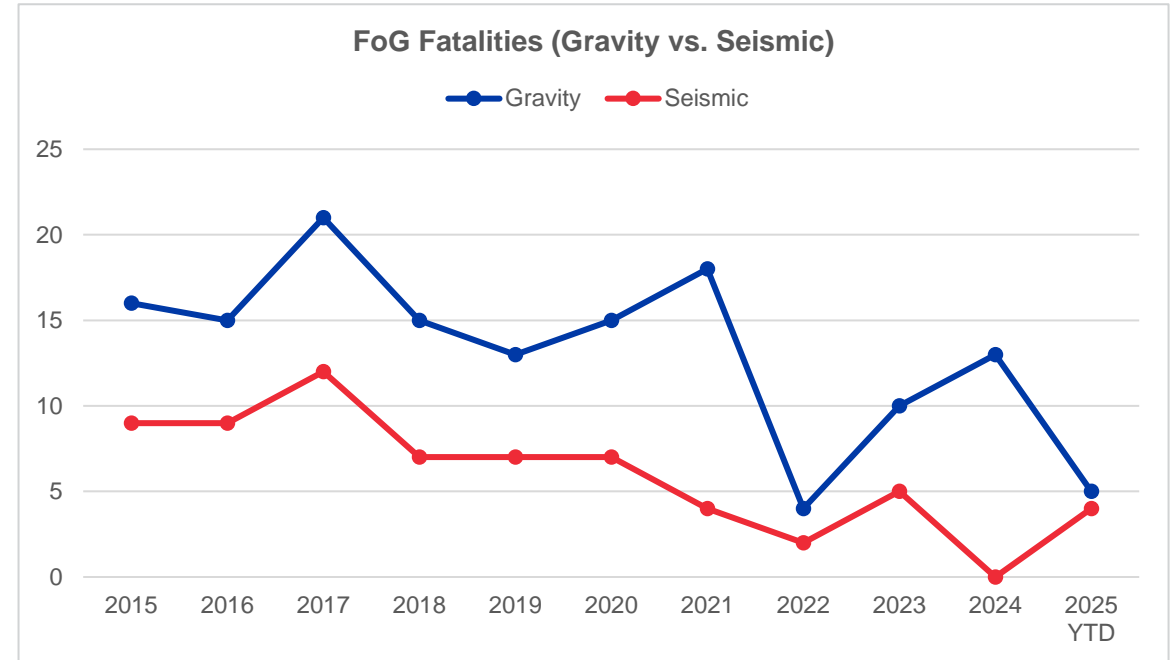
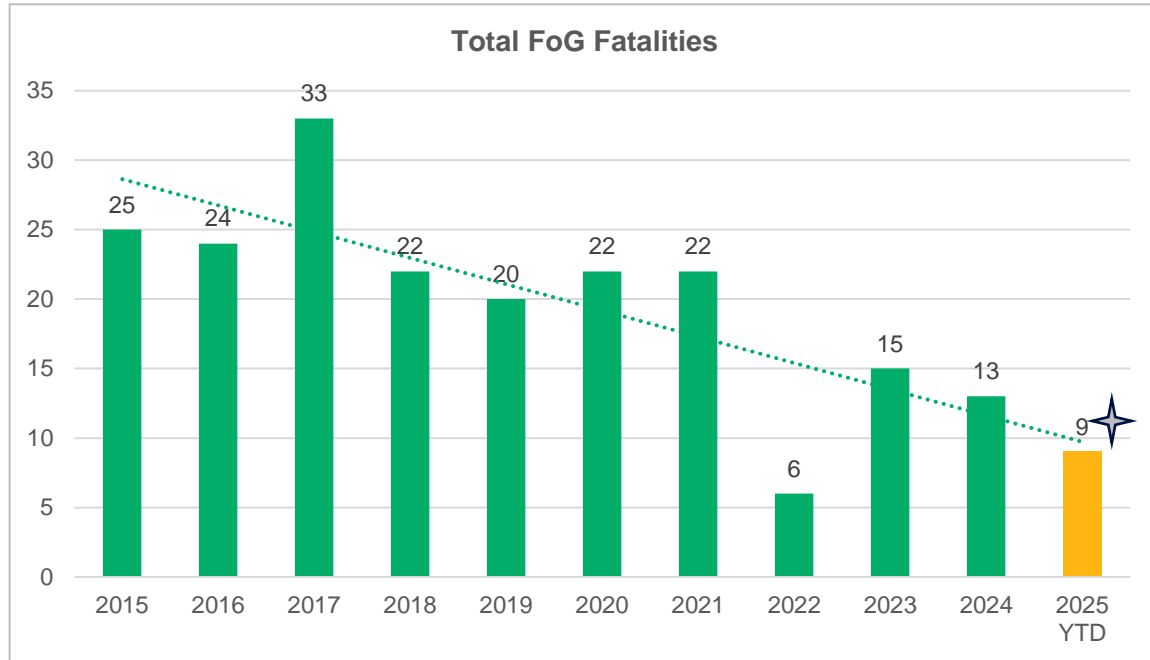


FALL OF GROUND STATISTICS



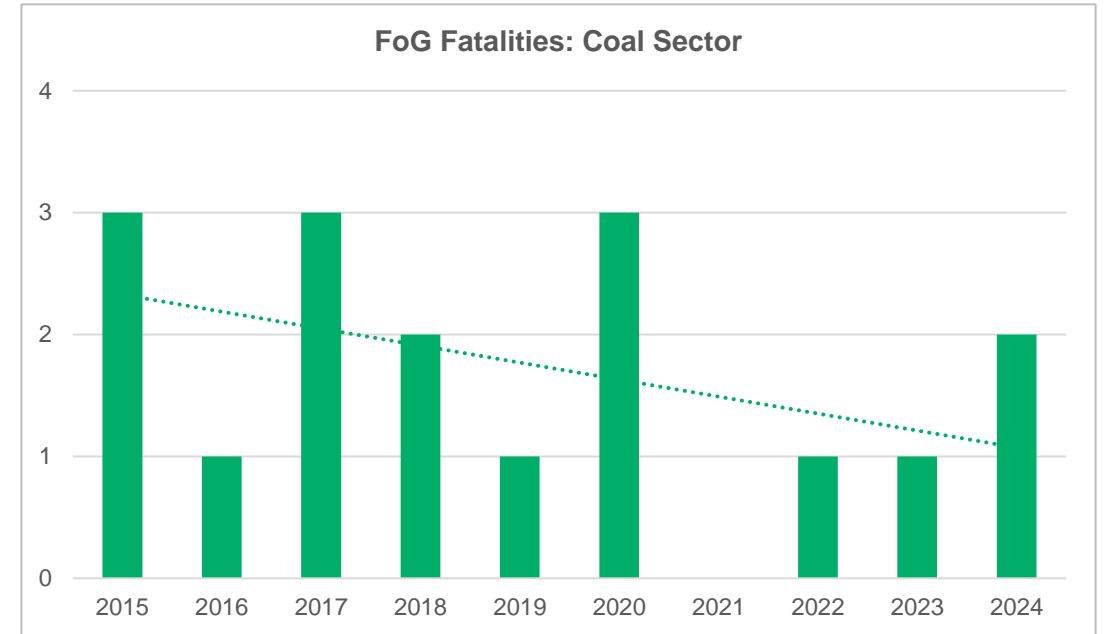
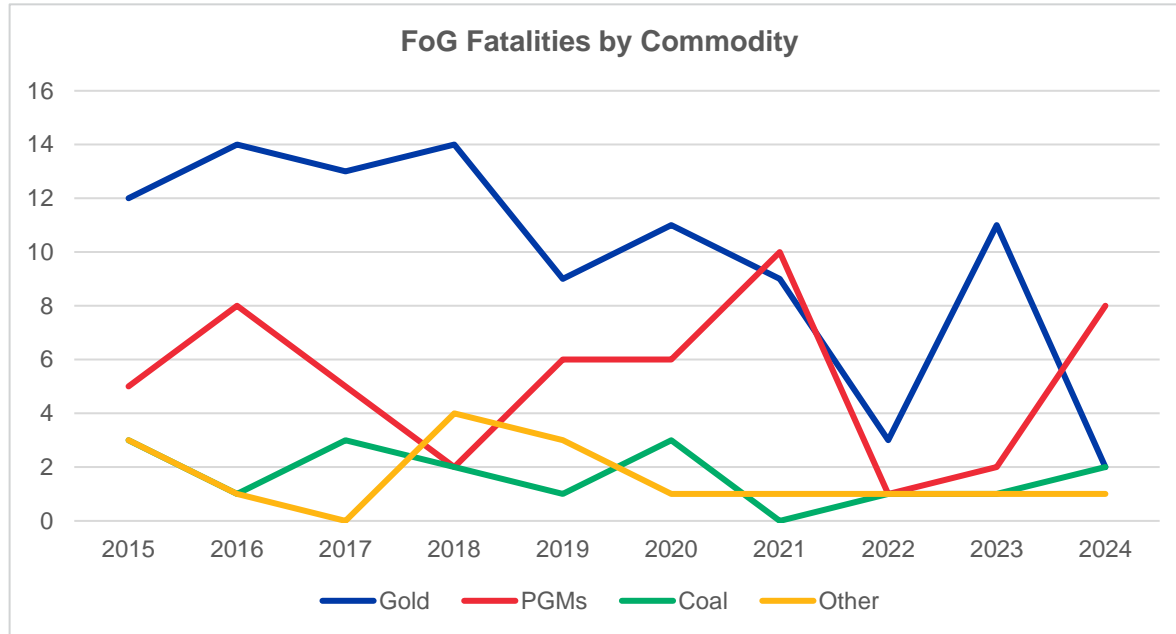
Stats provided by: Metse Mzondo

FoG Fatalities

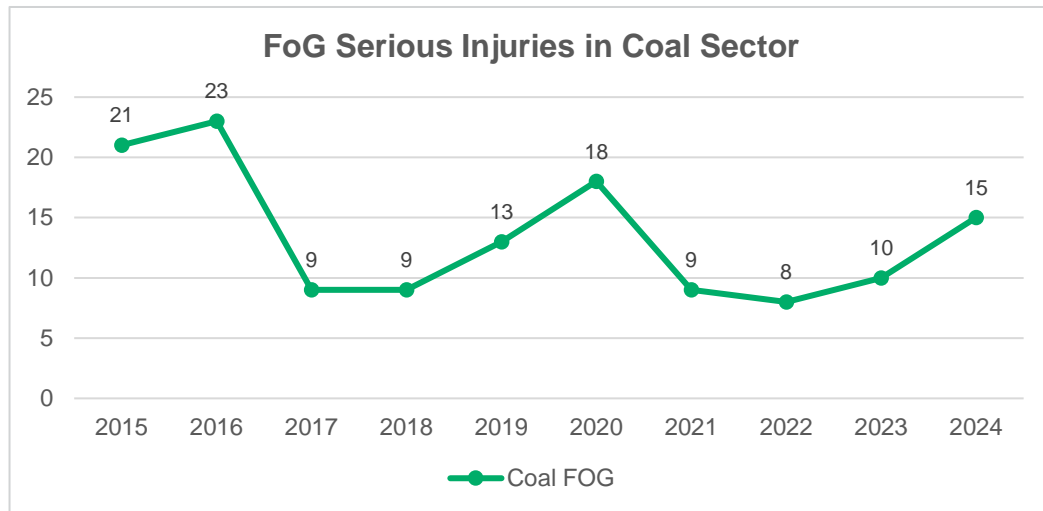
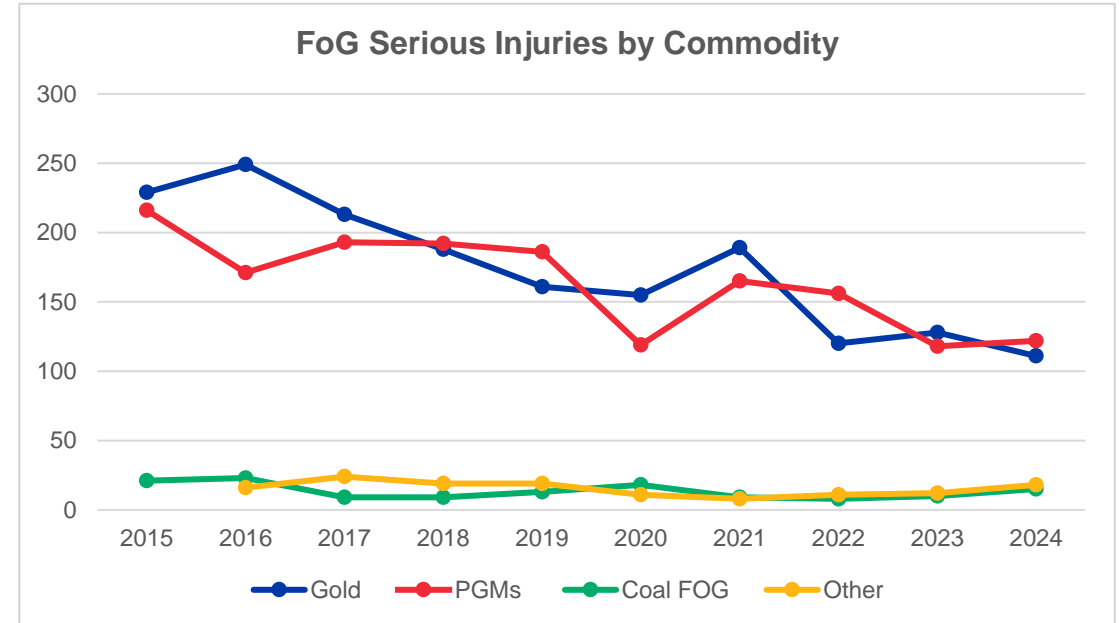
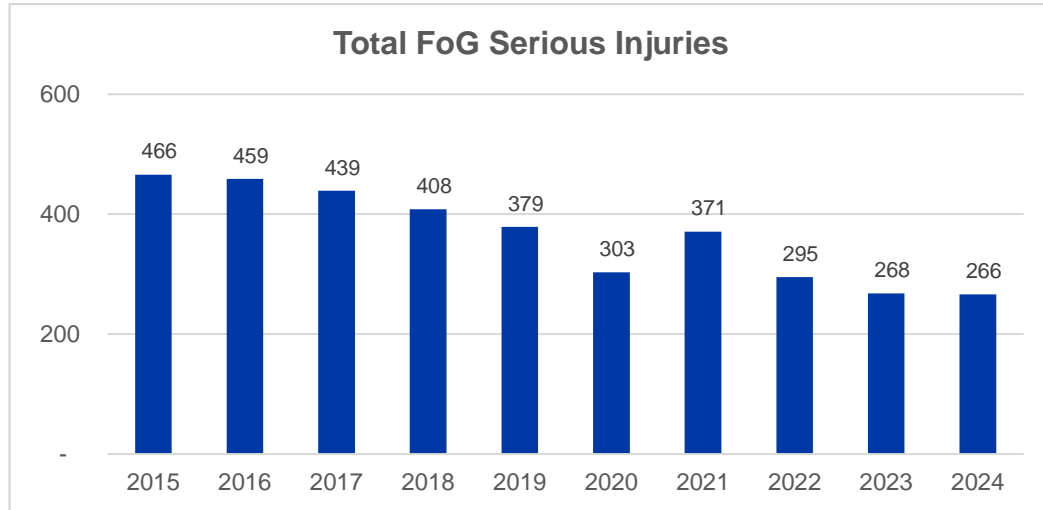


✦ 2025 YTD Fatalities: 10 (subsequent fatal from serious injury which occurred on 29 May 2025 in the gold sector). Not yet officially reported

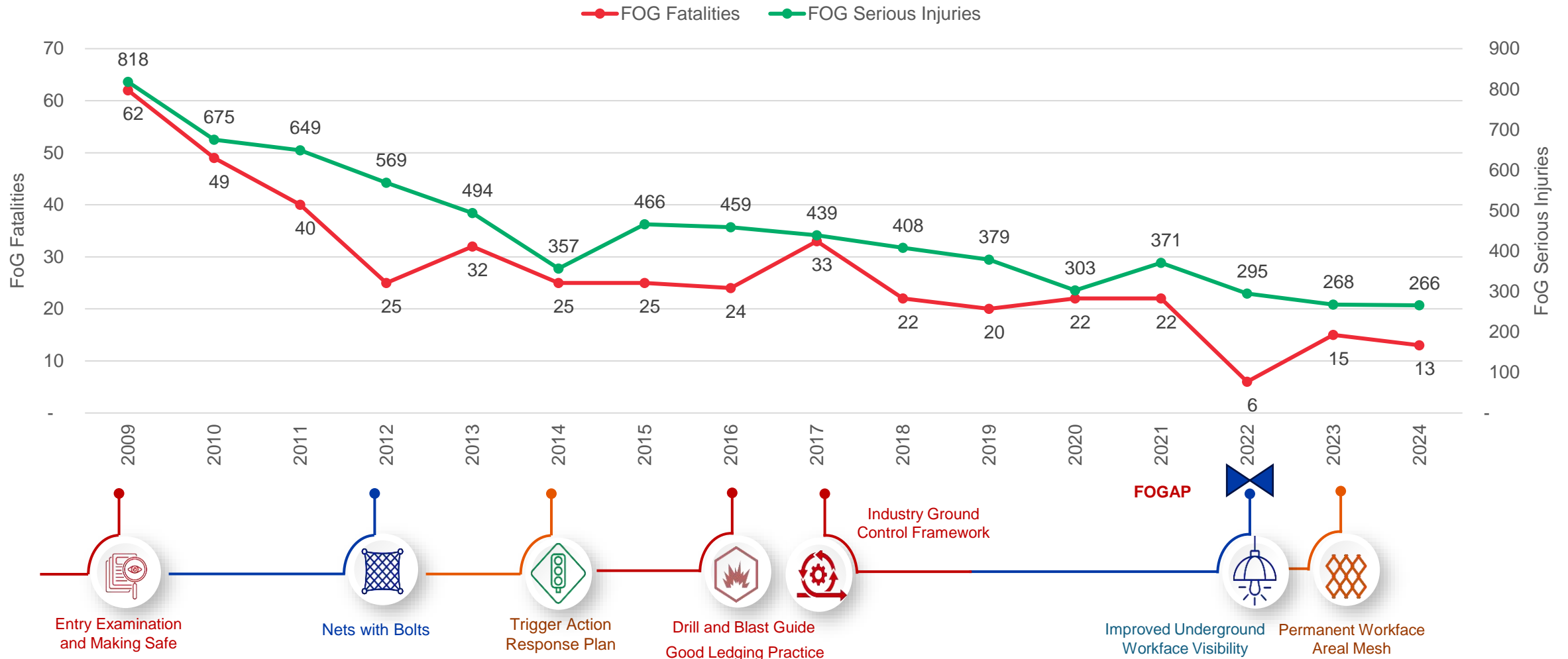
FoG Fatalities



FoG Serious Injuries



FoG Leading Practices and Initiatives



FoG Safety Milestones- Tripartite Summit

OCCUPATIONAL SAFETY	PROPOSED MILESTONE	OBJECTIVE	ACTIVITY	RESPONSIBILITY		DUE DATE
				LEAD	SUPPORTING	
Elimination of reportable accidents	Reduction of falls of ground (FoG) related reportable accidents by 20% per annum.	Elimination of FoG reportable accidents.	i. Implementation of the guideline for FoG.	Employer	<ul style="list-style-type: none"> Organised labour State 	Annually
			ii. Implementation of MOSH and MHSC leading practices.	Employer	<ul style="list-style-type: none"> Organised labour 	Annually
			iii. Increasing the capacity of rock engineers and strata control officers in the industry.	<ul style="list-style-type: none"> MHSC MQA 	<ul style="list-style-type: none"> Employers 	Annually
			iv. MHSC to facilitate workshops to promote R&D information sharing amongst industry stakeholders.	MHSC	<ul style="list-style-type: none"> Employer Organised labour 	Annually
			v. Increase the Visible Felt Leadership and safety campaigns close to holiday breaks and critical seasons.	Employer	<ul style="list-style-type: none"> Organised labour State 	Quarterly
			vi. Promotion of all leading practices at regional tripartite forum events.	State	<ul style="list-style-type: none"> Organised labour State Employer 	Quarterly

2. INNOVATIONS

a. EQUIPMENT DEVELOPMENT

UNDERGROUND

- Roof bolters
 - Walkway canopies
 - Mesh handlers
 - Fixed lasers to assist with spacing
- Continuous miners
 - Remote controlled continuous miners
 - Systematic corner support
 - CM operator workstations
 - Retrieval canopy
- Blasting
 - Blasting Cage
 - Consumables
 - Roadheader

OPENCAST

- Drill rigs
 - Onboard GPS
 - Drill depth sensors
- Dragline, Shovels & Excavators
 - Pegasus

UNDERGROUND



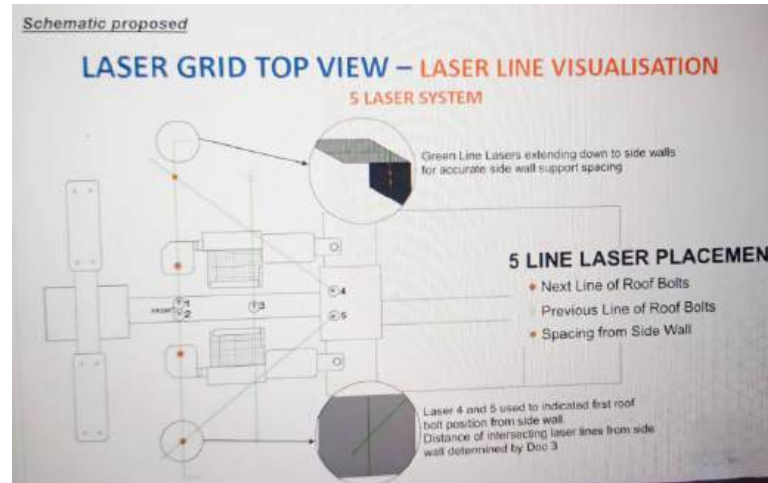
ROOF BOLTERS



Walkway Canopy



Mesh handler



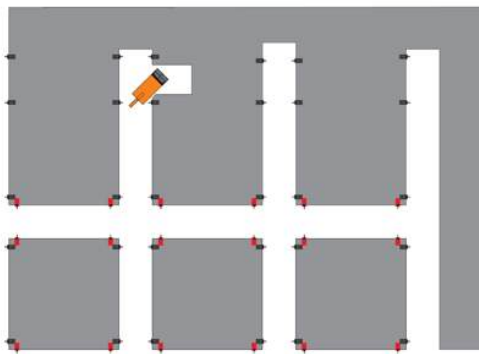
CONTINUOUS MINERS

Old vs NEW

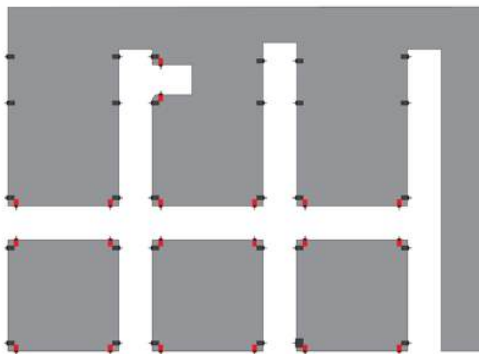


Cut out distance vs maximum unsupported distance

1. Corner support installed in the straights prior opening / creating an intersection



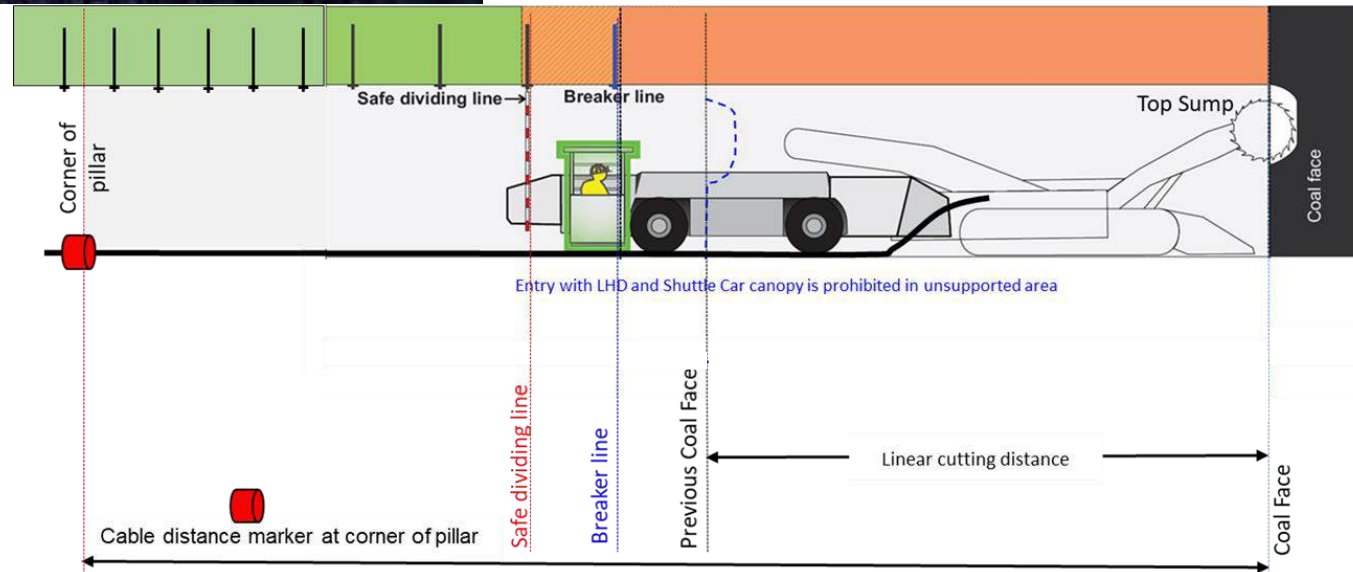
2. Corner support installed in the splits concurrent with roof support



■ Demarcated and installed on completion of adjacent lines of roof support prior to creating a corner.

■ Installed concurrent with roof support after creating a corner. Installed after line of roof support is installed. Area is restricted until supported and declared safe.

Systematic Corner support

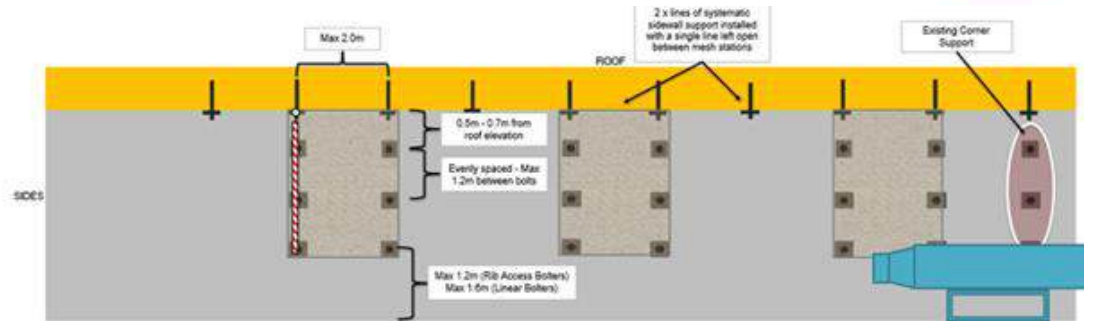
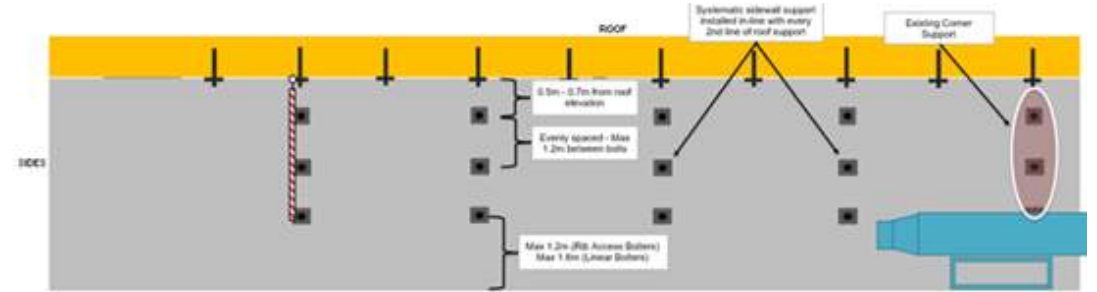
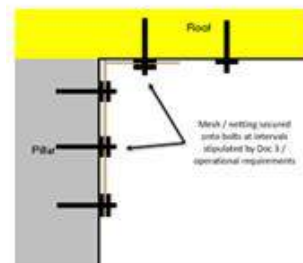
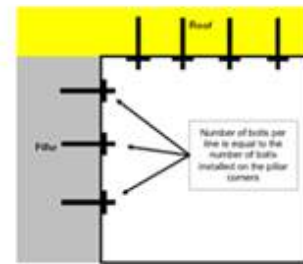


CONTINUOUS MINERS

CM Retrieval Canopy



CM Operator workstation and 'Bus' Stop principle



BLASTING

CAGE & CONSUMABLES



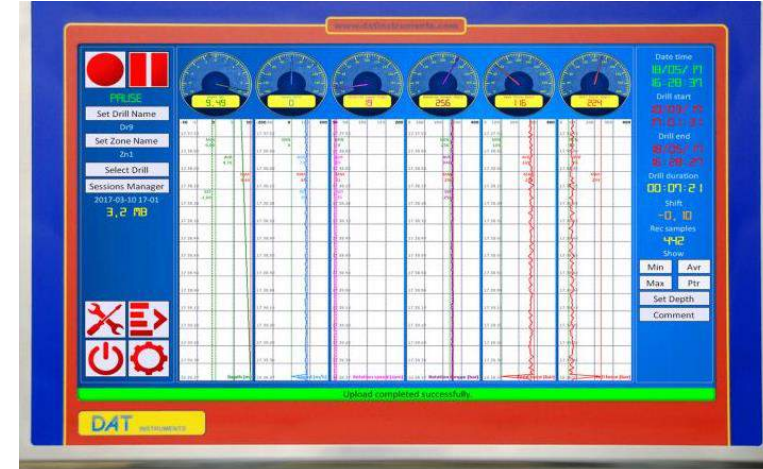
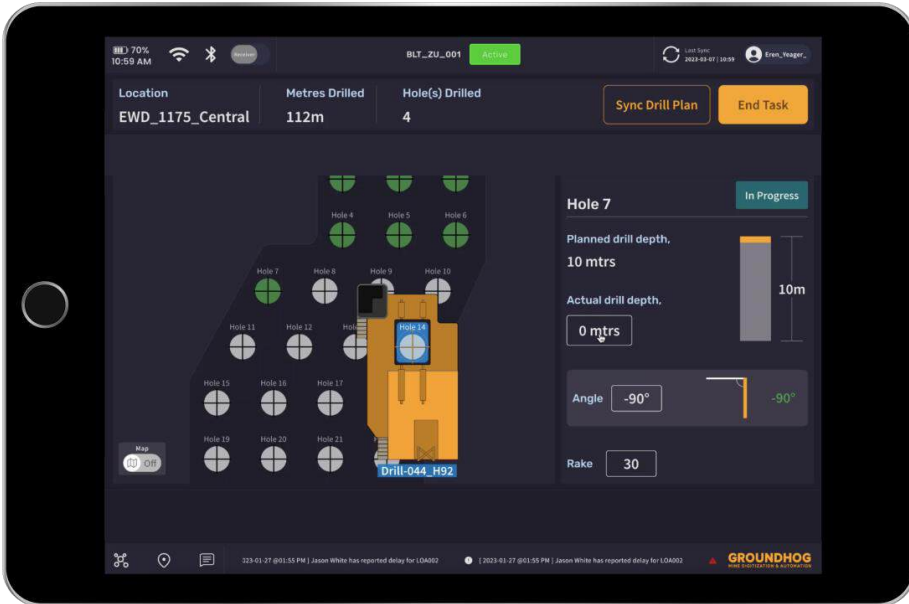
- **Safe Marking of the face (Direction, elevation and position of holes)**
 - Spray Paint Extender
 - Line spraying nozzle to enable marking from a distance
 - Green paint for better visibility
- **Cleaning of floor**
 - Long scraper for Face drill operator to clean around bottom holes after drilling
 - Short scraper for use from inside of the cage to clean around bottom hole when charging up
- **Cleaning of bottom holes for charging** - Scraper (Smaller hook to enable easier cleaning)
- **Flexible charging sticks and non-static resin injectors for explosive capsules**



OPENCAST



DRILL RIGS



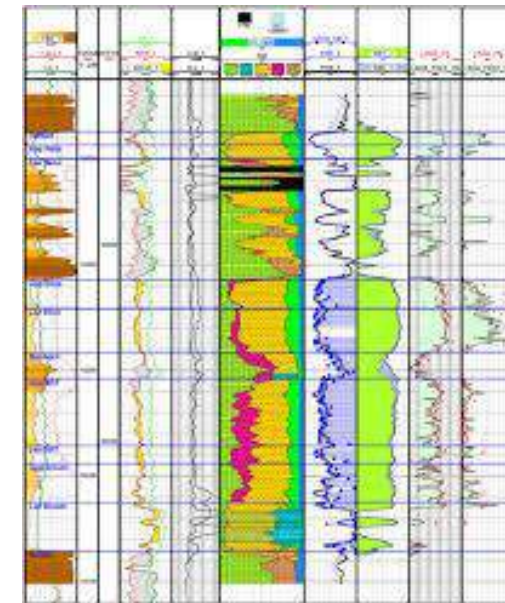
DAT instruments, DAT WideLog datalogger for drilling, MWD

Advantages using GPS technology in field Drill positioning

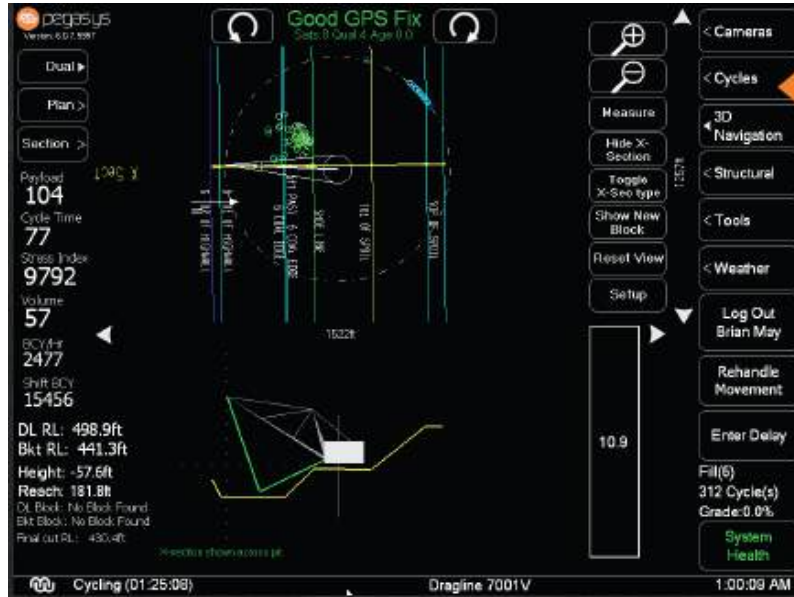
- Human error reduction
- Elimination of column and drill number errors
- No more drilling skipping or doubling



Wireline Logging

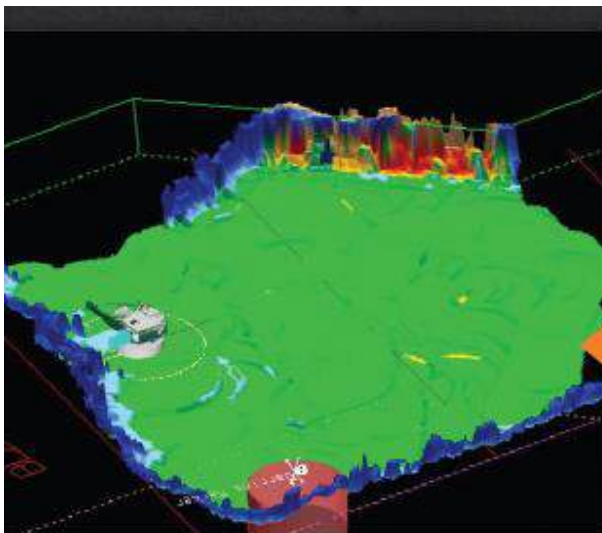
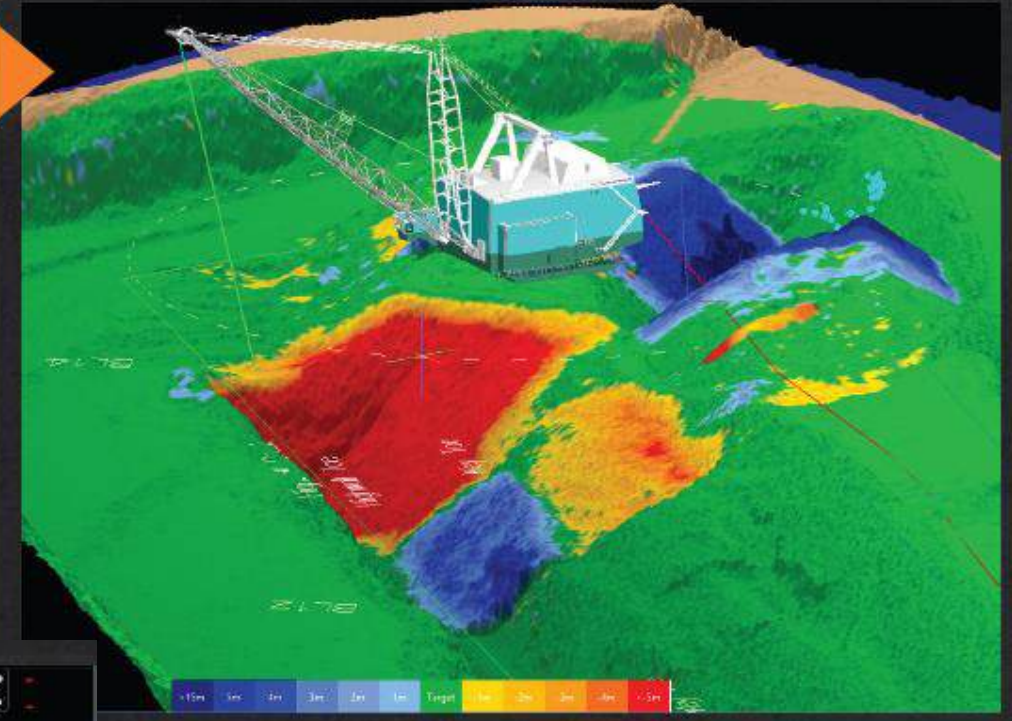


DRAGLINE, SHOVELS & EXCAVATORS



REAL TIME BUCKET POSITION CALCULATION AND INTEGRATED MINE PLAN FEEDBACK

DIG TO DESIGN, EVERY TIME. RECORDING MATERIAL MOVEMENT AGAINST THE MINE PLAN IN REAL-TIME AND FOR POST ANALYSIS



OPERATOR PAYLOAD INFORMATION IN REAL TIME PER BUCKET

DIG TO PLAN WITH HIGH ACCURACY



2. INNOVATIONS

b. SUPPORT CONSUMABLES & MONITORING DEVICES

SUPPORT CONSUMABLES

- Roof bolts
 - Point anchor / mechanical anchor
 - Single vs dual-speed resin – Passive vs active
 - Torque tension indicators
- Area cover
 - Nors net
 - Wire mesh – diamond (soft) vs welded (stiff)
 - Double nutting & mesh spirals / clips
- Liners
 - Shotcrete
 - Wetcrete / TSL

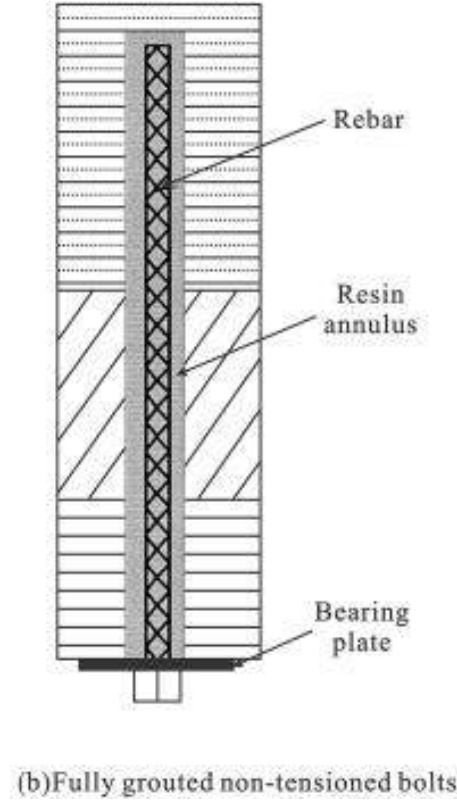
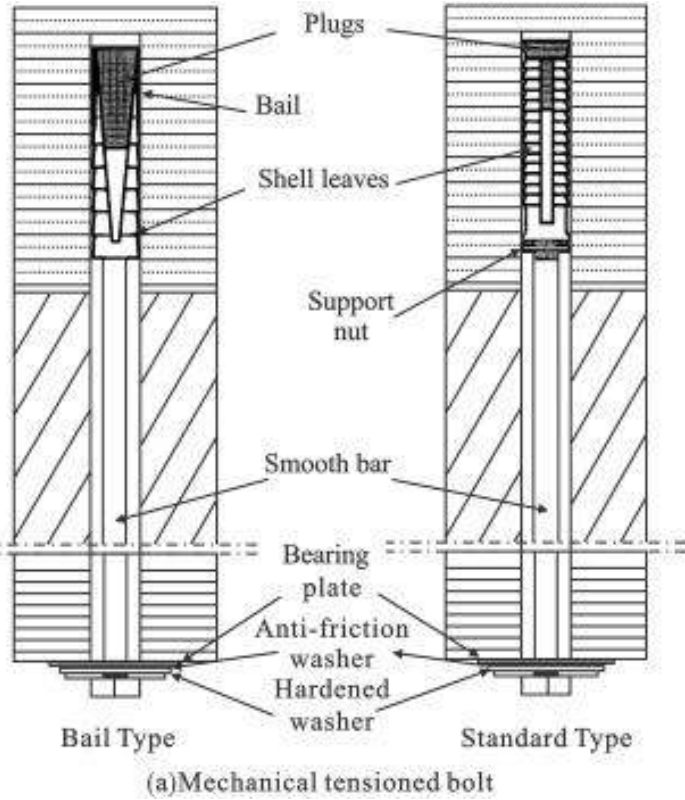
MONITORING & INSPECTION DEVICES

- Monitoring
 - Tell-Tale / Roof monitoring devices – mechanical vs electronic
 - Pinch bar & sounding stick
 - Distomat & Range finders
 - Radars
- Inspection
 - T-bar
 - Feeler Gauge

SUPPORT CONSUMABLES



ROOF BOLTS

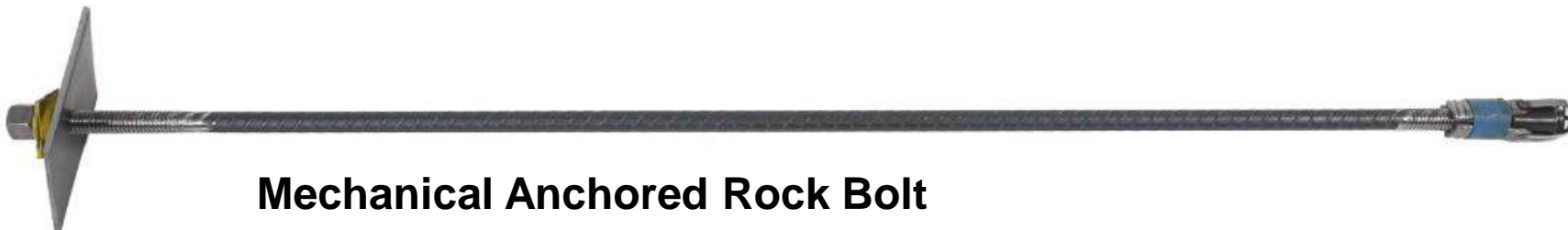
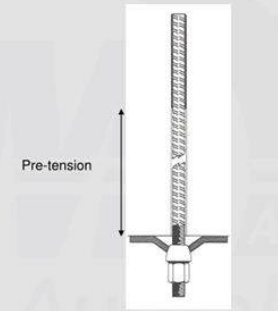


TORQUE / LOAD INDICATORS



Two-Speed Resin Operation

- Two-speed resin operates by the fast-set (yellow) going hard first and allowing the roof bolt to be put in tension by tightening the nut on the bolt.
- The slow-set (blue) gels and sets 60 seconds later.
- This system helps create the beam of support from the bottom of the fast set to the collar of the drilled hole.
- This is the area of the roof which is placed in tension – by “pre-tensioning the bolt”



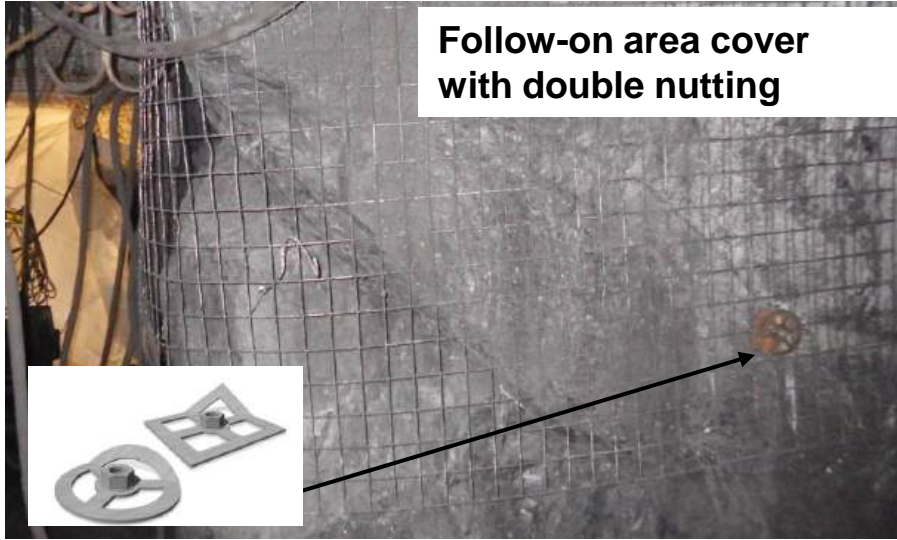
Mechanical Anchored Rock Bolt

AREA COVER

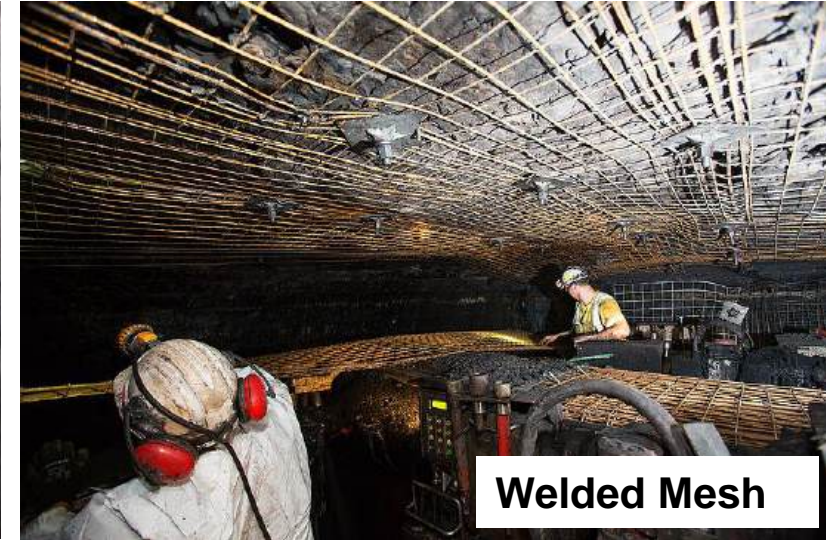
Diamond Mesh



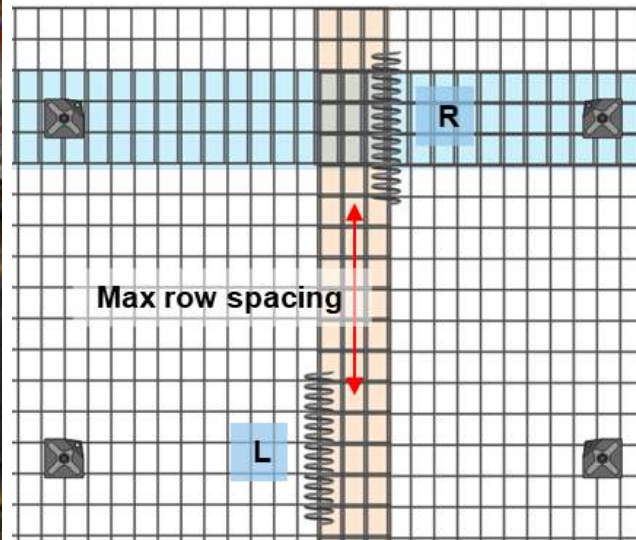
Follow-on area cover with double nutting



Welded Mesh



Nors Net



Spirals to join mesh sheets



Severely fractured roof

LINERS

Wetcrete



TSL



Mechanized shotcrete equipment



Shotcrete

MONITORING & INSPECTION

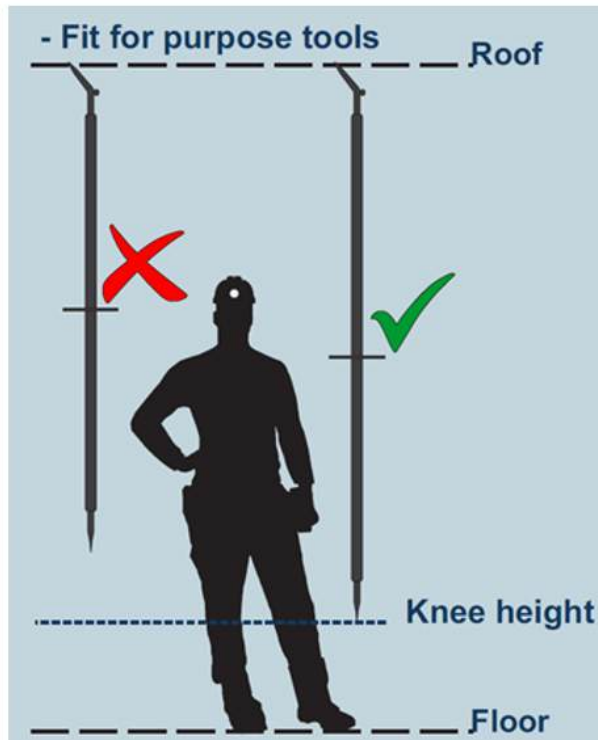


MONITORING

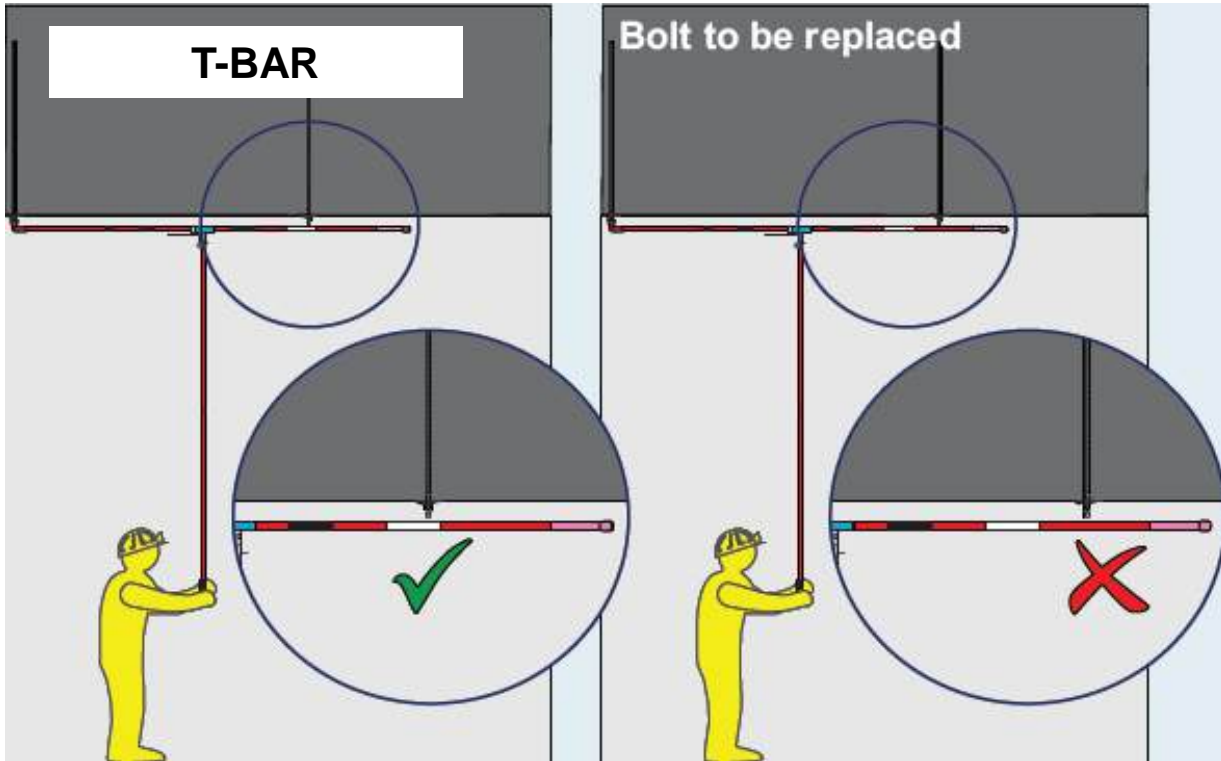


5 P's of barring

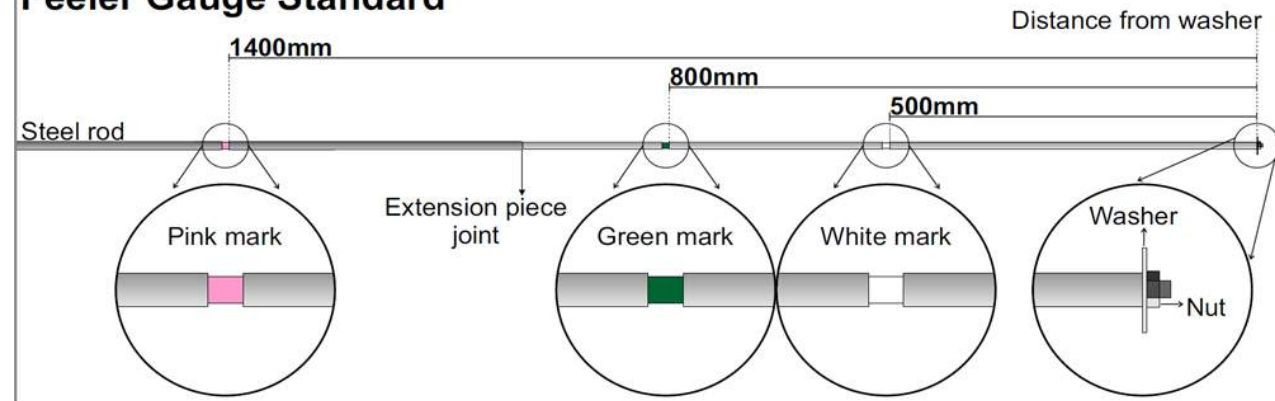
- 1. Prepare yourself
- 2. Prepare the area
- 3. Prepare others
- 4. Position yourself
- 5. Proceed



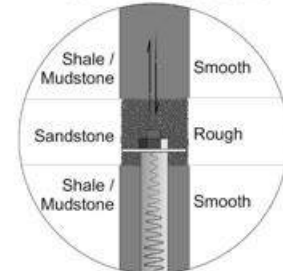
INSPECTION



Feeler Gauge Standard

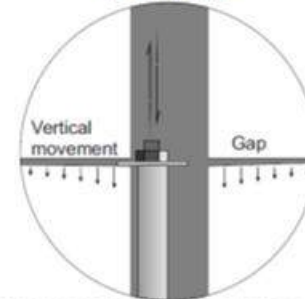


Roof Composition



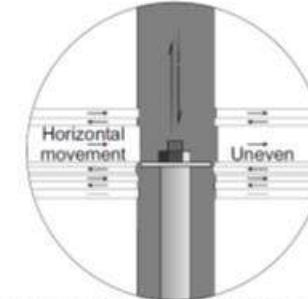
Vibration and sound transmitted through the washer and the Feeler gauge rod indicate the roughness and roof material competence

Beam sag

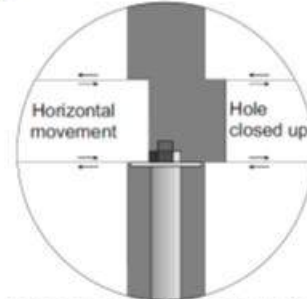


Gap detected with washer indicate vertical movement prior to or post support

Guttering



Uneven inspection hole side without a gap indicate horizontal movement of laminated strata



Feeler gauge washer cannot enter hole due to layer shift closing inspection hole

CURRENT CHALLENGES

1. TECHNOLOGICAL GAPS AND INFRASTRUCTURE LIMITS

- **Inconsistent adoption** of ground monitoring tech (like radar or real-time sensors) due to budget constraints, especially at smaller or marginal coal operations.
- **Lack of reliable underground data connectivity**, limiting real-time communication and monitoring systems in coal mines.
- **Incompatibility** of deep-level gold/platinum tech with coal's low-seam, high-moisture environments.

2. SKILLS AND CAPACITY DEFICIT

- **Shortage of skilled rock engineers** and geotechnical experts familiar with coal-specific ground conditions.
- **Supervisors lack formal FoG training**, especially in small mines or contracting firms.
- Training materials often **not contextualized for coal mining** (vs hard rock), reducing their relevance and uptake.

3. LEADERSHIP AND ACCOUNTABILITY GAPS

- **Inadequate Inadequate Inconsistent buy-in from line management—safety seen as a compliance task, not a production enabler.**
- **Inadequate consequence management** when safety protocols are ignored.
- **No clear FoG champion or owner** at many operations—action plans are fragmented.

4. IMPLEMENTATION AND MONITORING WEAKNESSES

- **Limited baseline data** on roof stability and fall-prone zones, particularly in older or previously mined-out coal seams.
- **Failure to close audit loops**—findings are not translated into sustained behavior or design changes.
- Lack of **standardized metrics and digital dashboards** across mines.

5. LABOUR-MANAGEMENT DISCONNECT

- **Worker safety concerns underreported**—fear of reprisal or lack of trust in response systems.
- **Insufficient inclusion of organised labour** in the design of training, risk assessment, and early warning systems.
- Cultural resistance to automation or changes in traditional roof bolting and support methods.

6. REGULATORY AND POLICY FRICTION

- **Delayed approvals** for innovative technologies (e.g., automated support systems, seismic monitoring tools).
- **Lack of enforcement consistency** from inspectors across regions.
- **Weak alignment** between FOGAP milestones and DMR's enforcement/inspection priorities.

7. PSYCHOLOGICAL AND CULTURAL FACTORS

- **Normalisation of risk**—routine exposure to minor falls leads to complacency.
- **High production pressure** may lead teams to take shortcuts in support installation or workplace inspection.
- **Mental fatigue** and long shifts in dark, humid coal environments reduce hazard awareness.

**Routine Work
Complacency
False Sense of Security
At Risk Behaviour
Ownership**

CALL TO ACTION

- Uniting to Eradicate Fall of Ground (FoG) Incidents in the Coal Industry
 - Every fall of ground is a preventable failure
 - We must refuse to normalize these events
 - Every injury, every fatality is one too many
- Eradicating FoG is not just a safety goal - it is a leadership imperative
“Together, we protect every worker, every shift, every site”
- To Office-Based Leaders
 - Champion FoG safety from the top
 - Budget boldly for predictive technology
 - Demand accountability in execution“Your decisions above ground save lives below it”
- To Operations Managers
 - Own your FoG zones and monitor them
 - Lead by example—every day, every shift
 - Empower workers to stop unsafe work“Don’t wait for a fall to act. Build safety into the face”
- To Industry Associations
 - Drive common standards across operations
 - • Amplify and share best practices
 - • Invest in skills and innovation“If we unite around zero harm, we define a new legacy for coal mining”

QUESTIONS ?



THANK YOU