



TOWARDS  
ZERO HARM

# HEALTH AND SAFETY ON SOUTH AFRICAN MINES

## A BEST PRACTICE REPORT



Deutsche Industrie- und Handelskammer für das südliche Afrika  
Southern African-German Chamber of Commerce and Industry

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**HEALTH AND SAFETY IN SOUTH AFRICAN MINES:  
A BEST PRACTICE REPORT  
2018**

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2018***



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## **A BEST PRACTICE REPORT**

## ACRONYMS AND ABBREVIATIONS

<b>AMS</b>	asset management system	<b>MQA</b>	Mining Qualification Authority
<b>CIM</b>	Chief Inspector of Mines	<b>MRV</b>	mine rescue vehicle
<b>COPA</b>	Community of Practice for Adoption	<b>NEMA</b>	National Environmental Management Act
<b>CRTM</b>	continuous real-time monitoring	<b>OEM</b>	original equipment manufacturer
<b>CTF</b>	Culture Transformation Framework	<b>OSH</b>	occupational safety and health
<b>DMR</b>	Department of Mineral Resources	<b>PM</b>	production manager
<b>FFR</b>	fatality frequency rate	<b>PPE</b>	personal protective equipment
<b>FOG</b>	fall of ground	<b>RIFR</b>	reportable injury frequency rate
<b>GDP</b>	gross domestic product	<b>ROM</b>	run of mine
<b>HMS</b>	heavy medium separation	<b>RTU</b>	remote terminal unit
<b>IFC</b>	International Finance Corporation	<b>SABS</b>	South African Bureau of Standards
<b>ILO</b>	International Labour Organisation	<b>SACU</b>	Southern African Customs Union
<b>ISSA</b>	International Social Security Association	<b>SADC</b>	Southern African Development Community
<b>ISSA Mining</b>	International Section on Prevention of Occupational Risks in the Mining Industry Worldwide	<b>SADC</b>	Southern African Development Community
<b>LHD</b>	load, haul, dump (machine)	<b>SAIMM</b>	South African Institute for Mining and Metallurgy
<b>LMS</b>	lamp-room management system	<b>SCADA</b>	supervisory control and data acquisition
<b>LOM</b>	life of mine	<b>SCBA</b>	self-contained breathing apparatus
<b>LTI</b>	lost time injury	<b>SCSR</b>	self contained self-rescuer
<b>LTIFR</b>	lost time injury frequency rate	<b>SLO</b>	social license to operate
<b>MBS</b>	metres below surface	<b>SLP</b>	social and labour plan
<b>MCSA</b>	Minerals Council South Africa	<b>SM</b>	safety manager
<b>MHSA</b>	Mine Health and Safety Act	<b>SME</b>	small and medium-sized enterprise
<b>MHSC</b>	Mine Health and Safety Council	<b>SS</b>	safety superintendent
<b>MHSI</b>	Mine Health and Safety Inspectorate	<b>STS</b>	standard threshold shift
<b>MIMACS</b>	mine-wide integrated monitoring and control system	<b>tpm</b>	tons per month
<b>MO</b>	mine overseer	<b>TWA</b>	time-weighted average
<b>MOSH</b>	Mining Occupational Safety and Health	<b>UN</b>	United Nations
<b>MPRDA</b>	Mineral and Petroleum Resources Development Act (2002)	<b>WITS</b>	University of the Witwatersrand
		<b>WMI</b>	Wits Mining Institute
		<b>ZHTT</b>	Zero Harm Task Team

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## FOREWORD

RENÉ ZARSKÉ

COMPETENCE CENTRE, MINERAL RESOURCES  
SOUTHERN AFRICAN–GERMAN CHAMBER OF COMMERCE AND INDUSTRY

**S**ixty-one – that's the number of workers who died in South African mines in 2018. Three major disasters took 18 lives, seven died during a seismic-induced fall-of-ground event, five were killed in a heat-related accident, and another six in a fire- and explosion-related accident.

Despite an 88% improvement in fatality rates between 1993 and 2016, the number of lives lost in South African mining operations is appalling.

The target of Zero Harm has been welcomed by all stakeholders in the mining industry. But what does Zero Harm in this context really mean? The South African mining sector has put in place a goal of Zero Harm by 2020; this implies that by 2020 there should be a significant and sustained improvement in the health and safety of all mineworkers, including no further fatalities.

The ongoing Mine Health and Safety Project aims to support the South African mining industry to achieve its self-defined target, by engaging in research and collecting key data for this report to help to raise awareness and highlight best practice in the industry. The report also introduces the reader to the fundamentals of the regulatory framework for mineral development and mine health and safety in South Africa.

Even though the overall safety records' development in the southern African mining industry is positive we cannot accept that lives continue to be lost in the process of extracting minerals; pursuing the goal of zero harm benefits us all.

To secure the longevity of the project, the Competence Centre for Mineral Resources will facilitate mine health and safety seminars and workshops across the Southern African Development Community (SADC). Workshops will take place in cooperation with the Minerals Council South Africa (MCSA) and ISSA Mining over a period of two years.

In the process of compiling this report, I have been blessed to meet specialists from many different fields in the South African mining industry. I am impressed by the commitment to zero harm among operative crews and executive managers alike.

I invite you to be inspired by this report in the hope that one day, every mine-worker around the globe can go to work knowing that they will return each day, unharmed.



## FOREWORD

ANDREA JÜNEMANN

FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY (BMWi)

**R**aw materials are an integral part of our lives. Not only are they used to make the products we consume every day; they are also the foundation of Germany's thriving manufacturing sector, which plays such a vital role in the economic success of our country.

To sustain this diverse sector it requires raw materials sourced from all over the world. We need to ensure that they are sourced responsibly, in line with German policy. This responsibility encompasses social and human rights concerns, which includes health and safety for workers and the communities in which they live, as well as sustainable environmental practices.

Since Germany's value chain includes raw materials from southern Africa it is crucial to ensure that these are recovered in a responsible way.

The aim of the Mine Health and Safety Project supported by the BMWi is to foster the South African government in attaining its target of zero harm in the mineral resources industry. The project will run for three years and will work to promote sector best practice and highlight innovations in this field. It will also explore solutions to the challenges that exist in the sector.

One of the outcomes for year one is the publication of the present health and safety best practices report compiled by the Competence Centre for Mining and Mineral Resources at the Southern African Chamber of Commerce and Industry. The function of this report is to raise awareness of health and safety in the mining environment, which, in any workplace, strongly influences the success of an enterprise.

It is hoped that this showcase will encourage all industries and their stakeholders to add their contributions to better health and safety for workers, and maintaining environmentally friendly practices and social responsibility in the interests of a transparent value chain and safe sourcing of raw materials.



## FOREWORD

PROF. FREDERICK CAWOOD

WITS MINING INSTITUTE,  
UNIVERSITY OF THE WITWATERSRAND

**T**his Best Practice Report on Health and Safety on South African Mines could not have come at a better time. Although much of the global conversation on the Future of Mining is dominated by the fourth industrial revolution, mining professionals are deeply aware of the immediate challenges.

At the top of the agenda is intelligent, precise mining that causes no harm to mine workers and their communities. As someone who comes from a mining family and lives in a farming community affected by mining, it gives me great pleasure to write this foreword knowing that this report offers information and solutions to support the industry's journey towards zero harm.

Miners are faced with countless risks every day – rock falls, working with and in the vicinity of heavy machinery, and health risks that arise from poor working and living conditions.

The South African mining sector faces unique and massive challenges. On the one hand, mining has a positive impact on economic well-being. On the other is a legacy of inequity among its workers that has rendered a great many of them vulnerable to poverty and disease. Constant innovation is required – to deal with our unique issues and find unique solutions.

Importantly, this report also covers the regulatory framework for mining with a focus on mine health and safety. Although there are notable successes – fewer mine fatalities and repealing or replacement of apartheid laws – more must be done on to improve livelihoods and increase inclusive growth on the back of mining.

The technology companies showcased here support the right of workers to a healthy and safe work environment. I am also pleased to see the section on energy because it is clear that there can be no conversation on the Future of Mining without deep thought about the Future of Energy.

### A zero-harm future

Digital technologies have the potential to take us to the next level when it comes to mine health and safety. Wits Mining Institute has collaborated with Sibanye-Stillwater to build the Digital Mining Laboratory (DigiMine) – a 21st century state-of-the-art mining facility suitable for doing health and safety research in a controlled environment. DigiMine is equipped with digital systems to enable research for the mine of the future and is a one-of-a-kind laboratory with a significant research agenda to transfer surface digital technologies into the underground environment – the enabler for a mine that can (automatically) observe, evaluate and take action. The ultimate objective is to use technology to put distance between mine workers and the typical risks they are exposed to on a daily basis.

Once these technologies are in place and work reliably, we will be able to 'see' risks more clearly and communicate their location to the workers. More importantly, technology can 'navigate' the individual to safety.

In conclusion, when education, research and development are coupled with effective policies and laws that respect the rights of all citizens, we can look forward to a truly prosperous mining sector in South Africa.

Prof. Frederick Cawood is Director of the Wits Mining Institute (WMI) at the University of the Witwatersrand (Wits) and former Head of the School of Mining Engineering at Wits. He is passionate about education, student development and responsible mining. His current research projects within the WMI include mine modernisation and technology development for the underground mining environment with a focus on real-time detection of abnormalities and risk management in an integrated, visual manner. He has served on professional bodies, and is active in academia, industry, government and international structures in the interest of responsible mining for national benefit.

# EXECUTIVE SUMMARY

The German manufacturing sector is the backbone of the German economy. As a relatively resource-scarce country, Germany imports almost all the raw materials it needs. As such, ensuring these inputs are sourced from countries and companies that mine responsibly is a vital objective of the German government and, by extension, German industry.

Responsible mining minimises environmental degradation, and ensures that host communities benefit from mineral development; the health, safety and well-being of mine employees is taken care of and the principles of sustainable development are employed across the mineral development value chain.

The Federal Ministry for Economic Affairs and Energy (BMWi) embarked on a Mine Health and Safety Project for the Southern African region in 2018. The first phase of the project is this mine health and safety publication followed by workshops and seminars in 2019 and 2020.

The publication begins by exploring mine health and safety from a global perspective and in so doing seeks to raise awareness of ISSA Mining – a division of the International Social Security Association (ISSA) – and Vision Zero, its global mine health and safety initiative.

Chapter 2 investigates key legislative and regulatory aspects of South Africa's mineral development and mine health and safety legislation and regulations, which are regarded as best practice in the Southern African Development Community (SADC) region.

Chapter 3 profiles German companies involved in the mining sector in South Africa. Part 1 is devoted to showcasing the products of German companies, Schauenburg Systems and Draeger, as the best available German technologies to help companies ensure that they have health and safety measures in place, and that they comply with the demands of mining legislation. Part 2 includes the initiatives undertaken by BASF in ensuring clean supply chains after the Marikana massacre in 2012 followed by a section about Lanxess Chrome Mine in Rustenburg, which is presented as a best case example of a mine with an excellent safety record compared to industry averages in the chrome sector as well the mining industry of South Africa as a whole.

The content in Chapter 4 is provided by the Minerals Council of South Africa and documents initiatives taken to improve mine health and safety in South Africa as well as best practices currently being used in the sector. The topics covered are: initiatives undertaken by the South African Mining Industry to improve occupational health and safety performance; drill and blast. ledging and managing dust in the mining environment.

The publication concludes with a profile of Lesotho's mining industry and an interview with Lesotho's Commissioner of Mines in Chapter 5.





## **CHAPTER 1**

# **HEALTH AND SAFETY IN MINING A GLOBAL OVERVIEW**





## THE INTERNATIONAL LABOUR ORGANISATION (ILO)

The International Labour Organisation (ILO) is a tripartite United Nations (UN) agency that brings together governments, employers and workers in its 187 member states. The ILO sets standards, develops policies and implements programmes to promote decent work for all. A key element of this is occupational safety and health (OSH). As such, the ILO has adopted more than 40 standards to address occupational safety and health in each economic sector.<sup>1</sup>

### The Safety and Health in Mines Convention

Occupational health and safety standards for the mining industry are set out in the Safety and Health in Mines Convention, 1995 (No. 176). This instrument regulates the safety and health issues unique to work on mines, and includes inspection, special work devices, and personal protective equipment (PPE). It also prescribes the requirements related to mine rescue. Signatories to the convention in the Southern African Development Community (SADC) region are Botswana, Mozambique (where it came into force on 14 June 2019), South Africa, Zambia and Zimbabwe.

## ISSA MINING: A GLOBAL INITIATIVE TO PROMOTE HEALTH AND SAFETY IN THE MINING SECTOR

ISSA Mining is a division of the International Social Security Association (ISSA), an institution with a membership of more than 320 social security agencies and organisations from 150 countries. ISSA's Special Commission on Prevention<sup>2</sup> comprises 13 prevention sections.<sup>3</sup>

The International Section on Prevention of Occupational Risks in the Mining Industry Worldwide – ISSA Mining – was founded in 1969 at the VII World Congress on Occupational Safety and Health. It covers large-scale mining operations as well as small and medium-sized enterprises (SMEs).

Any organisation that deals with the safety, health and well-being of mine workers – mining enterprises, associations, researchers and academics, governments and their agencies, trade unions, suppliers and other stakeholders – is a potential member of the ISSA Mining community. A global network enables ISSA Mining to promote social security in mining enterprises of all sizes, worldwide, with a focus on prevention of work-related casualties, and the achievement of acceptable levels of occupational health and safety and better working and social conditions.

According to the ILO, each year there are about 40 million accidents in the workplace worldwide – 360,000 of them fatal<sup>4</sup> – and approximately 2 million deaths from work-related illnesses. This translates to more than 2.3 million deaths a year – one death every 15 seconds!

Mining is inherently hazardous – in large and small-scale mines. Miners are exposed to many risks that include injury from fires, flooding, collapse, machinery and vehicles, from harmful substances such as dust, mercury and other chemicals, and from poor ventilation, inadequate space and overexertion.

No fatality, serious injury or life-threatening occupational disease should be regarded as acceptable. Every miner has the right to return home safely every day, with no adverse effects to their health.

ISSA Mining has the advantage of being able to consult with a range of mining stakeholders from around the globe, and has seen remarkable outcomes in safety and health.

1 <https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang-en/index.htm>

2 <https://www.google.com/search?client=firefox-b-d&q=Special+Commission+on+Prevention+>

3 The sections are: Agriculture, Chemical Industry, Construction Industry, Culture of Prevention, Education and Training, Electricity, Gas and Water, Health Services, Information, Iron and Metal Industry, Machine and System Safety, Mining Industry, Research, Transportation

4 This estimate includes incidents that result in more than four days of absence from work.

## VISION ZERO

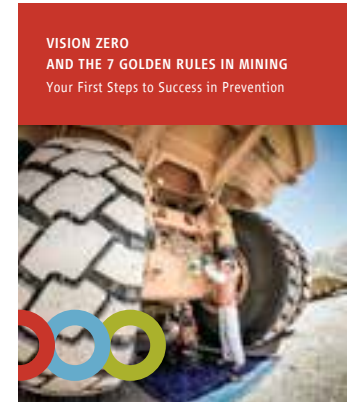
Vision Zero, the strategic backbone of ISSA Mining's work, is ISSA's vision for work environments in which nobody is injured or killed, or suffers from occupational disease. The 7 Golden Rules for Safe and Healthy in Mining have been introduced to high acclaim at many international congresses and workshops.<sup>5</sup>

Accidents at work and occupational diseases are avoidable because they always have a cause. By implementing the Vision Zero strategy at workplaces, these causes can be eliminated and work-related accidents, harm and occupational diseases can be prevented.

Vision Zero is flexible – it is designed to meet the health and safety requirements of any workplace.

### Health and safety leadership

Improving safety and health does not necessarily mean increased spending. It is more important for management to act with awareness, and lead consistently to build a climate of trust and open communication that is evident at every level of the company. Vision Zero requires active contribution and participation of many different actors. Its success is determined by the dedication, motivation and vigilance of employers and executives, managers and employees.



VISION ZERO  
Safety and Health

issa | International Society of Safety Engineers  
Association of Professionals in the Mining Industry



<sup>5</sup> <http://visionzero.global/guides>

# THE 7 GOLDEN RULES

## 1. LEADERSHIP

Every employer, executive and manager is responsible for safety and health in their enterprise. The quality of leadership determines how safety and health standards are practiced and how attractive, successful and sustainable the enterprise is.

Good leadership demands open communication and a clear management culture characterised by predictability, consistency and attentiveness.

Executives and managers should lead by example. What managers do, tolerate and demand sets the standard for other employees.

## 2. HAZARDS

Risk assessment helps to identify hazards and risks before accidents and production downtimes occur. It also assists with evaluating risk potential and establishing and documenting the required protective measures.

## 3. TARGETS

Successful OSH needs clear goals and concrete steps for implementation, established through a programme.

Prioritise and establish clear goals for OSH. Aim to implement them over the medium term – for example in a three-year programme. Set a goal to consistently reduce the number of accidents, or focus on themes, e.g. machine operation, personal protective equipment, reduction of dust exposure. Make sure to communicate regularly about the achievement of goals.

## 4. SAFE, HEALTHY SYSTEMS

Systematically organised OSH helps an enterprise runs smoothly because disruptions, production downtime and quality problems are reduced.

Check-lists can help. If possible, implement an OSH management system that allows for ongoing improvement.

Recognise a successful audit by awarding a certificate.

## 5. TECHNOLOGY

Safe production facilities, machines and workplaces are essential for accident-free working conditions. Health effects have to be considered as well. Effective occupational safety and health strategies include technical, organisational and personal measures. Technical measures should take precedence. It is essential to maintain OSH standards for machines, facilities, equipment and workplaces and to exclude or minimise detrimental effects on health.

## 6. COMPETENCE

Invest in training and skilling employees. Although technical facilities and production machines are getting faster, they are also more complex and prone to malfunction. This makes it all the more important to systematically deploy well-qualified and trained persons at the workplaces.

Make sure that the qualification requirements for every position in the enterprise are described in detail and that every worker is able to perform the duties of their position.

## 7. PEOPLE

Motivating your employees to act in a safe and healthy manner is one of your most important leadership responsibilities. Enterprises that show appreciation for their employees and actively involve them in safety and health are tapping into important potential: their knowledge, abilities and ideas.

When employees are consulted, for example while conducting the risk assessment or in the development of operating instructions, their willingness to follow the rules improves. It can shape the attitudes of employees and motivate them to work safely and with awareness and confidence. The goal is for everyone to look after their colleagues as well as themselves – 'one for all – all for one!'



## OBJECTS OF ACT

### 1. Objects of Act

The objects of this Act are-

- (a) to protect the health and safety of persons at mines;
- (b) to require employers and employees to identify hazards and eliminate, control and minimise the risks relating to health and safety at mines;
- (c) to give effect to the public international law obligations of the Republic that concern health and safety at mines;
- (d) to provide for employee participation in matters of health and safety through health and safety representatives and the health and safety committees at mines;
- (e) to provide for the monitoring of health and safety conditions at mines;
- (f) to provide for the implementation of health and safety measures at mines;
- (g) to provide for the promotion of health and safety at mines.



## CHAPTER 2

# **REGULATORY FRAMEWORKS OF THE SOUTH AFRICAN MINING SECTOR**

# REGULATORY FRAMEWORK MINERAL DEVELOPMENT

## THE MINERALS AND PETROLEUM RESOURCES DEVELOPMENT ACT

The Mineral and Petroleum Resources Development Act, Act No 28 of 2002 (MPRDA) is the principle legislation for mineral development in South Africa, and is based on a system of state custodianship of mineral resources.

The Minister of Mineral Resources issues licenses for mineral development companies to prospect, explore, develop, exploit and process, and for mine closure. These licenses are conditional; all applicants must demonstrate their ability to comply with the technical, financial, environmental, health and safety and socioeconomic development requirements set out in the legislation.

Two aspects of the MPRDA are particularly important in the context of health and safety: the environment and sustainable development. They are significant because ultimately they influence the quality of life of workers and the communities in which they live.

### Environmental management

According to the MPRDA, the Minister of Mineral Resources, who is responsible for implementing the Act, must 'ensure the sustainable development of South Africa's mineral and petroleum resources within a framework of national environmental policy, norms and standards while promoting economic and social development'.<sup>6</sup>

To ensure this, the MPRDA stipulates that the principles of the National Environmental Management Act (No. 107 of 1998) (NEMA) apply to all mining, and serve as guidelines for the interpretation, administration and implementation of the environmental requirements of the MPRDA.

**... the Minister may take such measures as may be necessary to protect the health and well-being of any affected person or to remedy ecological degradation and to stop pollution of the environment.**

*Section 45, Minerals and Petroleum Resources Development Act (MPRDA)*

<sup>6</sup> Chapter 2 of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA)

## THE ENVIRONMENTAL RESPONSIBILITIES OF A LICENSEE

- Take cognisance, investigate, assess and comprehensively communicate the impact of their activities on the environment.
- As far as is reasonably practicable, rehabilitate the environment to its natural or predetermined state, or to a land use that conforms to the generally accepted principle of sustainable development.
- Take responsibility for environmental damage, pollution or ecological degradation as a result of reconnaissance, prospecting or mining operations that may occur inside and outside the boundaries of the areas to which such right, permission or permit relates.
- Ensure that activities take place within the framework of national environmental management policies, norms and standards.
- Water-use authorisations issued under the National Water Act (No. 36 of 1998) are required for all mining operations.



## A SOCIAL LICENCE TO OPERATE

A social licence to operate (SLO) is essentially a community trust – an informal agreement and 'ongoing acceptance of a company or industry's standard business practices and operating procedures by its employees, stakeholders and the general public' (Investopedia, [www.investopedia.com](http://www.investopedia.com)).

The principles of the SLO are based on those of good citizenry and it does not adhere to a specific process. Because of this the SLO is 'difficult to define and impossible to measure' (Investopedia).

In the MPRDA the South African government has made social labour plans a mandatory component of the application process for mining licences in an attempt to formalise the social licence and encourage transformation in the sector.

South Africa's Mining Charter (2018) states: 'A mining right holder must meaningfully contribute towards mine community development, in keeping with the principles of the social licence to operate'. ([www.dmr.gov.za](http://www.dmr.gov.za))

**Below:** Much of the Pilanesberg area near Rustenburg in North West Province is a protected game reserve. It is also a platinum rich area; there are a number of mines on the outskirts of this ancient volcano. Source: Wikimedia



## Sustainable development



One of the aims of the MPRDA is to transform the mining industry by promoting employment and advancing the social and economic welfare of all South Africans and ensuring that holders of mining or production rights contribute to the socioeconomic development of the areas in which they are operating as well as the areas from which the majority of the workforce is sourced.<sup>7</sup>

To ensure effective transformation, the MPRDA requires potential licensees to submit a social and labour plan (SLP).

The SLP element of the MPRDA requires applicants to develop and implement a comprehensive human resources development programme that includes employment equity plans, local economic development programmes, and processes to save jobs and manage downscaling and/or mine closure.

A mandatory report submitted annually to the Department of Mineral Resources (DMR) must show the company's performance with regard to compliance with the Mining Charter's targets for black economic empowerment (ownership and employment equity), skills development and mentorship plans, housing, community development and enterprise supplier development.

The DMR has published a set of guidelines to assist applicants for mining and production rights in preparing the prescribed Social and Labour Plans specified in Part II of the Regulations of the MPRDA.<sup>8</sup>

**AFFIRMING the State's obligation to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources and to promote economic and social development.**

*Preamble to the MPRDA*

<sup>7</sup> Chapter 2 of the MPRDA

<sup>8</sup> Department of Mineral Resources. Guideline for the submission of a social and labour plan.

# REGULATORY FRAMEWORK

## MINE HEALTH AND SAFETY

Early South African legislation like the Mines and Works Act 12 of 1911 (also known as the Colour Bar Act) was designed primarily to give white workers the monopoly over higher paid skilled jobs. No provision was made for representation of the majority black mineworkers on health and safety matters and black workers had no right to leave a dangerous workplace without permission from white supervisors.

Although the Minerals Act introduced in 1991 included a chapter on health and safety and claimed that it provided for 'the safety and health of persons concerned in mines and works' it did little to promote the occupational health of workers.<sup>9</sup>

### A NEW CONSTITUTION

South Africa's transition out of apartheid after 1994 included the creation of a new constitution, which was promulgated by President Nelson Mandela in 1996, and is widely regarded as the most progressive in the world.

Section 24 in the Bill of Rights of the Constitution of the Republic of South Africa, 1996, includes the statement: 'Everyone has the right to an environment that is not harmful to their health and well-being' which must also be applied to the work environment.

### MINE HEALTH AND SAFETY ACT 29 OF 1996 (MHSA)

The MHSA comprises the Mine Health and Safety Act and the Mine Health and Safety Regulations.

Central to the MHSA is a tripartite approach – government, industry and workers' unions are all required to promote health and safety in the workplace.

Three principles emanate from the MHSA and place duties on all stakeholders responsible for health and safety on mines:

- **The employer** has a duty and responsibility to protect the health and safety of employees exposed to occupational health and safety hazards and risk.
- **The state** has a duty and responsibility to effectively regulate health and safety conditions at work places on the mine.
- **Employees** have the right to refuse to work in an environment that may endanger their health and safety.

**Everyone has the right to an environment that is not harmful to their health and well-being.**

*Section 24, Constitution of the Republic of South Africa, 1996*

### THE LEON COMMISSION

Even with legislation in place, very high fatality rates in the mining sector persisted.

According to the Leon Commission of Inquiry into Safety and Health in the Mining Industry, which was set up in 1994 by South Africa's post-apartheid democratic government to investigate health and safety in mining and make recommendations to improve standards set, there were an estimated 69,000 fatalities and 1 million injuries on South African mines between 1900 and 1993.

The commission found that the old (pre-constitution) legislative framework governing mine health and safety was inadequate. The laws that were in place had not been properly enforced by government and the mining industry had been allowed to disregard key aspects of existing laws.

Besides what the commission called an 'appalling' accident record there were 'serious occupational health problems' in the industry, with a high incidence of tuberculosis, silicosis, asbestos-related disease and pneumoconiosis.

It was also noted that the Mine Health and Safety Inspectorate was under-resourced. Urgent remedial action was needed.

The commission resulted in the promulgation of the Mine Health and Safety Act 29 of 1996 (MHSA). The MPRDA, which repealed the Minerals Act of 1991 in 2002, emphasises compliance with the MHSA.

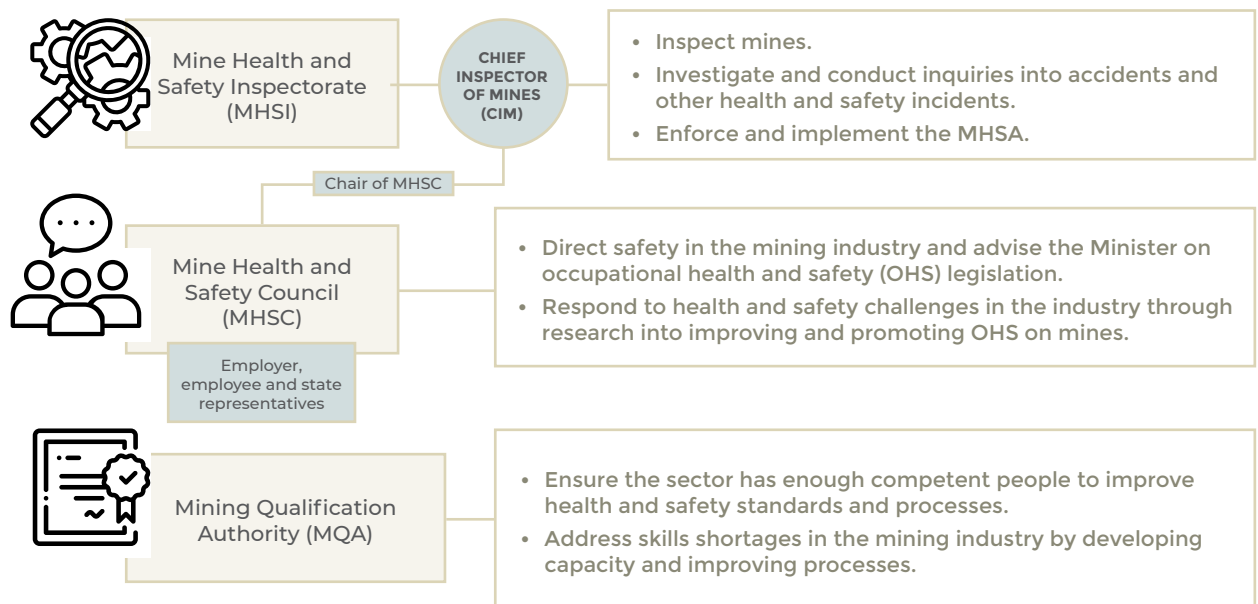
<sup>9</sup> Minerals Act, Act 50, 1991, Chapter 5, Safety and Health

## The objectives of the MHSA

- Promote a culture of health and safety in the workplace
- Promote training in health and safety in the mining industry
- Enforce health and safety measures
- Require employers and employees to identify hazards and eliminate, control or minimise risks to health and safety.

## TRIPARTITE INSTITUTIONS

Chapters 4 and 5 of the MHSA define the bodies established to ensure effective regulation of health and safety by the state: the Mine Health and Safety Inspectorate (MHSI), the Mine Health and Safety Council (MHSC) and the Mining Qualification Authority (MQA).



## Ministerial powers<sup>10</sup>

According to the MHSA, the Minister of Mineral Resources can restrict or prohibit any work on a mine and declare health hazards. The minister can also declare that any provision of the Occupational Health and Safety Act, 1993, or any other regulation must be applied to a mine.

The MHSA stipulates that the minister can only use these powers after consultation with the MHSC and must release a draft report three months before gazetting any prohibition of work or declaration of hazards, or applying any other regulations to a mine.

## Legal proceedings and offences

All courts, with the exception of the Labour Court, have jurisdiction in terms of offences committed under the MHSA. The Labour Court has 'exclusive jurisdiction to determine any dispute about the interpretation or application of any provision of the MHSA except where this Act provides otherwise'.<sup>11</sup>

Offences listed in the MHSA include discrimination against an employee who is exercising their rights, interfering with safety equipment, employing a person younger than 18 and falsifying certificates of competence.<sup>12</sup>

The Magistrates Court has the jurisdiction to impose penalties to offences committed.

<sup>10</sup> MHSA, Chapter 6, Minister's Powers (page 61)

<sup>11</sup> MHSA, Chapter 7, Legal Proceedings and Offences (page 64)

<sup>12</sup> MHSA, Chapter 7, Legal Proceedings and Offences (page 64)

## The Mine Health and Safety Inspectorate (MHSI)

The objective of the MHSI is to target activities that have the potential for considerable harm or risk to health and safety. The MHSI should be governed by the principles of enforcement illustrated in the graphic below. Depending on the seriousness of a breach of the MHSA, the MHSI may:

- Inform and educate stakeholders through letters or directives.
- Issue compliance or closure notices, or an instruction to suspend or halt operations in full or in part.
- Issue an administrative fine.
- Suspend or cancel a certificate of competence and recommend criminal prosecution.



**Any person who, by a negligent act or by a negligent omission, causes serious injury or serious illness to a person at a mine, commits an offence.**

MHSA, Chapter 7, Section 86



## QUALIFICATIONS OF INSPECTORS

The qualifications of inspectors and authorisation certificates for gaining access to mine sites are regulated by the MHSA.

An inspection officer's qualifications must comply with the appointment requirements of the Personnel Administration Standards for the Occupational Class.

The two occupational classes defined in law are the Inspector for the Mines or Occupational Class and the Inspector of Mining Machinery. These classes are approved by the Public Service Commission read in conjunction with the Public Staff Code K.11/1. Inspectors must meet these criteria.

Access to mine sites is granted by the Chief inspector of Mines who issues inspectors or authorised persons with a Certificate DME 34, Certificate DME 35 and a letter of authorisation.

## Health and safety at mines

Chapter 2 of the MSHA outlines the duties of employers with regard to health and safety policy, training, codes of practice, risk-assessment and reporting. It also outlines the rights and responsibilities of employees.<sup>13</sup>

### The duties of the employer

#### Identify risks:

- Identify hazards associated with every process and their associated tasks.
- Assess the likelihood of each hazard being realised.
- Evaluate the potential harm the hazard could cause either to people, property or the wider environment.

**Control and record risk:** The onus is on the employer to put in place measures to control all risks identified. The process for each individual risk assessment must be documented.

**Access to information:** The MSHA stipulates that each risk assessment must be freely available to anyone who wishes to see it, and must be reviewed on a regular basis (12–24 months) or changed according to prevailing circumstance (e.g. when new equipment or technology is introduced, when there is a change in ground conditions).

### The responsibilities and rights of the employee

Sections 22 and 23 of the MSHA place responsibilities on employees with regard to health and safety. Section 22 places the onus on employees to take reasonable care to:

- Protect their own health and safety and that of other persons affected by an act or omission of that employee.
- Use and take care of protective clothing, facilities and equipment provided by the employer.
- Report any risks to health and safety to their immediate supervisor.
- Cooperate with persons enforcing the provisions of the MSHA.

Section 23 of the MSHA gives employees the right to leave a workplace in circumstances that pose a danger to health and safety, or when a health and safety representative responsible for a workplace directs an employee to do so.

## THE RIGHT TO LEAVE A DANGEROUS WORKING PLACE

The employee has the right to leave any working place whenever:

- a. circumstances arise at that working place which, with reasonable justification, appear to that employee to pose a serious danger to the health or safety of that employee; or
- b. the health and safety representative responsible for that working place directs that employee to leave that working place.

*MSHA, Chapter 2, Section 23*

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13 MSHA, Chapter 2, Health and Safety at Mines (page 12)

## Health and safety representatives and committees

Chapter 3 of the MSHA stipulates that every mine with 20 or more employees must have a health and safety representative for each shift at each designated working place on the mine. Mines with 100 or more employees must have one or more health and safety committees.

**Health and safety representatives** elected by employees represent employees on all issues related to health and safety. The law requires the employer to train the elected health and safety representatives.

**A health and safety committee** comprises health and safety representatives and representatives from management. Appointment of health and safety representatives and committees is made after negotiation and consultation with the representative trade union and a collective agreement to regulate health and safety has been reached. The agreement must stipulate:

- The number of health and safety representatives and committees.
- The number of employer and employee representatives.
- Election, appointment and term of office of representatives.
- The manner and circumstances in which meetings may be held.

### What the MSHA Regulations say about health and safety representatives and committees

The MSHA Regulations prescribe the period for negotiation and consultations between management and labour to decide on the number of health and safety representatives on a mine.

The mine manager establishes an election committee that must include employee representatives to nominate and elect H&S representatives.

The regulations include procedures for nomination and election of H&S representatives and appointment of employee representatives to the H&S committee.<sup>14</sup>

**Every employee representative on a health and safety committee at a mine must be appointed by a majority of the health and safety representatives at the mine.**

*MSHA Regulations, Chapter 6 (page 165)*



### WHAT HEALTH AND SAFETY (H&S) REPRESENTATIVES DO

Health and safety representatives play a key role in promoting safe work practices on mines and can help to improve communication and increase the effectiveness of consultation between workers and management to make workplaces safer and healthier.

Although health and safety representatives play a role in inspecting the workplace to assess risk and investigating accidents or incidents, they do not have the same jobs as safety and health officers or inspectors, and are not responsible for solving safety and health matters.

#### Key tasks of H&S representatives

- Inspect the workplace areas they are elected to represent at agreed times and frequency.
- Immediately investigate the scene and details of any accident, dangerous incident or risk of serious injury or harm to any person.
- Keep up to date with workplace safety and health information provided by the employer and liaise with government and other bodies.
- Report hazards in the workplace to the employer.
- Refer any matters that should be considered by a safety and health committee.
- Consult and cooperate with the employer on safety and health matters.
- Liaise with employers and workers about safety and health matters.

<sup>14</sup> MSHA Regulations, Chapter 6 (page 165)

## WARNING, INFORMATIVE AND STATUTORY SIGNAGE

The signage displayed in areas where electrical apparatus is installed is designed to prevent injury that may occur because of electrical shock, arc flash or electrocution.



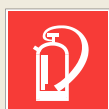
**WATCH OUT!  
HIGH VOLTAGE**



**DON'T TOUCH!**



**CALL EMERGENCY  
SERVICES**



**FIRE EXTINGUISHER**

**The aim of risk assessment is to identify hazards and risks to prevent accidents and production downtimes.**

*Golden Rule #2, Vision Zero*

## MHSA REGULATIONS

The MHSA Regulations provide details about mine health and safety. Important topics include electricity, explosives, fire and explosions, health and safety committees, the MHSI, machinery and equipment, trackless mobile machinery, mine environmental engineering and occupational hygiene.

### Electricity

MHSA electricity regulations address the responsibilities of the employer, which include ensuring that the design of the electrical apparatus and reticulation system is approved, as well as operated and repaired, by 'competent' personnel. Technical competencies for functions that relate to electricity on mines are gazetted in a schedule released in April 2015.<sup>15</sup>

The regulations also include guidelines about the area chosen to install electrical apparatus to optimise safety. It should, for example, be well-lit and well-ventilated with enough space to accommodate maintenance procedures.

### Explosives

Explosive regulations cover security, receiving and storage, issuing, transportation, and destruction of explosives; approved explosives on a mine; and, primary and secondary blasting.

Security is an important feature and includes measures to prevent unauthorised access to explosives. To prevent events like accidental explosions, the regulations include instructions on safe receiving, storage, issuing and transportation of explosives. There must be a written procedure in place for destroying explosives.

### Fires and explosions

As with most safety regulations the emphasis in the section on fires and explosions is on prevention. Reporting on preventive and ameliorative measures and their adequacy is thus high on the agenda. Risk assessment is the second of the Golden Rules in ISSA Mining's Vision Zero.

<sup>15</sup> Department of Mineral Resources, 24 April 2015. *Regulations relating competencies for electricity*

## Machinery and equipment

The chapter of the MSHA regulations that deals with machinery and equipment in mines includes regulations on air compressors, underground railbound transport (locomotives), winches, lifting equipment, fans, refrigeration and air-conditioning, conveyor belts, trackless mobile machinery, and lifts and chairlifts.<sup>16</sup>

Each section offers a detailed description of the precautions that should be taken to prevent injury as a result of incorrect, careless or unauthorised operation, lack of maintenance and testing, collisions between vehicles and collisions of vehicles with people, incorrect installation, and so on.

The exhaustive list of general machinery regulations (section 8.8) places the onus on the employer to take measures to ensure that workers are kept from harm. Measures include restricted entry of unauthorised people, warning devices on machinery and written procedures to ensure that energy sources are locked out and de-energised before anyone does maintenance on machinery.

Regulations for fuel include marking of storage areas and refuelling bays, storage regulations and ventilation to prevent build-up of fumes when starting engines.

### Locomotives (underground railbound transport)

- The braking system on every locomotive must pass the dynamic brake test before deployment and after upgrade, and pass the static brake test before use on every shift and after repairs. The braking system must be able to stop the locomotive under all conditions.
- Warning systems must be in place to alert people of the presence and direction of a locomotive, assist drivers or operators travel at a safe speed and prevent a locomotive from inadvertently being set in motion.
- No person may board a locomotive or train in motion.
- All rolling stock used for transportation of persons must be approved by a competent person and operated and maintained safely.

### Winches

- The employer must take measures to prevent injury from contact with moving parts of winches.
- Winches must be examined and declared safe by competent persons before use and may only be operated by competent persons authorised by the manager.
- All winches must be fitted with a signalling device.

**Machines can help improve production efficiency in the workplace. However, their moving parts, sharp edges, and hot surfaces can also cause serious workplace injuries such as crushed fingers or hands, amputations, burns, or blindness. Safeguards are essential to protect workers from injury.**

*Centers for Disease Control  
[www.cdc.gov](http://www.cdc.gov)*

**The mining industry has developed machine safety programmes with interventions and control technologies to reduce injuries to personnel working near machinery and mobile equipment.**

**Machine safety programmes try to understand the machine system requirements and specifications and address the human interface issues involving operation and maintenance of equipment.**

*Safety and Mining Machinery,  
[miningsafety.co.za](http://miningsafety.co.za)*

<sup>16</sup> MSHA, Chapter 8, MSHA Regulations (page 171)

## Lifting equipment

As with all mine machinery and equipment the employer is responsible for measures to prevent injury from failure as a result of incorrect design, incorrect installation or lack of maintenance of lifting equipment. The MHSA stipulates that lifting equipment or tackle must have a minimum safety factor of 4, and must not be used beyond its design capacity. The safe working load of lifting equipment must be clearly marked and in plain sight. The safety factors for each type of material (i.e. natural fibres, metal chain) are also listed in the regulations.



## Ventilation

Effective mine ventilation has a direct bearing on health and safety on mines, in the short term because lack thereof can result in overheating and fires, and in the long term because good ventilation minimises exposure of workers to dust and noxious gases and thus prevents occupational respiratory diseases such as silicosis.

The employer must ensure that fan installations and switch-gear are not damaged in the event of a fire and that fumes or smoke are not drawn into the underground workings of the mine.

Measures to ensure a constant supply of clean air to all underground workings include installing a main fan on surface, measures to protect it in the event of an explosion; and, ensuring that it is readily accessible to effect emergency repairs. A backup system must be in place to provide clean air if the main fan is not working.

## Conveyor belts

Designated sections of a conveyor belt installation must be guarded and no cleaning of conveyor belts must take place when any part of the installation is in motion. Lock out procedures must be followed during belt repairs, maintenance and cleaning and power supply and stored energy sources isolated. It must be possible to stop the driving machinery of a conveyor belt at any accessible point along if the belt breaks or jams or if there is excessive slipping.

## Trackless mobile machinery (TMM)

New TMM regulations for South African mines were introduced in May 2015. Collisions are to be avoided between TMM and people (pedestrians), with other trackless vehicles and with rail-bound vehicles. Compliance with the new regulations implies the need for:

- A proximity detection device identifying the presence of people or other vehicles in the vicinity.
- A mechanism to alert the machine operator and the nearby people / vehicles of each other's presence.
- An automated system to slow the vehicle to a safe speed without human intervention if no corrective action is taken.

## Environmental engineering and occupational hygiene

Chapter 9 of the regulations sets out the employer's responsibilities with regard to maintaining a healthy work environment and measures to prevent exposure to airborne pollutants and excessive heat and noise.

Measures include early warning systems, use of SABS-approved ventilation control devices, 'sufficient potable and palatable water', and 'suitable and adequate ablution and change-house facilities'.

The regulations also set out the specifications with regard to work clothing, respiratory protective equipment, and illumination of workplaces.

The miscellaneous and general provisions in Chapter 10 include instructions on what to do if there is an accident that results in injury or fatality, definitions and restrictions pertaining to hazardous locations and what the employer must do to prevent accidents in these hazardous locations.

Chapter 10 also stipulates the regulations regarding water storage and pumping regulations as well as definitions and regulations for draw points, tipping points, rock passes and box fronts.

## Occupational health

Chapter 10 of the regulations addresses the responsibilities of the employer with regard to the health of workers. The employer must allow for regular medical testing and surveillance that includes audiograms, and medical surveillance for asbestos-, coal- and silica-dust exposure.

The employer must also produce an annual medical report that records details of medical surveillance, strategies for future surveillance and the number of employees certified for compensation for occupational diseases, for which an exit certificate is issued. The regulations specify the details to be included on the exit certificate.<sup>17</sup>

The regulations also list the occupational diseases to which workers are exposed as a result of working in mines; the employer must report any incidence of these to the Principal Inspector of Mines within 30 days of the date of diagnosis.

Details of an employee's record of hazardous work, which is defined in Chapter 2 (14) of the Act as 'work in respect of which medical surveillance is conducted' must be kept on form DMR 276.<sup>18</sup>

**DMR 276**

**EMPLOYEE'S RECORD OF HAZARDOUS WORK**

MINE NAME: \_\_\_\_\_

EMPLOYEE DETAILS: ID: \_\_\_\_\_ SURNAME: \_\_\_\_\_ FIRST NAME: \_\_\_\_\_ GENDER: ☐ MALE ☐ FEMALE

ID NUMBER: \_\_\_\_\_ COMPANY/INDUSTRY NAME: \_\_\_\_\_

DATE STARTED EMPLOYMENT: DD / MM / YY DATE DROPPED EMPLOYMENT: DD / MM / YY

OCCUPATION	DATE		NUMBER OF EXPOSED SHIFTS	IDENTIFY STRESSOR AS PER MINE'S SPECIFIC RISK ASSESSMENT IN ACCORDANCE WITH THE DMR LISTING IN SCHEDULE 22 (S14)	NOISE	THERMAL STRESS	OTHER	RADIATION
	FROM	TO						

SIGNATURE OF MINE/MANAGER: \_\_\_\_\_ DATE: \_\_\_\_\_

SIGNATURE OF EMPLOYEE: \_\_\_\_\_ DATE: \_\_\_\_\_

Note: This form must be kept in the mine and a copy must be kept in the mine manager's office. It must be kept in the mine manager's office for at least 10 years after the date of completion of the form.

<sup>17</sup> MHSA Regulations, Chapter 11, section 11.3 (p 210)

<sup>18</sup> MHSA Regulations, Chapter 11, section 11.9 (p 219)

The employer must ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's risk assessment, on the adequacy of escape and rescue procedures at the mine relating to explosions, fires and flooding.

*MHSA Regulations, Chapter 16 (p 225)*



Dräger Oxy K30-K50 Self Contained Self Rescuer

## SELF-CONTAINED SELF RESCUERS

A self-contained self-rescuer (SCSR) is a portable oxygen source for providing breathable air when the atmosphere lacks oxygen or is contaminated with toxic gases like carbon monoxide. They are small, lightweight belt or harness-worn devices, enclosed in a metal case.

Self-rescuers are used in environments such as coal mines where there is a risk of fire or explosion, and where external rescue may not be immediately available in which case personnel have to make their own way to safety, or to a pre-equipped underground refuge.

SCSRs have a service life of around 10 years (longer for shelf storage) and are worn every day by each miner. They are discarded after they are opened and used. (Information adapted from Wikipedia)

## Rescue, first aid and emergency preparedness and response

Foremost in the section on rescue, first aid and emergencies (MHSA Regulations, Chapter 16) is a regulation about risk assessment, which is geared towards preventing accidents before they happen. Identification of hazards is the second of Vision Zero's Golden Rules.

The regulations stipulate that the employer must appoint a competent person to report on any hazards identified in the workplace.

### Mine rescue teams

The employer must 'provide and maintain' mine rescue teams which must each consist of at least five competent people. The number of rescue teams depends on the number of people underground at any one time. For example, for between 1,101 and 3,600 persons, at least two rescue teams are required.

There must be enough SANS-compliant sets of breathing apparatus to 'render the user independent from breathing from the atmosphere for a minimum of two hours' readily available to rescue teams.<sup>19</sup> Apparatus must be tested and maintained according to the Regulations.

The mine must have a contract with a mine rescue service provider to coordinate and facilitate rescue teams and other services.

The regulations also specify what is required of a mine rescue service provider to qualify as such, as well as minimum standards for membership of a mine rescue team, i.e. fitness to perform work as per the Code of Practice, and the age limit for rescue personnel.



**ABOVE:** Firefighters during a live fire training exercise (Source: Wikimedia Commons)

<sup>19</sup> See MHSA Regulations, Chapter 16, 16.5.1 (b) SANS 50145:1997/EN 145:1997 'Respiratory protective devices - Self-contained closed-circuit breathing apparatus - Compressed oxygen or compressed oxygen-nitrogen type-Requirements, testing, marking'





## CHAPTER 3

# GERMAN TECHNOLOGY: SUPPORTING HEALTH AND SAFETY IN SOUTH AFRICAN MINES

## SCHAUENBURG SYSTEMS

# ENSURING COMPLIANCE THROUGH TECHNOLOGY

Schauenburg (Pty) Ltd (trading as Schauenburg Systems) is a subsidiary of the Schauenburg International Group. This family-owned business, comprised of more than 30 companies, has its roots in the German shipping and ship-outfitting industry. Schauenburg International has four divisions: electronic technologies, plastics processing, machinery and equipment, and engineering products.

Schauenburg Systems falls under the electronic technologies division and is an original equipment manufacturer (OEM) for mine safety. Schauenburg offers system integration services with comprehensive turnkey solutions that include the full bouquet of multi-disciplinary services and programme-management methodologies to ensure cost-effective solutions for the full spectrum of mine safety and management.

Successful design, manufacturing and implementation of products have given Schauenburg the experience and assurance to offer real solutions at competitive prices. With an emphasis on all-in-one systems and solutions, Schauenburg defines its goals and introduces a world-class electronic product range for health and safety for underground mining. Schauenburg's ability to design innovative electronic products with cutting-edge technologies allows it to not only focus on products but also on the integration of turnkey communication systems and solutions.

## PRODUCT PORTFOLIO

Schauenburg's range of equipment includes intelligent instrumentation, gas detection, safety-enhanced cap lamps, computerised radio-relayed monitoring, safety systems, radio communication, and anti-collision systems.

Continual research and development, state-of-the-art manufacturing capabilities, as well as an international distribution and technical service network, enable Schauenburg to serve the international mining and tunnelling markets and other industries to the highest professional standard.

Regular interaction and liaison with clients as well as technology suppliers ensures that state-of-the-art products are of the highest quality. Schauenburg focuses on modern electronic technologies to set standards in international health, safety and productivity monitoring applications for underground mining.

Schauenburg's acclaimed mine-wide integrated monitoring and control system – MIMACS – addresses multiple safety concerns of underground mining. A typical MIMACS offering consists of:

- New-generation cap lamps for underground workers equipped with wireless and digital communication.
- Paging-tracking, collision (PTC) miner's cap lamp (paging facility: communication between PTC cap lamps and the control room)
- Sentinel hand-held gas-detection instrument with near real-time communication up-links
- Lamp-room and asset-management system – control and monitoring
- Near real-time personnel location, distress-call function and short text-messaging
- Verification and near real-time reporting of vehicle-to-vehicle and vehicle to-pedestrian systems deployment.
- Schauenburg Collision Awareness System (SCAS) Underground and Surface Proximity detection solutions

Schauenburg products are modular in concept and application. All systems can be configured to meet mine- and site-specific requirements.

A key feature of the MIMACS offering is the SCAS II Collision Awareness System, which provides early perimeter-warning notification to give vehicle operators and pedestrians a head start in deciding how to manoeuvre before a critical decision is required. A distinct advantage SCAS II has over other systems is that it can be integrated with all other MIMACS modules. SCAS II is designed to mitigate Level 7 to Level 9 risks identified in a typical mine collision management system.

Other MIMACS features include a lamp-room and asset management system (LMS and AMS), a comprehensive database and software suite that offers a total management solution for compliance with Department of Mineral Resources regulations for lamp-room operations, and enhances the safety and security of daily operations.

Continued enhancement of the system is in place in order to ensure Schauburg remains the pioneer of a world-class mining software suite for the Smart Mine of tomorrow.

The extensive variety of reports that can be generated by MIMACS include daily exception reports and backup shaft-clearance reports. The system configuration also offers remote client access, which allows management to generate reports from the comfort of their offices.

Full maintenance agreements ensure that the equipment supplied to the mine remains in good working condition at all times. Technical support teams at Schauburg Systems undergo stringent technical training to ensure the highest standard of workmanship, especially where lifesaving equipment is involved.



**ABOVE:** An overview of the MIMACS system and its components

## LEGAL COMPLIANCE AND SCHAUENBURG PRODUCTS

The MHS Act places the onus on employers to create safe working conditions for employees, and establish a risk-management approach to health and safety. Schauenburg Systems products assist with compliance under the following subsections of the Act: fires and explosions; workplace illumination; trackless mobile equipment; mine environmental engineering and occupational hygiene; rescue, first aid and emergency preparedness; and, response and reporting.

### Fires and explosions

Regulation 8.9(3) of the MHS Act states that 'the employer must take reasonably practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a conveyor belt installation catching fire, including instituting measures to prevent, detect and combat such fires' and Regulation 9.1 (2) states that 'Where the risk assessment at the mine indicates a significant risk of a fire and/or explosion and/or toxic release, that could lead to an irrespirable atmosphere or an atmosphere immediately dangerous to life or health, the employer must provide an early warning system or systems at all working places'.

#### Portable gas detection

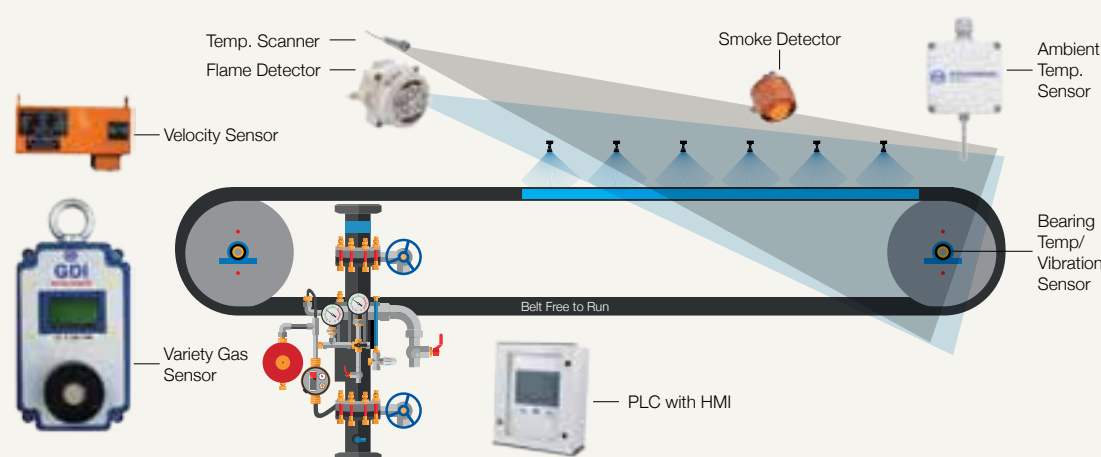


The GDI Sentinel (left), which was designed and developed as part of MIMACS, can transmit gas intersections to the control room from the working face and can also be used as a comprehensive standalone product.

The Sentinel's passive radio frequency (RF) interface makes fire patrol functionality possible based on locations represented by unique passive tag IDs that do not require a power source. Three sensor ports allow for configuration of up to four gases with the aid of a combination sensor. The three-way alarm includes audible and visual annunciation as well as vibration alert. Capacitive touch buttons and inductive charging enhance the International Protection (IP) rating of the device and eliminate ineffective battery charging due to poor contact. User testing, calibration and downloading functions are RF-based and fully automated.

The Sentinel's MIMACS-interface capabilities, in terms of the common RF communication platform, allow it to interface with SCAS II-equipped vehicles in terms of interlocking mechanisms when gas is intercepted.

### Fixed environmental monitoring



Schauenburg's environmental monitoring systems offer proactive solutions for early warning and continuous monitoring of environmental conditions and consist of three sub-systems: ventilation monitoring, fire detection and conveyor-belt monitoring. The systems available use strategically deployed sensors to route data to a control room. Data are viewed on an industry-standard supervisory control and data acquisition (SCADA) MIMACS application to provide the user with a mine-wide monitoring and control system.



**Schaulicht SmartLite**



**Schaulicht OptiLite**

## Workplace illumination

Regulation 9.2 (9) of the MSHA states that the employer must ensure that illumination at all workplaces is sufficient to enable employees who have conformed with the requirements of the vision tests conducted in terms of the Guideline for the minimum standards of fitness to perform work at a mine, to perform their work safely. Schauenburg illumination technologies include the paging-tracking-collision (PTC) Schaulicht SmartLite and the Schaulicht OptiLite.

### SCAS II Schaulicht SmartLite

The SCAS II Schaulicht SmartLite is fitted with a dual-band data radio and liquid-crystal display (LCD) module that allows for user-configurable text messages to be dispatched from the control room to a specific user or group of users. Via the MIMACS environmental monitoring graphical user interface, control-room operators can be warned of dangerous underground conditions like gas build-up, fires or seismic movement and communicate the threat to underground personnel in near real-time. The lamp supports full two-way communication and personnel who are trapped or require assistance can inform the control room of their whereabouts by using the distress-call feature. The lamp offers collision warning, location monitoring and paging functionality in a single device.

### Schaulicht OptiLite

The Schaulicht OptiLite has a compact and powerful battery pack with a life cycle of two years that may be charged on existing racks. The LED light source has a primary illuminating intensity of more than 3000 lux (1m distance) at the start of operation and 2000 lux (1m distance) after 11 hours. It has a five-year life.



**The Illuminating Engineering Society of North America (IESNA) has stated that an underground mine is the most difficult environment to illuminate because of dust, confined spaces and surfaces that reflect light poorly and offer low visual contrasts.**

**Illumination greatly affects the ability of mine workers to perform their jobs safely because they depend on visual cues to see fall of ground, pinning and striking hazards, and slipping and tripping hazards.**

## Trackless mobile machinery (TMM)

Regulation 8.10 of the MHSA stipulates that employers are required to ensure that collisions between pedestrians and trackless mobile machinery (TMM) are prevented. There are also additional requirements in respect of diesel-powered TMM. A diesel-powered TMM must be equipped to automatically detect the presence of a pedestrian, other TMM and/or hazards in its vicinity. The operator of the TMM and the pedestrian must both receive a warning signal of the other's presence.

### Underground Proximity Detection

The SCAS II Collision Awareness System uses dual-band radio frequency (RF) technology to warn a vehicle operator that a vehicle, pedestrian or fixed hazard is in one of three configurable warning zones. The system will also indicate the orientation of the potential hazard. SCAS II can also be configured to provide vehicle interface signals such as 'crawl & stop' via Controller Area Network (CAN) bus. The equipment is designed for underground trackless and track-bound machinery. SCAS II will in turn warn pedestrians of approaching vehicles and possible hazard areas by means of an LED warning device and audible alarm.

Warning events are stored on the vehicle unit as well as the cap lamp radio and selected data events can automatically be transmitted to the control room from strategic locations while the vehicle is in transit. Should the mine infrastructure not allow for automatic data downloading, information can be manually uploaded through a manual wireless interface unit.

### Surface PDS applications

The Schauenburg Surface Proximity Detection System (PDS) is a vehicle and personnel collision-awareness system. It is compatible with SCAS II underground equipment and uses advanced detection technologies and algorithms that will save lives and reduce costs. The surface PDS is designed to operate in a variety of rugged and demanding conditions, and, unlike GPS-only systems, uses multiple detection technologies to create a fail-safe system with greater precision than single technology systems.



# EXAMPLES OF APPLICATIONS IN THE SOUTH AFRICAN MINING INDUSTRY

## Large mechanised hard-rock mine, Rustenburg

In 2013, a large mechanised, hard-rock platinum mine issued a user requirement scope for a Comprehensive Mine Safety System (CMSS) which could address the following safety disciplines:

- Communication between control room and underground using text and data
- Mine communication network infrastructure
- A proximity detection system to interface with a vehicle control system to retard and stop a mine vehicle in the event of significant risk between a mine vehicle and mining pedestrians

Schauenburg Systems was selected to implement solutions for this scope and is particularly proud of the following successfully implemented MIMACS modules:

### Communication – Two-way paging

To make the mining space safer for women workers, the client wanted a communication system that would enable women to communicate with the control room and vice versa from underground and notify the control room and/or section foreman if a woman worker registered on the system did not report according to a predetermined schedule.

The system Schauenburg installed and implemented for the client used the PTC Safelite mining cap lamp to hold all the applicable communication devices which send pre-defined text messages to the control room via capacitive touch buttons on the paging cap lamp. The control room can also respond with messages to a specific or group of paging cap lamps underground.

The system was rolled out mine-wide and each underground miner was issued with a PTC Safelite.

### Proximity Detection System (PDS)

The client also requested a two-way system that would:

- Enable mine vehicles and pedestrians to alert one another to their presence
- Automatically retard and stop a mine vehicle if a dangerous situation was not resolved

Schauenburg installed SCAS II, a state of the art Proximity Detection System (PDS) system that informs the vehicle operator of imminent threats in the vicinity of the vehicle with an in-cab human interface which displays information based on the orientation of the detected hazard with reference to the front, rear, and left- and right-hand sides of the vehicle.

Through additional system development SCAS II will integrate with the control systems of the vehicles to automatically retard and stop the vehicles according to dynamic detection zones. Current trials are a stepping stone towards assisting the mine with proposed legislation due by the end of 2020.

## Large platinum mine near Thabazimbi: Personnel Location Monitoring System

When a miner at a platinum mine near Thabazimbi went missing 10 years ago, it resulted in a huge loss in production days. This incident prompted them to request a 'near real-time' personnel location monitoring system to inform the mine control room and management at any given time of the most recent location of an employee.

Schauenburg was selected as the service provider after stringent tests and trials to prove its system capabilities. The system was installed in 2011 and is still in use today. On many occasions the system helped to locate persons who were presumed missing and in this way has enhanced safety and prevented or minimised production losses.

## INTERVIEW WITH ETTIENE PRETORIUS

### ESS Business Unit Manager | Schauenburg Systems (Pty) Ltd

#### What is the history of Schauenburg Systems in the South African mining sector?

Schaubenburg Systems has been involved in South African mining since the 1970s. Initially we supplied mine ventilation consumables – apparatuses used to control the flow of air in the underground mining environment, for example, ventilation ducting, ventilation curtains and brattices.

#### Why is mine ventilation important?

The purpose of mine ventilation is to supply fresh air underground. The principle objective is to dilute gases, and remove heat and dust. Empirical data show that the highly flammable gas, methane, and the noxious gas, carbon monoxide, cause the most fatalities in underground mines.

#### Besides low ventilation installations, what other products and services do you supply?

The Mine Health and Safety act of South Africa sets limits on the maximum allowable levels of methane and carbon monoxide in the ambient environment and we identified electronic gas detection as a gap in the South African market. We developed a hand-held gas detection instrument – a GDI – to monitor methane and carbon monoxide levels in the ambient environment.

#### Have there been any advances in your GDI technology?

Early GDIs only measured gas levels and had no logging functions; readings had to be taken manually for reporting purposes. We have really moved up the technology curve since then. From 2000–2005, in the first step towards digitalisation, Schauenburg Systems produced a GDI with automatic logging capabilities which allowed data to be downloaded from the GDI onto a report. Mines were then able to retrieve and log information retrospectively about the occurrence of gases and their concentration levels in different locations and at different times underground during a shift.

#### Can you elaborate on your proximity detection monitors, lamp room management and asset management solution?

Trackless Mobile Machinery or TMM is a major cause of accidents underground – collisions between TMM, collisions with the rock mass and mine infrastructure, and collisions with workers.

Schaubenburg's proximity detection system or PDS minimises the risks associated with TMM operation by detecting the proximity of a TMM, mine workers and hazardous areas. When the interface is within a particular distance the TMM operator or mine employee receives a warning signal. In advanced applications a fail-safe mechanism shuts down the TMM engine when it is within the pre-configured proximity. The PDS system also offers automatic logging with a report download feature to enable retrospective safety management on mines.

Schaubenburg's lamp room management system logs data about the collection and testing of the functionality before use of GDIs and TMM caplamps by mine workers before going underground and the asset management system (AMS) that assists mines with their asset fleet management.

#### Do you have competition? What is your competitive advantage?

Although other companies have developed GDIs and PDSs most are non-scalable systems. Schauenburg offers modular solutions; our value proposition is the fact that our MIMACS – mine-wide integrated monitoring and control system – integrates data logging and management. This gives us a competitive advantage.

#### How does MIMACS give you a competitive advantage?

MIMACS is a data collection system that transmits all data from Schauenburg safety equipment to a central database via our standalone proprietary wireless networks. Data are transmitted from end devices or sensors to data-acquisition units, then onto the mine's network – a single database and a single reporting tool. MIMACS is an all-in-one software package suitable for lamp rooms, control rooms and mine management. It is a dashboard-based system that is easy to use and provides near real-time data on demand.

**If a mine wants to purchase MIMACS, do they have to purchase all your modules?**

A key feature of the MIMACS system is that it offers flexibility to the end user. It allows mines to use any of our modules as a standalone system or in various combinations. MIMACS is a very successful system; Schauenburg products are used in all mining regions in South Africa, especially in the hard rock underground mining environment.

**What is your growth strategy and is Africa on your radar?**

Schauenburg has identified coal mining, surface mining and the industrial sector as key markets for growth in South Africa. Mine legislation is a big demand driver for Schauenburg's safety solutions. In southern Africa the focus is on South Africa because mine health and safety legislation in most neighbouring countries does not necessitate implementation of our solutions.

Our strategy for other African markets is through obtaining strategic partnerships with large mine houses that implement our systems as part of their best practice. If legislation is amalgamated for other African mining countries it will create a potential market for our solutions.

**What are challenges you face in doing business in the South African mining industry?**

In older mines one of the implementation challenges is connectivity underground. Their ICT infrastructure is usually designed for voice analogue systems and the bandwidth is not suitable for data transmission. These mines have to install new infrastructure which escalates the costs of implementing our system.

A new challenge is that mines are demanding data from the underground faces to surface in real time. To achieve this our controllers and ICT infrastructure must be flexible and able to withstand the forces associated with blasting. Underground faces are dynamic and keep advancing as mining progresses and our infrastructure has to advance as well.

Change management is a challenge in the mining industry, especially when it comes to new technology. There is culture of being averse to change. To add to this the budgetary constraints as a result of the high cost nature of underground mining are a barrier to entry. However, the legislation enforcement initiatives of the Department of Mineral Resources necessitate implementation of our products and those of our competitors as part of best practice in the sector.

**Is there room for new entrants in the mining industry supply chain – foreign suppliers in particular?**

We believe there are opportunities in the South African mining sector for foreign suppliers. However, a major hurdle could be the rand-euro exchange rate; the weakness of the rand might make their products uncompetitive. Further, mining legislation is designed to promote local manufacturing and procurement spend is heavily skewed towards local suppliers. However, the niche product market is a potentially viable market entry point. Alternatively, a manufacturer (in partnership with a local business) can set up a local unit of their company to ensure compliance with the legislation and fall under the definition of a local supplier.

**What is your market penetration as a company and do you consider yourselves successful?**

With a presence in over 50 mine houses in South Africa and represented in all the mining sectors in the country, Schauenburg Systems is very successful. We entered the market with general technology products, identified niche markets in gas detection, lamp room management, asset management and proximity detection monitoring. We have adapted to the changing needs of the mining environment, invested in the necessary technology to remain competitive and lead the pack with our MIMACS system. It shows that with the right leadership and strategy, South Africa can be a successful destination for business.

## BASF

# CREATING CHEMISTRY

BASF is the largest chemical producer in the world. The BASF Group comprises subsidiaries and joint ventures in more than 80 countries and operates six integrated production sites and 390 other production sites in Europe, Asia, Australia, the Americas and Africa. Its headquarters are in Ludwigshafen, Germany. BASF has customers in over 190 countries and supplies products to a wide variety of industries.

### BASF in the mining value chain

One of BASF subsidiaries is Engelhard (Material Services). BASF is the world's leading supplier of catalysts with unsurpassed expertise in the development of emission control technologies for a wide range of market applications to protect the air we breathe. This expertise enabled BASF to pioneer the development of the first catalytic converter for automobiles in the 1970s and our line of emissions catalysts today.

### Product Portfolio



#### Catalysts for diesel engines

Emissions from diesel engines are of increasing concern to government regulators around the world. Cars, trucks and off-road equipment that run on diesel fuel are a source of harmful hydrocarbons (HC), nitrogen oxides (NOx) and particulate matter (PM) that pollute the air and are linked to respiratory diseases. BASF is the leading supplier of cost-efficient, effective diesel-emission-control technologies. Catalyst technologies for diesel engines include diesel oxidation catalysts (DOC), top left, ammonia oxidation catalysts (AMox), lean NOx traps (LNT) bottom left, catalysed soot filters (CSF), selective catalytic reduction (SCR), selective catalytic reduction on filter (SCRoF), multi-functional catalysed soot filters and retrofit solutions.



#### Catalysts for gasoline engines

The patented construction of BASF's three-way conversion (TWC) catalyst technology from precious metals (i.e. platinum, palladium and rhodium) enables it to significantly outperform conventional TWCs in the oxidation of hydrocarbons (HC) and carbon monoxide (CO). Using BASF's patented, segregated wash coat technology, this state-of-the-art platform technology precisely places the precious metals within the wash coat with several important benefits: Optimal use of precious metals, lower cost and higher effectiveness, and higher conversions of CO, HC and nitrogen oxides (NOx) over a wide range of conditions

#### Motorcycle and small engine catalysts

BASF's innovative and cost-effective catalyst solutions to control emissions from two- and four-stroke small engines are helping nations around the world meet the growing need to control air pollution from motorcycles, mopeds, scooters, and other small engines like lawn mowers, leaf blowers, edgers, trimmers and chainsaws.

By leveraging advanced materials and novel architectural designs, BASF catalyst technologies can meet motorcycle Euro 3 emission standards with low precious metal content, even for carbureted engines. BASF small engine catalysts are designed to cut pollution from two- and four-stroke engines that run on gasoline fuel. More than half of the hydrocarbon and carbon monoxide emissions from these engines can be eliminated in most applications.

## Sustainable development

BASF's mission is to contribute to a world that provides a viable future with enhanced quality of life for everyone by creating chemistry for our customers and society and by making the best use of available resources. We live our corporate purpose – 'We create chemistry for a sustainable future' – by sourcing and producing responsibly, acting as a fair and reliable partner, and connecting creative minds to find the best solutions for market needs.

### **THE ROLE OF BASF POST THE MARIKANA MASSACRE: BASF statement about enforcing compliance with the MPRDA**

Thursday, 16 August 2012, tragedy struck the South African mining industry in a way no one individual could have foreseen. The Marikana massacre has since become a gloomy example of what the outcome could possibly look like when employee concerns and disputes are not resolved.

#### **What happened?**

It is important to note that the Marikana protest was not an isolated incident. The Rustenburg area was rife with unprotected protest action months before the Lonmin employees took up the baton. January 2012, six months ahead of the Marikana massacre, 5000 Impala Platinum rock-drill operators (RDOs) engaged in an unprotected protest. Demanding a 200 percent wage adjustment, which most considered to be outrageous. The National Union of Mineworkers (NUM- at the time the only recognized union) failure to achieve their demands resulted in the election of independent committees to organise the remainder of the protest action. Generally unprotected protest action is met with refusal to engage on the part of the company until such time regulation lines of engagement have been followed. Impala Platinum initially stood their ground but ultimately they yielded and awarded the employees their requested wage increase.

This ultimately set the tone for the Lonmin protest. Five months later, once again lead by the RDOs, their demands were delivered to Lonmin's management. Following the Impala protest, Lonmin opted to negotiate with the RDOs outside the union. Lonmin's offer was intensely rejected to which Lonmin retracted their offer and further refused to engage outside of NUM. The RDOs elected independent committees and commenced with unprotected protest action in the days leading up to 16 August 2012. Protest action soon included employees beyond the parameters of RDOs. Not all of these participants were partaking willingly. It was reported that employees unwilling to stay away from work were intimidated into doing so. Falling victim to violent attacks on their way to work. There were reported incidences of attacks on and fatalities on the side of the protesters as well as mining security and even NUM officials. Finally, resulting in an eruption of violent tension as law enforcement opened fire on the protesters on 16 August 2012 killing at least 34 protesters.

#### **What were the actions taken?**

According to the South African Labour Relations Act in the event an internal agreement cannot be met by employer and employee a certificate of non-resolution is obtained from the Commission of Conciliation, Mediation and Arbitration (CCMA). It is with this certificate that employees can peacefully protest legally with both parties protected. In the event this regulatory process is not followed the protest is deemed unprotected and is thus illegal. Following this regulatory process is pivotal in offering both parties the opportunity to safely and effectively resolve disputes. For this reason, it is not considered to be best practice for an employer to engage with unprotected protesters.

The action taken by Lonmin was to engage with their employees in negotiation outside of NUM and a legal protest. Retracting their original offer and further refusing to engage without the presence of NUM representatives.

## Underlying issues

Below follows a number of underlying issues that may have altered a protest around a wage increase to fight for human rights fuelled by emotions.

### Lack of basic services

It is important to note that the employee plea to Lonmin was not limited to wage increases but deeply rooted in living conditions. For many living in the community basic services was a luxury. Potable water, electricity and a working sewage system is the minimum requirement from an employer when providing housing. These requirements were not met by Lonmin. Living in conditions of this nature is bound to have an effect on employees emotionally and psychologically. As Judge Ian Farlam put it "Lonmin's failure to comply with its housing obligations created an environment 'conducive to the creation of tension, labour unrest, disunity among its employees or other harmful conduct.'"

### Competitive salaries

The South African mining industry has been characterised by exploitation since the late 1800's. To this day the industry battles to shake this stigma. For this reason, it would be expected that Lonmin had kept their employee wages competitive with the international market. That was not the case regrettably. Although the RDOs requested a wage increase of 200 percent that would have taken them to R12 500 per month. Compared to the average Australian or British RDOs these employees would be earning between eight and ten times less than the foreign counterparts.

### Loss in confidence of union

NUM lost favour with the employees, not only those employed by Lonmin but among all protesting groups in the Rustenburg area. The reason being that according to the employees the representatives of NUM had lost sight of what their role was as the representative union. The employees were of the opinion that NUM had started siding with the mining companies. For them proof of this were in two major examples; the way communications were delivered. Language used was English and other local languages. Where in the past communications were carried out in Fanakalo, a language mix of a number of South African languages born in the mining industry and still spoken in the industry to this day. The second were that the NUM representatives were seen living in the suburbs rather than in the informal settlements similar to the employees. This coupled with the fact that Cyril Ramaphosa, the founder of NUM, at that point in time was a non-executive director of Lonmin was too much for the Lonmin employees to forgive.

## Prevention of future incidences through industry initiatives

### Steps taken by BASF

Following the Marikana incident BASF responded by stressing the importance of prioritising the legal obligation Lonmin has to improve living and working conditions. BASF not only drives the compliance of these obligations but are actively involved in doing so according to best practice. Partnering with other industry leaders, both South African as well as German, to adjust the auditing process of mining operations in South Africa was the first step in contributing constructively to comprehensive processes fit for numerous industries involved. In addition, Lonmin is required to comply with BASF's Supplier Code of Conduct and its policies related to human rights, labour and social standards as well as environmental protection. A continuous auditing process will ensure that this high standard BASF expects from its suppliers are continuously upheld.

Constant communication with various stakeholders including regional operators and NGOs guarantees progress as well as growth.

### Other industry initiatives

The International Finance Corporation (IFC) makes reference to living conditions in: *Performance Standard 2: Labour and Working Conditions*; advising that in the event a client/company provides accommodation that said client/company in the very least provides basic services. This includes electricity, potable water and sanitation. In addition to the IFC's best practice one can take into account the International Labour Organisation (ILO) Workers' Housing Recommendation. Here reference is made not only to the three basic serves as above but rather a number of standards that should be paid attention to, to name a few:

- Minimum space allocated between each individual;
- Appropriate protection against the elements, fire, animals and disease carrying insects;
- Adequate sanitary and washing facilities;
- Ventilation, cooking and storage facilities;
- Artificial and natural lighting;
- A minimum degree of privacy between individuals;
- Separate beds per worker in the event of single accommodation;
- Gender specific accommodation;
- Common dining rooms, canteens, rest and recreation rooms.

Reference is made to the management of worker accommodation impact on the greater community. For example, the potential impact on community health and safety or community cohesion. The list on what to consider when providing accommodation to workers has the potential to be endless. It becomes impossible to decide what would be the correct action to take. Ultimately when actions are driven by treating employees with basic respect for human life these decisions become less complicated.

Communication with all employees is not only best practice but is pivotal to building strong, lasting relationships. When lines of communication are blurred so are the lines of trust between employer and employee. As these employees form part of the surrounding communities as well a relationship based on trust and communication becomes a key ingredient in daily operations. It is in understanding this connection that one comes to the realisation that trusting lines of communication and strong relationships with these employees are crucial to a company like Lonmin's social license to operate.

## LANXESS

# ENERGIZING CHEMISTRY

Lanxess is a leading specialty chemicals company with about 15,400 employees in 33 countries and is represented at 60 production sites worldwide. The core business of Lanxess is the development, manufacturing and marketing of chemical intermediates, additives, specialty chemicals and plastics. As the only company in South Africa that handles the entire value chain, Lanxess mines its chrome ore at its Rustenburg mine to further process at its plants in Newcastle and Merebank in Kwazulu-Natal.

Lanxess Chrome Mine is located 7 km east of Kroondal and 11 km south-east of Rustenburg and falls within the Rustenburg Local Municipality of the North West Province.

The mine has been operational since 1958. Currently, only underground mining of chrome takes place at the site, but there are plans for open-cast operation. Chromite ore produced is processed at beneficiation plants on the operation.

Mine output is used in the ferrochrome industry and to produce chrome chemicals primarily as leather-tanning agents.

The current mining rights of Lanxess cover an area of 952.5 hectares (ha). The mine's mineral deposits occur within the Western Limb of the Bushveld Igneous Complex, which holds the majority of South Africa's chrome ore deposits.

### Mining activities

Mining is conducted using the bord-and-pillar method. The ore is broken underground and hoisted to the surface on conveyor belts. Proposed future mining activities will include expansion into the neighbouring Glencore underground areas (Mining Rights transferred in 2018) as well as the opening of an opencast mining operation (pit) within the existing LANXESS mining right area.

### Underground mining

Underground mining is undertaken using the standard bord-and-pillar system. The pillar dimensions and bord widths are such that a safety factor of 1.6 is maintained. Primary extraction is carried out using hand-held pneumatic drills to drill the faces and conventional explosives. Access to the underground chrome reserves is gained by means of surface declines that are developed from the reef outcrop. Run of mine (ROM) clearance is facilitated by a series of conveyor belts fed by underground load, haul, dump (LHD) loaders. It is calculated that the production rate will be 30,000 to 40,000 tons per month (tpm) with a total life of mine (LOM) of approximately 10 years, depending on mining volumes.

### Proposed opencast mining

Access to the shallow resource will be by an opencast pit cut 1,374 metres in strike length to a depth of between 50 and 70 metres below surface (MBS). After free digging up to 14 MBS, blasting will mine 100 x 300 metre blocks at 10 metre cuts using LHD loaders with excavators and dump trucks.

The opencast mining sequence will start on the eastern side of the proposed pit area and progress towards the west. The final void area will be at the western extent of the opencast pit. Waste rock and topsoil will be stockpiled separately to the south of the opencast area.

As opencast mining progresses, the voids created will be backfilled with overburden from the progressive Digby Wells Environmental 3 opencast mining, and then overlain by the various soil horizons and rehabilitated. The design of the high-wall has been adapted to fit the topography and crown pillar position with an angle of 60°.

Ore production rate is estimated to be 40,000 tons per month with a life of mine (LOM) of five years for the opencast pit.

## Processing

The processing plants treat LG6 ore to produce four chrome products by means of heavy medium separation (HMS) and gravity concentration. The HMS plant has a capacity of 3,600 tons per day and the gravity plant has a capacity of 1,800 tons per day. Products are sold to external clients. Chemical grade is also sold to other LANXESS business sites for production of chrome chemicals.

## Product portfolio

Lanxess produces four products: lumpy ore, metallurgical grade chrome ore, foundry grade chrome ore and chemical grade chrome ore.

- Lumpy (metallurgical) ore with a typical concentration of 38% – 41%  $\text{Cr}_2\text{O}_3$  and a specified size distribution is sold to the ferrochrome industry where it is processed with coal in an electric furnace to produce ferrochrome, the master alloy used to produce corrosion- and heat-resistant stainless steel.
- Metallurgical grade chrome ore (44% chrome) is sold to the local ferrochrome industry where it is processed together with coal in an electric furnace to form ferrochrome.
- Foundry grade chrome ore with a  $\text{Cr}_2\text{O}_3$  content of typically 46.5% and a strictly specified grain size distribution is used to manufacture casting moulds in foundries. The same material is also used to produce refractory materials; and
- Chemical grade chrome ore with a typical  $\text{Cr}_2\text{O}_3$  content of 46% is the raw material for the production of sodium dichromate the main constituent of all chrome chemicals. Sodium dichromate is processed by LANXESS in its other operations (chemical plants), and is used, for example, as a leather-tanning agent.

LANXESS produces approximately 1 million tons of ROM per year – approximately 600,000 tons of finished product per annum. 29% of production is lumpy, 75% foundry sand, 25% chemical grade and 39% metallurgical concentrate.

## Legal context

Lanxess has to comply with the full prescripts of the MRPDA, the MHSA, NEMA and the Water Act.

## World-class safety performance

Lanxess mine achieved a 0.00 lost time injury frequency rate (LTIFR) and a 0.00 reportable injury frequency rate (RIFR) for the first quarter of the year. The last reportable injury was in November 2018. The Department of Mineral Resources (DMR) has identified Lanxess chrome mine – which currently boasts 150 LTIFR-free days – as the safety leader in chrome production in South Africa's North West Province.

## Fatality and injury frequency rates

Fatality frequency rate (FFR) and lost time injury frequency rate (LTIFR) are lagging indicators of safety performance in mining. They are calculated per million man-hours worked using a rounded-off conversion factor of 2,200. Mines do not report on the actual hours worked: the assumption is that each person works an average of 45 hours per week for 48.9 weeks per annum. The formula for the annualised rate is:

$$\text{Fatality/injury rate} = \left\{ \frac{\text{Number of fatalities/injuries for calendar year}}{(\text{Number of persons at work} \times 2\,200)} \right\} \times 10^6 \text{ hours}$$

A comparison of LANXESS Chrome Mine with South African mining industry averages and chrome industry averages is presented in the following tables.

Year	Fatality Frequency Rate (FFR)		
	Lanxess	SA mining industry average	Chrome industry
2015	0.00	0.08	
2016	0.00	0.08	0.03
2017	0.00	0.09	0.03
2018	0.00	0.09	

Year	Lost Time Injury Frequency Rate (LTIFR)		
	Lanxess	SA mining industry average	Chrome industry
2015	1.57		
2016	0.96	2.98	1.73
2017	0.24	2.75	0.8
2018	1.06	0.09	

### Community engagement (MPRDA compliance)

The total budget for community commitments under Lanxess Chrome Mine's last social and labour plan (SLP) which ended on 31 March 2018 exceeded R12 million. The new SLP is under consideration for approval by DMR for the new SLP (SLP2) document 2018–2022 SLP (Mining Charter).

Under the previous SLP, Lanxess Chrome Mine had three projects – one enterprise development project and two infrastructure projects. The library and garment factory projects were completed by 31 March 2018. Thekwane Clinic Section 102 has been approved by DMR.

Project	Focus Area	Status	Budget	Action Plan
Library	Thekwane	Overall project 98% complete.	Budget: R8m, Spent: R7.7m	Construction complete, shelves and burglar-proofing installed, furniture delivered. Awaiting certificate for electrical power supply.
Garment Factory	Photsaneng	Overall project 98% complete.	Budget: R1 million (SLP 2 Training budget), Spent: R800k	Building renovation is complete. Keys handed-over to LCM. Fencing and partitioning completed. Machinery purchased. Relevant stakeholders for technical training and beneficiary nomination were engaged; awaiting training candidates.
Thekwane Clinic	Photsaneng	Project has just started.	Budget: R7 million Phase 1: R4.1 million Phase 2: R2.9 million (SLP 2) S102 approved from DMR.	Drawings were approved by Royal Bafokeng Authority in December 2018. Procurement busy with the PO process. Awaiting SLP approval to begin construction.

## MINES RESCUE SERVICES SOUTH AFRICA

The depth of South African mines compounds stresses underground, an added risk in an already dangerous sector. In 2018, Mines Rescue Services (MRS) South Africa attended to eight seismic-related emergencies; 148 rescue teams were deployed to recover 33 persons and rescue 15.

MRS South Africa has more than 95 years of experience. MRS has attended to 2,000 underground fires in the last 30 years – an average of 66 fires a year – and has deployed more than 16,000 rescue teams. In the last five years MRS has rescued over 1,300 people from underground fires.

MRS South Africa looks after more than 100 mines to ensure they have well-prepared emergency response teams – more than 900 MRS team members are available in an emergency.

MRS strives to keep abreast of new developments in the field of mine rescue operations and has established good relationships with similar organisations internationally and locally in forums where MRS can share its knowledge of the challenges of the unique South African mining environment.



57

### HLOBANE COLLIERY EXPLOSION

September 1944  
57 workers killed

### COALBROOK MINE COLLAPSE

January 1960  
435 workers died  
after being trapped  
underground

435

64

### HLOBANE COLLIERY EXPLOSION

September 1983  
64 workers killed

177

### KINROSS GOLD MINE FIRE

September 1986  
177 workers killed

53

### MIDDELBULT COLLIERY EXPLOSION

May 1993  
53 workers killed

# MINES AND MINING IN SOUTH AFRICA

Although gold, diamonds, platinum and coal are the best-known of the minerals and metals, South Africa also mines chrome, vanadium and titanium, among others. The mining sector's share of the South African economy is estimated at 7% of its gross domestic product (GDP). For many years, South Africa was the world's primary gold producer but shrinkage of the industry has changed this footprint and today it accounts for only 4.2% of global gold production.

In 2017, the South African coal industry employed 83,000 people – about 17% of total employment in the mining sector – and produced some 252 million tons of coal. Platinum is found in the South Africa's Bushveld Complex, which hosts approximately 90% of the world's PGM-bearing ore.

The first diamond discovered in South Africa, appropriately named Eureka, was found near Hopetown in 1867 – it weighed 21.25 carats. The largest diamond discovered was the Cullinan found at the Premier Mine in 1905 – it weighed 3,106 carats, uncut. In 2017, South Africa produced 9.7 million carats (Mct) of diamonds.

South Africa hosts the world's largest gold resource – the Witwatersrand Basin. Goldfields-operated South Deep mine in South Africa is the second largest gold mine in the world and AngloGold Ashanti's Mponeng is the tenth largest.

South Africa also hosts eight of the world's ten deepest mines. Reefs are at depths of 3,000 to 4,000 metres and in some cases need three shaft systems – main-, sub- and tertiary shafts.



## DRÄGER

# PROTECTING, SUPPORTING AND SAVING LIVES

Dräger is an international leader in the fields of medical and safety technology founded in 1889. Dräger products protect, support and save lives. They have product ranges for the hospital industry, fire services, chemical industry, oil and gas industry, mining, and water treatment and also offer safety services.

## DRÄGER IN THE MINING INDUSTRY

For generations, miners have relied on Dräger's safety equipment and products for protection. Dräger's technical solutions are components of an integrated safety concept dedicated to improving mine safety – from respiratory protection and gas detectors for everyday workplace safety to self-contained self-rescuers and refuge shelters for emergency situations.

The close relationship Dräger has with the mine rescue community dates back to 1904 with the development of Model 1904/09, the world's first closed-circuit breathing apparatus, which allowed mine rescue teams to extend their mission time dramatically in the pursuit of saving lives.

Did you know that Dräger products are used at almost every stage of the value creation chain, in all work areas, from production to processing, above and below ground, when mining coal, ores or minerals? Dräger has expert knowledge in the area of ventilation and mine safety, in occupational health and safety, and in emergency planning and mine rescue.

### Our century of experience matters

There are few industries in which safety plays such an important role as in mining. Every step must be carefully planned and every decision is critical to ensure efficient and safe mining operation. For generations, miners have relied on Dräger to provide quality products to protect their lives.

The history of Dräger and mine rescue date back to 1903 when Bernhard Dräger devised the first breathing apparatus during a physiological self-test after the mine disaster in Nova Scotia, Canada. The first documented application of oxygen rebreathers, the Dräger breathing apparatus, for work and rescue in the mining industry was during the devastating mine disaster in 1906 in Courriers, France. The new possibilities offered by Dräger's breathing apparatus paved the way for the emergence of a completely new profession mine rescue. In North America, mine rescuers are called 'Drägerman', even today.

The further development of breathing apparatus for the mining industry was represented by the Dräger Model 1924, which dominated the market for over ten years with its long duration breathing protection for up to two hours. In 1963, the Dräger BG 174 was introduced and has been used for over 40 years in underground mine rescue. Today, mine rescue teams in different parts of the world are equipped with the new generation of close circuit breathing apparatus – the Dräger PSS BG4 plus, which has been developed and constantly improved to provide the best breathing protection and comfort for up to four hours.

Dräger is proud to have played a role in creating mine rescue history with these products. To stay abreast of the evolving requirements in today's complex work environment, Dräger supplies a broad spectrum of safety equipment – from respiratory protection and gas detection for daily operational safety to self-contained self-rescuers and refuge shelters for emergency situations. All these products can be combined and used as an integrated safety concept to improve mine and workplace safety. In addition, Dräger also offers a selection of professional service and support programmes, from product maintenance and inspection to training courses, to meet individual customer's needs. The importance of Dräger can be associated with Mines Rescue Services South Africa who have been using Dräger equipment for their emergency teams for nearly 40 years. The Dräger PSS BG4 plus is used for every emergency operation performed by Mines Rescue.

The Dräger PSS BG4 plus is a vital tool for the safeguard of all Mines Rescue Team Members ensuring the successful outcome of all missions.

## PRODUCTS AND SERVICES

### Occupational health and safety

The many guidelines for occupational safety and health in the mining industry have led to a significant reduction of many risks and hazards. In the same way, modern mining can now utilise innovative detection technology as well as effective personal protective equipment (PPE). Warning employees about exposure to hazardous substances such as toxic dust, diesel emissions, and blast emissions, and protecting them from such hazards is extremely important as is an emergency alarm in the event of a fire, gas outburst, or failure of the ventilation system.

#### Occupational safety



**Dräger X-plore® 1700** (top left) makes breathing easy and comfortable. The CoolSAFETM filter material ideally combines low breathing resistance and high filter performance in one mask and the CoolMAX™ valve efficiently releases humid and warm exhaled air to the outside. This makes breathing particularly easy and keeps users cool under the mask.

The **Dräger X-am® 5000** (top right) belongs to a generation of gas detectors developed especially for personal monitoring applications. This 1- to 5-gas detector reliably measures combustible gases and vapors as well as oxygen and harmful concentrations of toxic gases, organic vapors, Odorant and Amine.

The **Dräger X-am® 8000** (left) 1 to 7 gas detector detects all toxic and flammable gases, vapours and oxygen simultaneously – in pump or diffusion mode. Innovative signalling design and handy assistant functions ensure complete safety throughout the process.

#### Handling hazardous substances

The **Dräger X-plore® 9000** supplied-air system (below) is designed for light duty industrial applications that require an independent air supply. This modular system provides comfortable and reliable respiratory protection in accordance with EN 14594:05.

Chemical protective suits like the **Dräger SPC 3800** are used to protect a person's skin from the harmful effects of hazardous liquids. If there is a risk that the entire body may come into contact with solid or liquid chemicals, complete coveralls are the only way to ensure full protection.



## Ventilation and plant safety

### Mine ventilation



The **Dräger X-dock®** series provides full control of portable Dräger gas detection instruments. Automatic bump tests and calibrations with reduced test gas consumption and short testing times save time and money and comprehensive documentation and evaluations provide a clear overview.



The **X-am 5600** is Dräger's smallest gas detection instrument and can measure up to six gases. Ideal for personal monitoring applications, this robust and water-tight detector provides accurate, reliable measurements of explosive, combustible and toxic gases and vapours, as well as oxygen.

### Area monitoring



The **Dräger Polytron® 7000** (left) gas detector satisfies all toxic and oxygen gas measurement applications on a single platform. It meets the requirements of the compliance market as well as the high-specification requirements of customised solutions.

The **Dräger X-zone® 5500** in combination with the Dräger X-am® 5000, 5100 or 5600 gas detection instruments can measure up to six gases and extends portable gas detection technology to a comprehensive system with many applications.



The **Polytron® 8100 EC**, Dräger's top-of-the-line explosion-proof transmitter for detection of toxic gases or oxygen, uses a high-performance plug-and-play electrochemical DrägerSensor® to detect specific gases. It offers 3-wire 4 to 20 mA analogue output with relays as well as Modbus and Fieldbus protocol, making it compatible with most control systems.

The **Dräger REGARD® 7000** is modular and therefore highly expandable analysis system for monitoring various gases and vapours. Suitable for gas warning systems with various levels of complexity and numbers of transmitters, it also features exceptional reliability and flexibility. An additional benefit is backwards compatibility with the REGARD®.

## Fire protection: Thermal imaging



The **Dräger Flame 3000** is an imaging-based explosion-proof flame detector. This visual flame-detection system uses digital image processing and advanced algorithms to process and interpret flame characteristics. This principle offers an extended field of view and fewer false alarms.

## Emergency escape



The **Dräger Saver CF** (left) constant flow emergency escape breathing apparatus allows safe, effective and uncomplicated escape from hazardous environments. Simple to put on and featuring practically automatic operation, this hood-based, positive-pressure breathing device can be used with minimal training.

The combined fire and industrial escape hood **Dräger PARAT® 7500** (right) developed in collaboration with users, focuses on the fastest possible escape. Optimised operation and comfort, a robust housing and a tested ABEK CO P3 filter ensure protection from toxic industrial and fire-related gases, vapours and particles for at least 15 minutes.

Operating independently from ambient air and designed to withstand the harshest conditions, the **Dräger D-7000 Quick Fill Station** enables miners and site personnel to safely escape from an underground emergency or enhance the capabilities of underground firefighting teams. The filling panel allows up to six SCBA sets to be filled simultaneously and independently. The unit is simple and intuitive to use even in low visibility or smoke-filled environments.



The **Oxyboks K 35 A** Oxygen Self-Rescuer was developed for applications involving difficult working conditions, and to provide personal protection in an emergency, for use in mining, tunnel-rescue and shipping. It is carried by the user at all times and is intended for self-rescue, for example, when working underground or in enclosed spaces. It can be carried on the user's belt without impeding normal activity, thanks to the ergonomic design of the carrying case. The fact that the self-rescuer is worn at the head in case of application means that users can move freely even when narrow and low openings make an upright stance impossible.

In an emergency, Dräger-Simsa mine refuge chambers such as the **Dräger MRC 5000** (right) provide mining personnel with shelter and breathing protection at the highest quality and safety standards.

The robust and highly portable construction, as well as low cost of maintenance, makes them ideally suited for diverse underground conditions.



## Emergency response and rescue



Designed especially for tough missions, the **Dräger PSS® BG 4** plus closed-circuit breathing apparatus combines uncompromising safety with the highest level of breathing and carrying comfort. The positive pressure unit supplies the wearer with up to four hours of breathing air, even in toxic atmospheres.



The **Dräger FPS®-COM 5000** communication unit was developed for the full-face mask, Dräger FPS® 7000, and ensures clear communication through a voice amplifier unit or radio device – even under extreme conditions.



The **Dräger HPS® 7000** firefighter's helmet is in a class of its own, thanks to its innovative, sporty and dynamic design, ergonomic fit and components which make it a multifunctional system solution. It provides optimum protection during every operation.



Developed by professionals for professionals, the **Dräger PSS® 7000** breathing apparatus is a major milestone in our continuing development of breathing devices for the professional fire-fighter.

The **Dräger Mine Rescue Vehicle (MRV) 9000** (below) is the answer in an ever-changing mining environment. This robust vehicle extends the mission time for mines rescue teams by providing safe transportation closer to the incident. Innovative and customer driven – this Mine Rescue Vehicle is a unique solution in the field of mine rescue worldwide.

Tailor-made for use under extreme conditions: The gas-tight **Dräger CPS 7900** (right) provides protection against industrial chemicals, biological agents, and other toxic substances. Its innovative material qualifies the CPS 7900 equally well for work in explosive areas and for handling cryogenic substances.



# NEW ENERGY FOR NEW MARKETS

**'Access to energy is fundamental to the struggle against poverty. Without energy, there is no economic growth, there is no dynamism, and there is no opportunity.'**

*Rachel Kyte  
CEO, Sustainable Energy for All*

**The German Chamber supports pilot projects and partnerships like B4i Energy Projects, SkyVault Africa, Umbono, and PECO and context-specific technology developed by leading engineers and local universities to aid the leap to powering and transforming the lives of those who live outside the national grid.**

**Power-poor areas in cities like Johannesburg, which has more than 180 informal settlements and over 500,000 households, could access energy in this way.**

Informal settlements often mushroom on the periphery of mineral developments or in mining lease areas because of an influx of local and transnational migrants seeking job and business opportunities. These settlements are usually off national water, electricity and road networks and access to electricity is non-existent, intermittent or obtained via illegal connections.

Energy poverty – lack of access to a safe energy supply – is to blame for many dangers and health risks. According to the World Health Organization (WHO), 3.5 million people die each year from respiratory illness caused by indoor pollution from wood and biomass cook stoves. Paraffin, a commonly-used cooking fuel in South Africa, is also a major cause of fire – according to Stats SA there is an average of 10 shack fires a day in South Africa. Informal settlements are also poorly lit, which enables crime.

Although electrification is one solution, the investment and planning needed to connect off-grid settlements to electricity networks is huge, and lead times could run into decades. In mining areas costs are compounded by the remoteness of some mine sites and other economic considerations.

The SA-German Chamber of Commerce and Industry has researched alternative energy solutions through the Competence Centre for Mining and Mineral Resources and has identified solar (DC power in particular) as a potentially viable and economical solution to the energy poverty found around mine sites.

## **B40i and small-scale generation**

B40i's New Energy for New Markets is a cost-effective way to achieve this. Small-scale distributed electricity generation based primarily on solar-photovoltaic power (mini- or micro-grids) is a leapfrog technology that can help developing regions bypass the need for national grids.

This clean disruption movement depends on new technology. German Companies like Infineon, Würth-Elektronik, and Neosid are leaders in manufacturing, management, control and distribution of energy in this need economy. Until recently funding came primarily from development aid, but commercial business and social entrepreneurs have begun to fund, sell and install solar panels and batteries and pumps, refrigerators, grain mills, and other appliances and tools enabled by off-grid energy solutions.

Viable commercial markets in the new-energy space for indigent communities requires solutions to difficult problems like reducing the cost of hardware and technology, locating off-grid solutions with productive demand for energy to ensure a strong and predictable revenue stream and stimulating and managing demand and access with local ownership of infrastructure.

These problems can be addressed with ingenious and disruptive partnerships, context-specific technology and asset-based community development methodologies. The ultimate goal is successful handover of a profitable business model to private-sector black entrepreneurial enterprises that can scale rapidly with access to start-up support and funding.





**CHAPTER 4**  
**BEST PRACTICE INITIATIVES:**  
**MINERALS COUNCIL**  
**SOUTH AFRICA**

# SAFETY PERFORMANCE TRENDS:

## SOUTH AFRICAN INITIATIVES TO IMPROVE OCCUPATIONAL HEALTH AND SAFETY PERFORMANCE IN THE MINING INDUSTRY

SIZWE PHAKATHI, Minerals Council of South Africa

KATLEGO LETSOALO, Vice Chairperson, Young Professionals Council, SAIMM

**The South African mining industry has instituted a variety of programmes over the past two decades to improve occupational health and safety (OHS) in mining operations. Initiatives introduced since the advent of democracy in 1994 to improve OHS performance, by industry stakeholders from business, government and organised labour, are presented here.**

In the mid-1990s, South Africa's first democratically elected president, Nelson Mandela, commissioned an inquiry into OHS in the South African mining industry. The Leon Commission was established following the 1995 Vaal Reef disasters.<sup>20</sup> The commission resulted in the enactment of the Mine Health and Safety Act (MHSA), 1996, which today governs occupational health and safety in the South African mining industry.

The MHSA is based on an outcomes approach guided by risk assessment and risk analysis.<sup>21</sup> One of its features is the granting of rights to employees regarding occupational health and safety, for the first time in the history of the South African mining industry.

A formalised tripartite structure – the Mine Health and Safety Council (MHSC) – was established in 1998 to ensure alignment of government, business and labour. Its mandate includes advising the Minister of Mineral Resources on OHS issues, reviewing and developing legislation, recommendations to the minister, promoting OHS, liaising with other bodies concerned with OHS and overseeing research into OHS in the mining industry.

### 10-year health and safety milestones

In 2003, the tripartite stakeholders agreed on a first set of 10-year milestones to accelerate the reduction of occupational injuries, fatalities and illnesses in the South African mining industry. These milestones entailed benchmarking the OHS performance of the South African mining industry against that of other mining countries across the globe, including Australia, Canada and the United States.

<sup>20</sup> <https://www.mineralscouncil.org.za/special-features/113-we-remember-vaal-reefs>

<sup>21</sup> M Hermanus, et al. 2015. Mine Occupational Safety and Health Leading Practice Adoption System (MOSH) examined – the promise and pitfalls of this employer-led initiative to improve health and safety in South African Mines



The Minerals Council South Africa (Minerals Council) is a mining industry employers' organisation that supports and promotes the South African mining industry. The Minerals Council serves its members and promotes their interests by providing strategic support and advisory input.

A key role of the organisation is to facilitate interaction among mining employers to examine policy issues and other matters of mutual concern to crystallise and define desirable industry standpoints.

A variety of initiatives are in place to promote collaboration between members. Consultation and collaboration are voluntary and never encroach on the autonomy of members.

The Minerals Council also acts as a principal advocate for mining in South Africa to government, communicating major policies endorsed by its members. A further vital function of the organisation is to represent some sectors in collective bargaining with organised labour.

[www.mineralscouncil.org.za](http://www.mineralscouncil.org.za)



**MINERALS COUNCIL  
SOUTH AFRICA**

To this end, the industry sought to achieve levels of OHS performance comparable with those of international benchmarks by the year 2013. It set its target at reducing fatalities annually by 20 percent.

In 2008, a tripartite summit of industry stakeholders from government, business and organised labour noted that the number of fatalities, injuries and illnesses was not decreasing at the desired rate. Industry stakeholders developed a Tripartite Action Plan and the Chamber of Mines established the Mining Occupational Safety and Health (MOSH) Learning Hub.

### **The Mining Occupational Safety and Health (MOSH) Learning Hub**

The MOSH Leading Practice Adoption System is a people-centric initiative – for industry by industry – with high-level involvement of organised labour at all levels. The main purpose of MOSH is to identify and facilitate the adoption of leading occupational health and safety practices in four risk areas, namely, dust, noise, transport and machinery, and falls of ground.

Key MOSH principles include:

- Objective investigation of available leading practices.
- Reasonable steps to address risks related to dust, noise, falls of ground, transport and machinery.
- An understanding by leadership at all levels of what they must do to enable and lead sustainable adoption (appropriately included in their performance contracts).
- Early and effective involvement of those affected by adoption.
- Adequate training, technical support and explicit financial resources for adoption.
- Monitoring of progress with the adoption and sustained monitoring of its impact through self-assessment and independent verification.

### **The Mining Charter and a Culture Transformation Framework (CTF) for the mining sector**

In 2010, following a review of the broad-based socio-economic empowerment charter for the mining industry (the Mining Charter), OHS was included in the sustainable development elements of the Mining Charter.

At the tripartite Mine Health and Safety Summit on 18 November 2011, industry stakeholders approved the Culture Transformation Framework (CTF) for the South African mining sector. The backdrop for this culture-change initiative was an understanding of the impact of the underlying social, psychological, behavioural and human factors on the health and safety of employees.

Industry stakeholders recognised that the industry focus had for many years been on technical and engineering controls rather than addressing behavioural and cultural factors that influence OHS performance.

The CTF was established to transform the culture of health and safety in the workplace through effective management of behavioural risks. Research conducted by the MHSC in 2010 concluded that there is a significant relationship between organisational culture and OHS (MHSC, 2010). The CTF consists of eleven pillars, of which five have since 2012 been prioritised for implementation by the tripartite stakeholders – employers, organised labour and government. Table 1 outlines the prioritised pillars, their objectives and the roles and responsibilities of stakeholders.

**Table 1. Prioritised pillars of the Culture Transformation Framework (CTF)**

<b>CTF pillar</b>	<b>Intended objective</b>	<b>Responsible stakeholder</b>
Leading practices	Common approach to identifying and facilitating the adoption of leading OHS practices and research outcomes	MHSC, Chamber of Mines and Government
Risk management	Eliminate risks at their source and investigate root causes	Individual mines, holding companies, organised labour, Chamber of Mines and Government
Leadership	Lead by example and walk zero harm	All stakeholders
Bonus and performance system	Prioritise Zero Harm over production	Holding companies, organised labour and Chamber of Mines
Elimination of discrimination	No racism, gender bias or any form of unfair discrimination	Individual mines, holding companies, organised labour, Chamber of Mines and government



### The CEOs Elimination of Fatalities Team

In 2012, the Minerals Council South Africa established the CEOs Elimination of Fatalities Team – renamed the CEO Zero Harm Forum – to acknowledge the importance of leading by example and OHS leadership.

The first safety focus area of the team was Falls of Ground (FOG), historically the greatest contributor to fatalities, with 40 fatalities during the previous period. It was encouraging that the focus on Falls of Ground contributed to a 50% reduction in FOG fatalities in the first year.

The CEO Elimination of Fatalities Team continues to lead health and safety and share experiences from the top to effectively address the key health and safety challenges. The objectives of this CEOs forum are to:

- Develop a model for industry leadership at CEO level.
- Model leadership behaviours to demonstrate commitment and expectations.
- Share experiences and help each other deal with and solve key challenges.
- Establish working protocols with industry stakeholders and community.
- Monitor and agree on adjustments to industry models to suit needs.

## 2024 OCCUPATIONAL HEALTH AND SAFETY SUMMIT

### OBJECTIVES AND MILESTONES

#### Eliminate fatalities and injuries

Every fatality is one too many: we will **eliminate fatalities by December 2020**.

Every mining company to have a target of zero fatalities.

Up to December 2016, **20% reduction in serious injuries** per year.

From January 2017, **20% reduction in Lost Time Injuries (LTI)** per year.

#### Eliminate occupational lung diseases

**Eliminate silicosis:** By December 2024, 95% of all exposure measurement results will be below the milestone level for respirable crystalline silica of 0.05 mg/m<sup>3</sup>

**Eliminate pneumoconiosis:** By December 2024, 95% of all exposure measurement results will be below the milestone level for platinum dust respirable particulate of 1.5 mg/m<sup>3</sup>

**Eliminate coal workers' pneumoconiosis:** By December 2024, 95% of all exposure measurement results will be below the milestone level for coal dust respirable particulate of 1.5 mg/m<sup>3</sup> (<5% crystalline silica)

*Results based on individual readings, not averages*

#### Eliminate noise-induced hearing loss

**Through quietening of equipment:** By December 2024, the total operational or process noise emitted by any equipment must not exceed a milestone sound pressure level of 107 dB.

**For the individual:** By December 2016, no employee's Standard Threshold Shift (STS) will exceed 25 dB from the baseline when averaged at 2,000, 3,000 and 4,000 Hz in one or both ears.

# 2024 OCCUPATIONAL HEALTH AND SAFETY

## PLEDGE AND ACTIONS

### Tripartite visible felt leadership and relationship building

Principals and leaders of all stakeholder groups commit to a **minimum of two facilitated H&S sessions** a year.

**Representation by:** union presidents and general secretaries, DMR minister and deputy minister, director general, CIM, principal inspectors and mine CEOs.

### Amend the trust deficit

Address the trust deficit between stakeholders and shift from a transactional to a transformative approach.

### Communication

Commit to improving communication across all levels to ensure that the message of Zero Harm reaches all mine employees and contractors, and in so doing support and transmit actions intended to improve OHS.

### Empower supervisors and employees

Collectively and collaboratively empower supervisors, health and safety representatives and employees through extended visible felt leadership and empowering conversations. This will be implemented by employers and stakeholders from organised labour, Government and MHSC.

Empower women in mining especially with regard to safety and security, personal protective equipment and hygiene issues.

### Host annual company health and safety days

Each mining company will commit to hosting an annual health and safety day tailored to their respective needs as part of their overall health and safety campaigns.

## 2024 milestones

In November 2014, industry stakeholders held the Mine Health and Safety Summit to review the OHS performance of the mining sector and agreed on a new set of 10-year milestones with clear roles and responsibilities for each stakeholder to ensure that every mine-worker returns from work unharmed every day.

The 2024 milestones are geared towards accelerating the industry's journey to zero harm. The following commitments were made at the 2014 Summit:

- Elimination of fatalities and injuries.
- Rehabilitation of mine workers injured in the line of duty.
- Elimination of occupational lung diseases including silicosis, pneumoconiosis and coal workers' pneumoconiosis.
- Elimination of noise-induced hearing loss.
- Reduction and prevention of tuberculosis, human immunodeficiency virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) infections, in line with the National Strategic Plan.
- Integration and simplification of compensation systems.
- Implementation of the approved CTF, including a programme to deal with concerns on Women in Mining and the Rights of Workers.
- Launching and implementing the Centre of Excellence that will focus on research and capacity building of mineworkers.

Stakeholders at the 2014 summit agreed that even one fatality was one too many and that the industry should not attach targets to fatalities. This signalled a morally conscious and caring industry.

Stakeholders also acknowledged that occupational injuries were still a challenge and agreed that the industry needed to reduce injuries annually by 20% (including lost time injuries [LTIs]). Stakeholders expressed concern about the slow or lack of progress on reducing occupational lung diseases caused by dust and hearing loss from excessive noise. The graphic summarises the milestones agreed upon at the 2014 Summit on Mine Health and Safety.

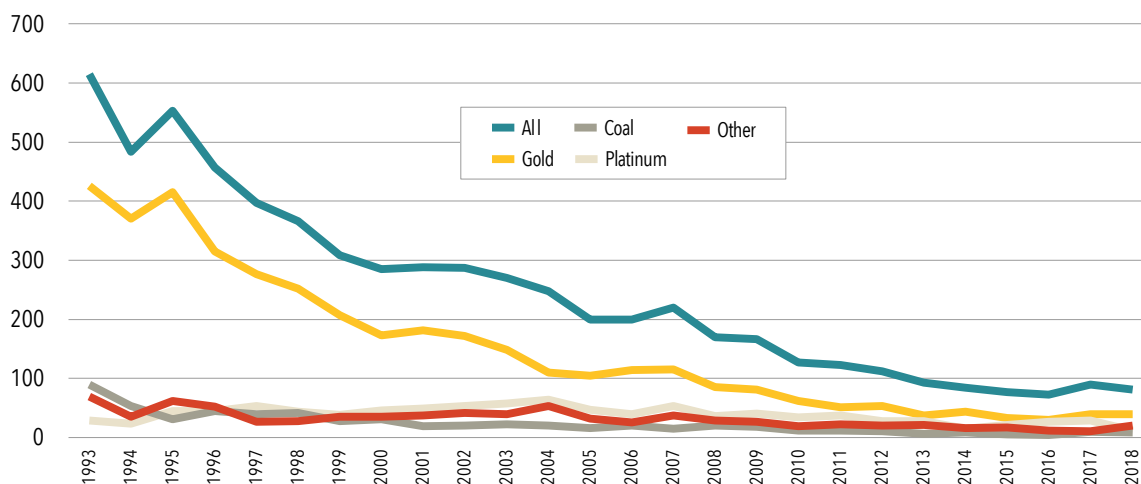
In November 2016, the MHSC and its tripartite stakeholders held the biennial Mine Health and Safety Summit to review progress on implementation of the milestones, targets and actions of the 2014 Summit.

The MHSC was mandated to develop actions as part of a pledge signed by stakeholders. CEO Zero Harm Task Team members and the Minerals Council approved the declaration of actions before signing the pledge. Presented in Table III is the declaration of actions (the pledge) signed by the tripartite stakeholders at the summit.

The objective was to reinforce tripartism; raise the bar on tripartite visible felt leadership, as per the CTF; to harness the achievement of the 2024 milestones; and, accelerate achievement of the industry goal of zero harm.

## Progress and successes

A highlight of the industry's journey to zero harm since the advent of democracy has been the collaboration of stakeholders from government, business and organised labour. Through the tripartite institution, the MHSC, industry stakeholders have collectively contributed to the improving the industry's OHS performance over the past two decades. Implementation of various OHS initiatives has significantly reduced the number of fatalities and injuries in the sector, as shown in Figure 1.

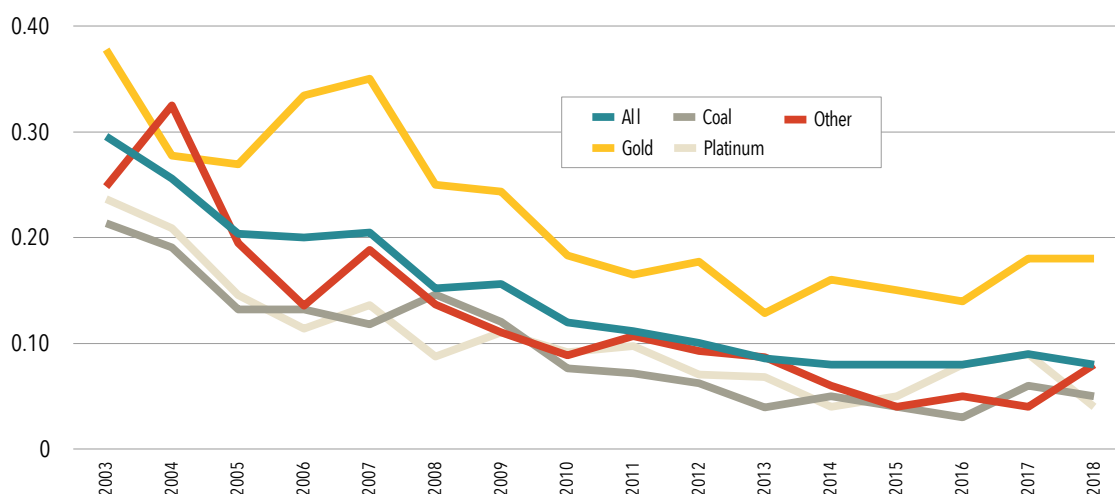


**FIGURE 1.** Number of fatalities by commodity. 'Other' includes diamonds, chrome, copper and iron ore. 'All' includes those not specified here.

In the last 25 years there has been an 87% reduction in the number of fatalities from 615 in 1993 to 81 in 2018. In 2017 and 2018, however, we started to see a reversal of the trend – a matter of deep concern to the mining industry and the Minerals Council.

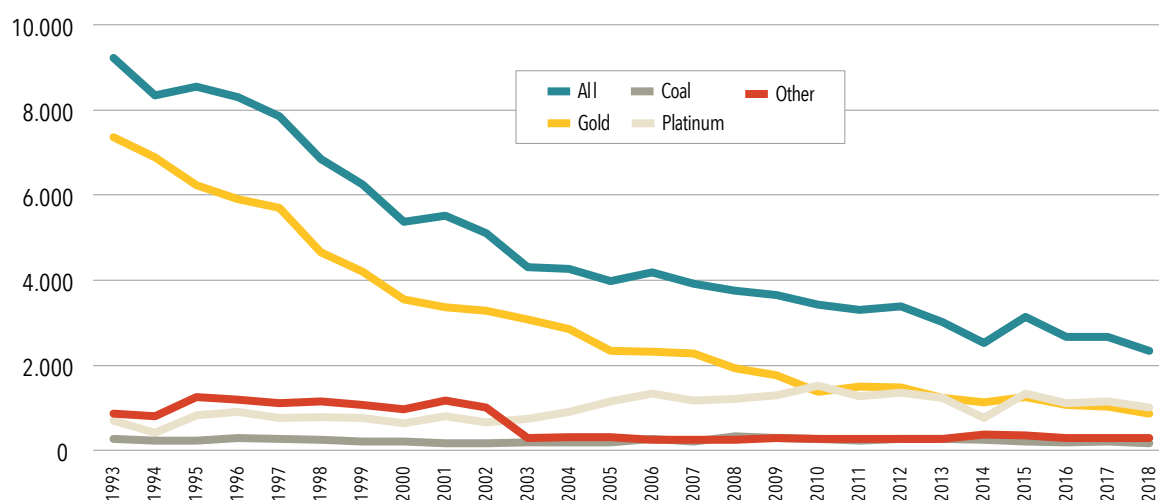
We share the loss of those families and feel the grief and concern of all mining industry stakeholders and society-at-large. We remain resolute in our determination to work collaboratively to find a solution to this problem.

The Minerals Council and its member companies convey their deepest sympathy to the families, friends and communities of the deceased miners and remains committed to the industry goal of zero harm in which every mine worker returns from work without harm every day.



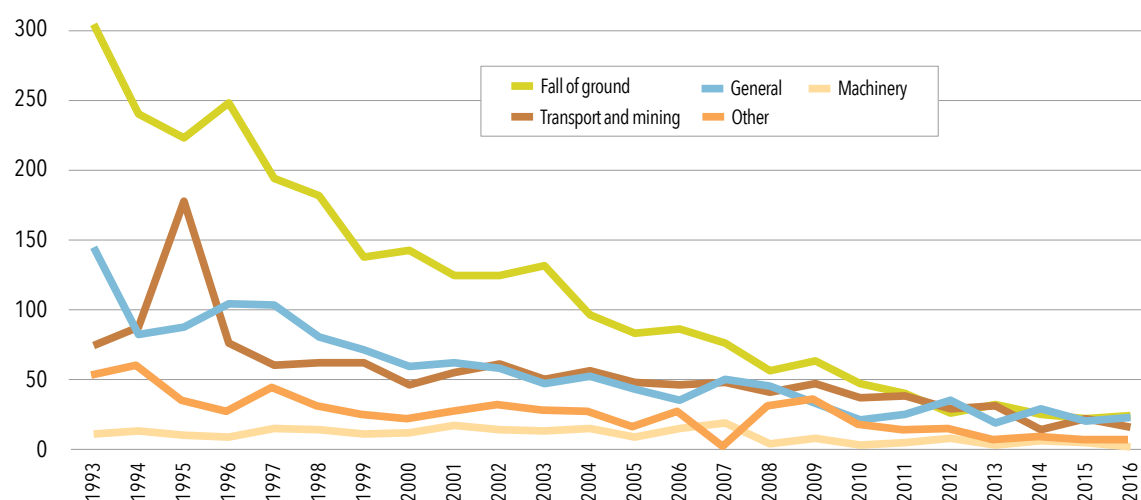
**FIGURE 2.** Fatality frequency rate by commodity, 2003–2018.

In 2016, there was a decrease in the number of serious injuries of 476, from 3,138 in 2015 to 2,662, a reduction of 15% (see Figure 3).



**FIGURE 3.** Number of serious injuries by commodity, 2003–2018

Progress in the reduction of major causes of accidents has also been realised in recent years. Initiatives such as the adoption of the MOSH leading practices and the focus of the Minerals Council’s CEOs Zero Harm Forum have contributed to reduction of fatal risks. However, this does not mean that fall of ground and transport risks no longer pose a serious challenge to the industry’s OHS performance, as seen in Figure 4.



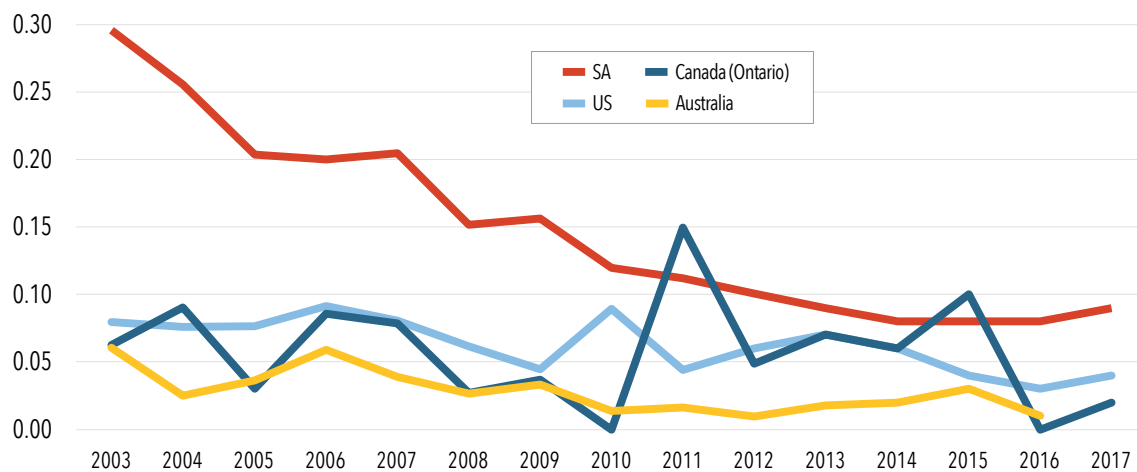
**FIGURE 4.** Number of fatalities by risk area

### South Africa’s safety performance in the context of the international mining community

In 2007, a paper by MA Hermanus<sup>22</sup> acknowledged that there had been improvements in South African mine safety, albeit not at rates comparable with mining countries such as Australia, Canada and the US. Six years later, in 2013, an international comparative analysis showed that the safety performance of the South African mining industry had reached levels that compared favourably with international benchmarks. The analysis revealed that the safety performance of South African coal mines surpassed that of those in the US.

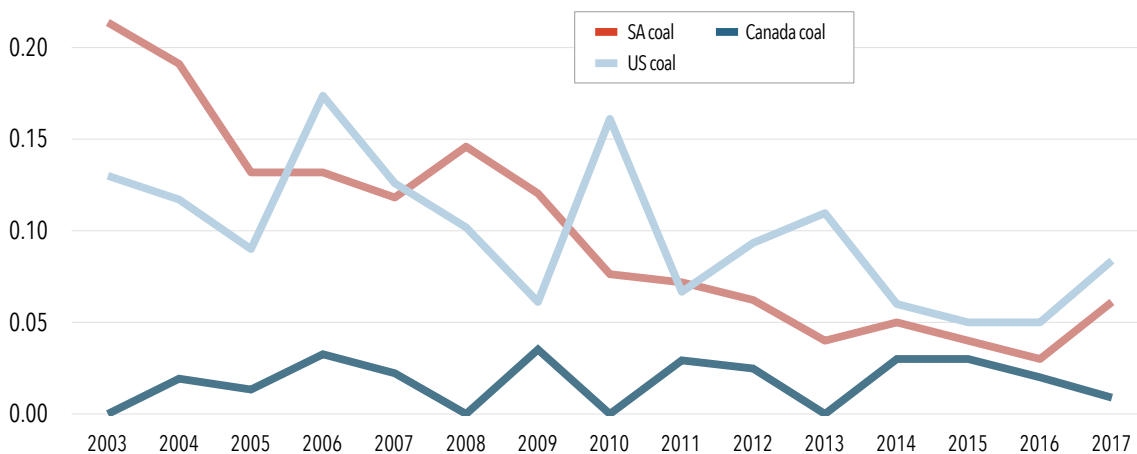
22 Hermanus, MA. 2007. Occupational health and safety in mining—status, new developments, and concerns.

Figure 5 indicates the fatality rates per million hours of South Africa in comparison with other countries. It is worth noting that industry has had a downward trend and surpassed Canada's safety performance in 2015.



**FIGURE 5.** South Africa fatality rates per million hours worked against international benchmarks

Between 2003 and 2016, South Africa recorded the biggest safety performance improvement against international benchmarks at 70%, followed by the US at 50%, whereas Australia and Canada regressed by 16% and 60%, respectively. South African coal mines performed better than US coal mines up to the end August 2017, with an overall fatality rate per million hours of 0.04 against 0.06, as seen in Figure 6 (Chamber of Mines, 2017).



**FIGURE 6.** Coal fatality rate per million hours



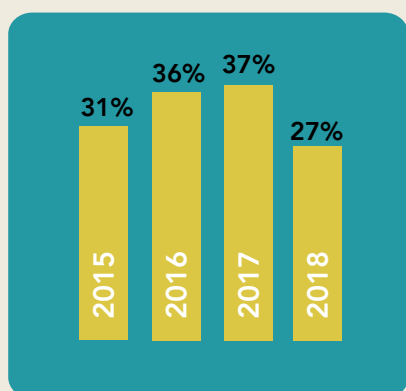
Methods to improve the **Drill and Blast**  
Cycle in Conventional Narrow Tabular  
Orebodies in South African Mines:

A Reference Guide



The Mine Health and Safety Council reported that FOG fatalities contributed 31% of all fatalities in the mining sector in 2015. In 2016, 2017 and 2018, this increased to 36%, 37% and 27% respectively. In addition, the number of FOG fatalities has also increased.

From: *Methods to improve the Drill and Blast Cycle in Conventional Narrow Tabular Orebodies in South African Mines*



**ABOVE:** This graph from the guide shows FOG fatalities as percentages of the total fatalities in the South African mining industry from 2015 to 2018 (Source: MOSH Drill and Blast Reference Guide).

# DRILL AND BLAST REFERENCE GUIDE

CHRIS LEGODI, Principal Adoption Specialist (MOSH Falls Of Ground), Minerals Council of South Africa

SHANE DURAPRAJ, MOSH FOG Adoption Manager, Minerals Council of South Africa

In March 2019 the Minerals Council launched the reference guide, *Methods to improve the Drill and Blast Cycle in Conventional Narrow Tabular Orebodies in South African Mines*. The guide, which can be downloaded from the MOSH website,<sup>23</sup> includes information from mining operations, interviews with professional mining staff, relevant research material and subject matter experts and took approximately three years to complete.

Although the guide is not exhaustive it represents the best thinking to achieve the original scope.

## Background to the initiative

Since the inception of formal large-scale mining in South Africa 120 years ago, the most economically feasible and most productive method of extracting the ore-body has been through blasting operations.

To gain the greatest benefit from the ore-body and achieve the required targets, particular steps must be completed and repeated. Although this process has not changed much, despite significant technological advances and improvements in the mining sector, in the last decade, the efficiency and productivity of the drill and blast cycle has come under increased scrutiny. It is evident that the quality of the drill and blast has a significant impact on the productivity and stability of working areas.

Against the backdrop of a persistently high number of fall of ground (FOG) accidents, the Minerals Council South Africa through the Mining Industry Occupational Safety and Health (MOSH) Learning Hub's FOG Team produced a Drill and Blast (DB) reference guide to address this need and improve the mining industry.

The guide is an industry initiative in the quest for zero harm and will result in significant safety improvements in the industry, particularly with regard to falls of ground. It serves as a constant reminder of the impact of accurate extraction of the rock mass and how this improves the efficacy of a mining operation.

<sup>23</sup> <https://www.mosh.co.za/falls-of-ground/documents>

## A summary of the guide

1. Data from drilling and blasting underground South African mines showed that:

- Many FOG problems result from poor rock mass and strata conditions created by unfavourable geological structures and/or high-stress zones. Geological weaknesses are worsened and non-problematic geology destabilised by mining. In particular, poor drilling and blasting of the rock mass contributes significantly to instability and the potential for failure.
- Vibration and explosive effects within the confined space of a stope are exacerbated by incorrect marking, poor drilling, overcharging, and incorrect timing and sequencing. The results may be degradation of the rock mass, damage to support elements – which invariably impacts on support performance – and instability in the stope, especially during seismic incidents. The mechanisms of damage from drilling and blasting are clearly misunderstood and often controversial.

2. Issues raised during ad hoc visits and interview analyses were grouped into the following themes:

- Design
- Quality
- Leadership
- Training
- Technical

'Quick wins' or short-term solutions are presented in the leadership behaviour and behavioural communication realm under these themes.

3. Business optimisation and value chain gains are expected if the user:

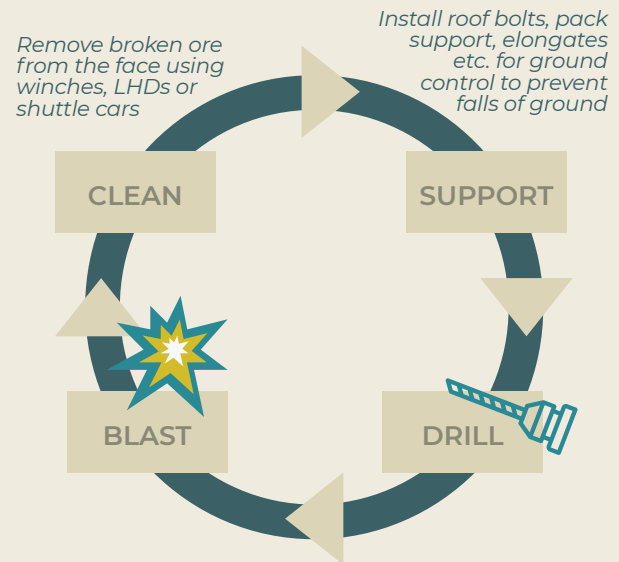
- Understands the key elements of the mining cycle,
- Resources and project manages the activities within the key elements
- Manages the project
- Considers the consequences of poor execution of an element or activities within elements

4. The effectiveness of a blast can be attributed to:

- Technical capacity of the designed blast.
- Ground reaction to the force applied by the designed blast.

5. Factors that aid blast design and the parameters used to review a blast include:

- **Technologies** to improve the drill and blast cycle include 3D simulations and virtual reality in training methods.
- **Monitoring and review** of the parameters measured for each blast.
- **Centralised blasting** minimises the exposure of workers to latent seismic incidents and ensures that tasks within the cycle are completed in the time allotted.



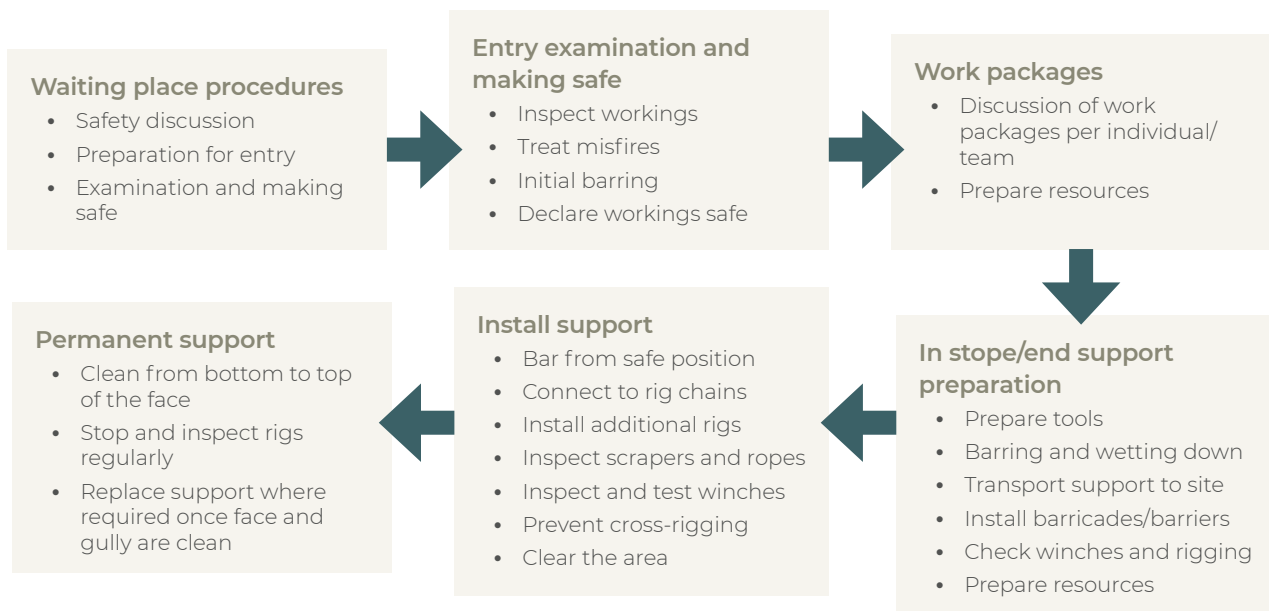
**ABOVE:** A typical mining cycle for conventional inclined tabular ore deposits. The cycle may begin at any point but often starts with an unsupported, clean face. The face has to be inspected and supported before it is drilled, blasted and cleaned (Source: MOSH Drill and Blast Reference Guide).



**ABOVE:** The effectiveness of a blast can be attributed to two factors: The technical ability of the detonation system to move the rockmass in the desired manner and the ground reaction to the force applied to it (Source: MOSH Drill and Blast Reference Guide).

**Accurate blasting practices in underground mining environments have been proven to deliver improvements in safety and productivity and should therefore be considered part of the core foundation upon which a mine is developed and operated.**

*Mining Review*  
([www.miningreview.com](http://www.miningreview.com))



**ABOVE:** The cleaning flow chart. Cleaning is one of the elements in the mining cycle. Each activity has several sub-processes or work activities/packages that need to be completed in order to achieve an efficient, successful blast (Source: MOSH Drill and Blast Reference Guide).

## Conclusion

In pursuit of the goal to improve the safety, efficiency and productivity of the drill and blast cycle, the Minerals Council MOSH Learning Hub FOG Team sourced best practice from a number of mining operations, conducted interviews, reviewed relevant subject matter research and tabled innovations that could result in improving the extraction process.

It was clear that the understanding of the mining cycle process was imperative to attain these goals – key elements of the support, drill, blast and clean process are described and processes tabled to enact business optimisation.

In addition, the need to retrain using more innovative methods would result in a culture shift to actualise a safety and business improvement for the South African mining industry.



**ABOVE:** A mineworker making accurate, clear markings on the face to indicate where the shot-holes should be drilled. This procedure is critical to a successful blast (Source: MOSH Drill and Blast Reference Guide).

# LEDGING BEST PRACTICE

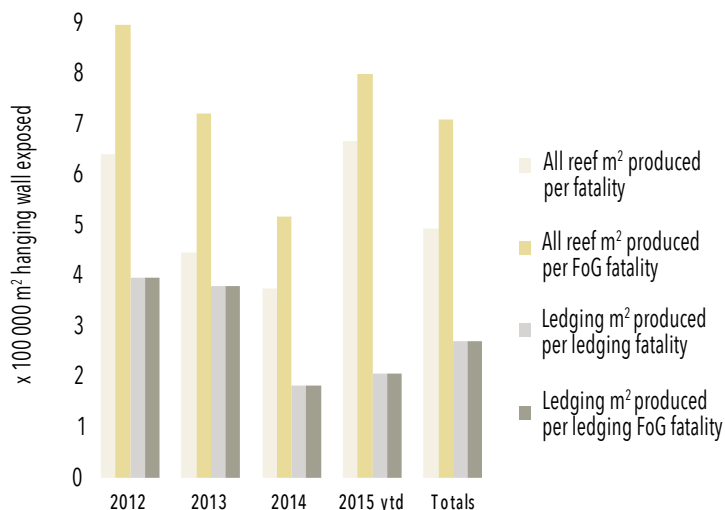
SHANE DURAPRAJ, Chief Rock Engineer, Minerals Council of South Africa

CHRIS LEGODI, Principal Adoption Specialist (MOSH Falls Of Ground), Minerals Council of South Africa

South Africa has an abundance of tabular ore bodies<sup>24</sup> from which most of the country's precious metals<sup>25</sup> are derived. A process called ledging is used to open up these ore-bodies and prepare the mining environment for full extraction. Ledging is similar to the creation of door frames in the corridor of a building – stable openings made to allow safe access to a room.

With ledging, an initial cut of reef is taken from narrow tabular ore bodies. The cut is accessed from an on-reef raise (similar to a corridor) to establish a robust centre gully and set up and equip the area for the stoping phase that follows. The quality of the ledging process is very important because it determines the quality of the mining stope (i.e. the room) and the accessibility of ore for the life of that stope.

Although it should be one of the safer mining processes, an unacceptably high number of fatalities and injuries have been associated with ledging. Ledging constitutes a small percentage of a mine's production volume, but the risk of fatalities was found to be high compared to general stoping.



The above graph shows that the risk of a fatal accident during a ledging excavation may be twice that of a stoping excavation when compared to square metres of hanging wall exposed in each type of excavation. The graph also shows that all fatalities in ledging during this period (2012–2015) were related to uncontrolled falls of ground.

<sup>24</sup> Mining of narrow tubular orebodies is referred to as narrow reef mining

<sup>25</sup> Gold and platinum



## GOOD LEDGING PRACTICE FOR HARD ROCK NARROW TABULAR REEFS



### MINING INDUSTRY OCCUPATIONAL SAFETY & HEALTH

The Chamber of Mines established the MOSH Learning Hub in 2009 to encourage mining companies to draw and learn from the areas of excellence that exist throughout the industry.

The process involves identifying, documenting, demonstrating and facilitating the widespread adoption of leading practices with the greatest potential to address the major risks in health and safety areas including falls of ground, transport and machinery, dust and noise.

## Ledging planning leading practice

In response to a high number of fatalities and an increased safety risk in ledging areas, the CEO of the Elimination of Fatalities Zero Harm Task Team (ZHTT) requested an investigation and recommendations to mitigate the risk of these accidents happening.

The MOSH FOG leading practice adoption team from the Learning Hub at the Minerals Council South Africa was asked to investigate and ascertain whether leading practices in the industry might help to eliminate these accidents.

The scope of the MOSH FOG team was to investigate, identify and disseminate a Ledging Planning Leading Practice through the MOSH Leading Practice Adoption system.

The team conducted the investigations in mines that carry out ledging and began with gathering statistics on ledging-related injuries and fatalities from seven major mining companies with ledging programmes.

Although not all companies keep injury statistics in a format that allows easy differentiation between stoping and ledging, fatality statistics were readily identifiable.

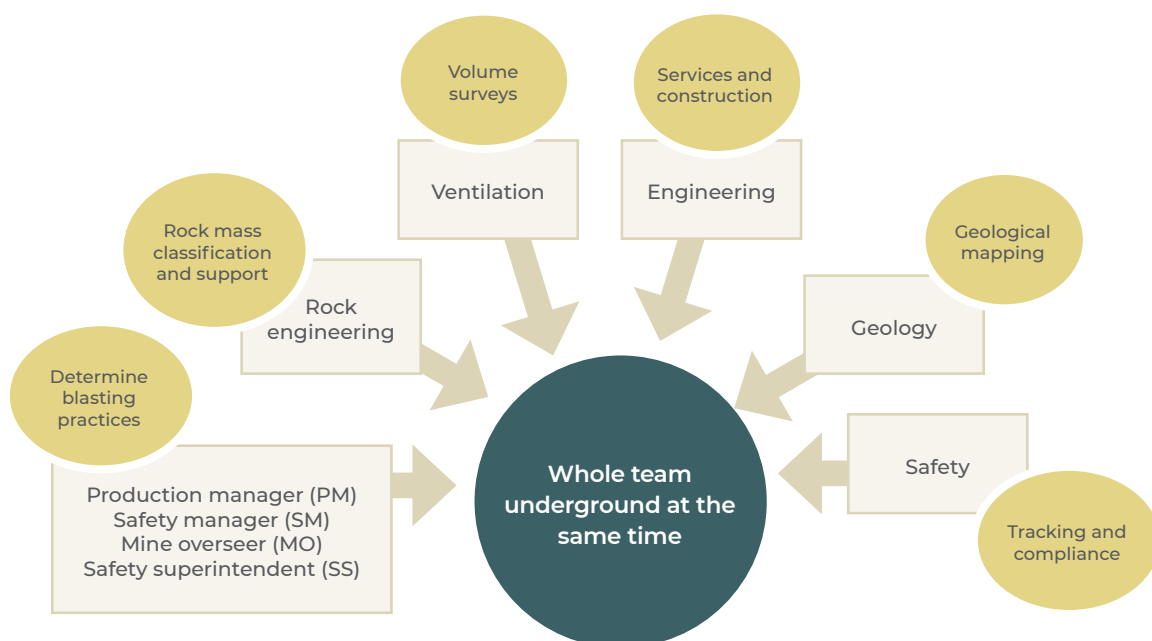
The team gathered fatality-related statistics for ledging and stoping operations from a period of three-and-a-half years (2012–2015 YTD) and a common denominator of square metres of hanging wall exposed was used to compare the occurrence of fatalities in each process.

Once this information was obtained, interviews were conducted with senior management at the operations, as well as line managers and organised labour.

Investigations showed that there are pockets of excellence in the industry. Two mining companies were identified as having comprehensive ledging practices that could be documented and shared with the rest of industry as a guide to good ledging.

Common to these two companies is their extensive planning for ledging, called pre-ledging. Execution of this extensive and detailed process resulted in the Ledging Planning Leading Practice, which emphasises that ledging should be handled like a project and calls for project management principles to be applied.

The leading practice has three components: pre-ledging, ledging and post-ledging. Pre-ledging focuses on the micro-planning processes and is limited to a cross-cut and a raise line. In some cases, limited macro-planning is revisited to realign the two plans. Figure 2 below shows the pre-ledge activities by multi-disciplinary team.



**ABOVE:** The multidisciplinary team needed for pre-ledging planning (Source: MOSH Good Ledging Practice)

While there may be many forms of ledging (up-dip, down-dip, breast, checker-board, wide raising or wide-winzing) it is not the intention of the Ledging Planning Leading Practice to prescribe any format or standard to be applied at any specific mine site. The intention is rather to provide a set of principles and leadership behaviours that will ensure a safe, sustainable and productive ledging process within the industry where it is practiced. These principles are as follows:

- Ledging is not a production phase. It is a set-up phase to ensure the safe, sustainable and productive extraction of ore from a stope, which is to follow. This means budgets, control measures and efficiencies are different to those of the stoping phase.
- Ledging does not start by taking the first reef-cut from the raise, but with the planning process at a point preceding the cross-cut, boxhole(s), travelling ways and raise (or winze) or centre gully development.
- Ledging is a specialist task and ideally requires dedicated ledging teams.
- An intimate knowledge of all relevant geological factors and ground conditions is paramount to get the best layout for mining a block of ground and to ledge in a manner that will best serve the life of the stope. To this end it is necessary to follow a drilling and mapping programme to establish discontinuities, accurate reef positions and cut-off points and fault losses (or gains) etc. Without this information, accurate layouts cannot be made.
- Ownership of the ledge and the associated behavioural requirements needs should lie with the mining or production manager (3.1 management appointee) for the area, as he or she will co-ordinate the planning and execution of the mining process from the development phase through to the post-ledging phase.
- An inter-departmental assessment of the entire process, from the development phase (generally the start of the development of the cross-cut) must be maintained and includes controls that stipulate that no new step can be undertaken unless the quality assurance of the previous step has been evaluated and verified and signed off by the 'owner' of that step. A permit-to-execute system should be applied throughout, where quality assurance and control will indicate progress or remedial process.

Leadership and worker behavioural components play a key role in determining if the practice will be a successful or not. Leadership behaviour (what leaders must do) and behavioural communications (the communications of leaders to correct or reinforce behaviour of employees) ensure that a leading practice becomes an adopted and sustainable practice, rather than merely a new process description.

## CONCLUSION

Twenty-seven mines have adopted the Ledging Planning Leading Practice. Ledging is a very important part of the mining process in narrow tabular gold and platinum mining as it will determine the stability of a mining stope for the duration of its life.

Statistics show that ledging is one of the highest-risk activities in the mining process despite its small contribution to mineral output. The MOSH team, CEOs and industry experts believe that if mines adopt the ledging leading practice by accurately following the MOSH 16-step adoption process, the ledging process will become safer.



**MINING INDUSTRY  
OCCUPATIONAL  
SAFETY & HEALTH**

*MOSH focuses on 'people' issues to overcome resistance to adoption of leading practices. MOSH is for industry by industry and facilitates achievement of the Tripartite Mine Health and Safety Milestones that the industry has agreed on and aspires to.*

*A MOSH Leading Practice comprises technical aspects, behaviour communication and leadership behaviour – three pillars of equal importance. Sustainable adoption of the practice requires adoption of all three.*



# DUST

## CONTINUOUS REAL-TIME MONITORING (CRTM) OF AIRBORNE POLLUTANT ENGINEERING CONTROLS

**DR VUKOSI BANYINI, Adoption Specialist – Dust**

**ISRAEL SIBISI, Adoption Team Manager – Dust**

**TABBY RESANE, Adoption Team Manager – Dust**

In the MOSH occupational dust-exposure space, activities with high liberation potential are established during the baseline as well as from occupational activity personal sampling of workers as stipulated in the Airborne Pollutant Code of Practice for the South African mining industry is recognised. While this legislation governs the monitoring of personal airborne occupational airborne pollutant exposure, MOSH Dust Leading practices aim to identify practices with the highest potential to engineer out dust at source

Since the inception of the MOSH system in 2008, four MOSH Dust 'engineering-out' practices have been made available for industry to adopt – a fogging dust suppression system, footwall and sidewall treatment, a multi-stage filtration system and a scraper winch cover.<sup>26</sup>

A fifth MOSH Dust Practice is Continuous Real-time Monitoring (CRTM) of Airborne Pollutant Engineering controls, which has been identified by industry experts as a leading practice with the greatest impact for addressing the risk of harmful airborne pollutants at source.

Predictive and preventative maintenance of airborne pollutants engineering control management enabled by CRTM prevents worker overexposure by allowing immediate intervention when set limits are reached. This may mean stopping the activity, activating the engineering control or adhering to a predictive maintenance schedule programme.

In effect, CRTM forces an operation to move away from reactive ways of managing engineering controls. The introduction of CRTM allows more time for problem management; CRTM is not an engineering control.

Monitors are placed strategically to monitor airborne pollutant engineering controls (Figure 1). A CRTM monitor at the intake airway measures ambient air in the working area. If the set limit is reached the monitor's alarm is activated and kick-starts the intervention selected by the mining operation. A second CRTM monitor can be placed at return airways to monitor ambient air from the activity areas and communicate with the first monitor.

<sup>26</sup> <https://www.mosh.co.za/dust/leading-practices>

Before purchasing and installing CRTM, the mining operation will decide on the functionality of intervention criteria, which may, for example, trip-stop production, activate engineering controls, or reduce the time needed to maintain engineering controls

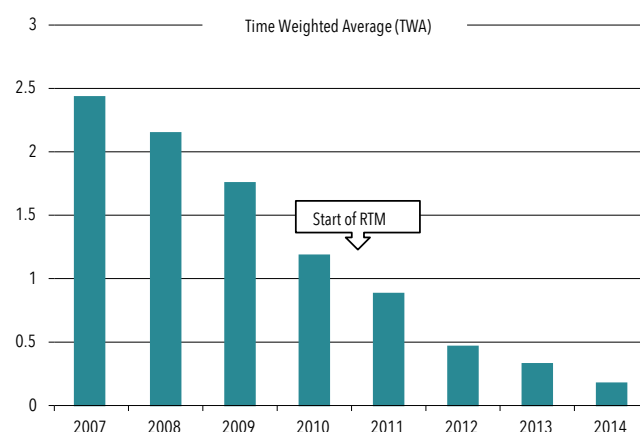
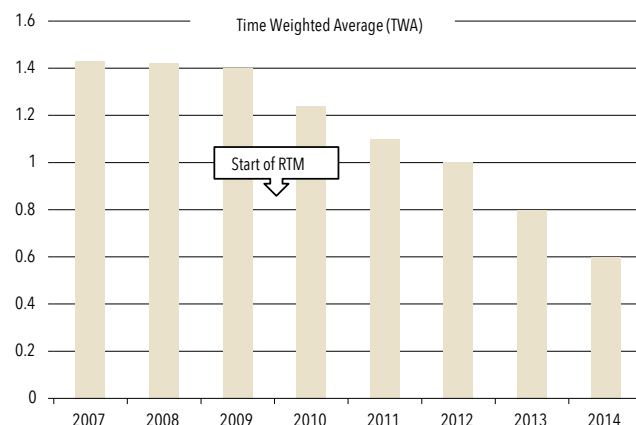
Once criteria have been selected, operations must design a process flow on the method to be followed, including roles and responsibilities in installation of the CRTM, interventions, and maintenance of engineering controls and the CRTM.

The following key elements address unresolved airborne pollutant exposure. For areas with existing engineering controls relevance, the operation starts with element 3.

1. **Identify:** Document areas and activities associated with sources of airborne pollutants.
2. **Evaluate:** Interpret the airborne pollutant data and propose appropriate interventions and controls
3. **Communicate:** The management team must sanction adoption. Leadership behaviour plans must be in place early in the adoption process.
4. **Demonstrate:** Prove the effectiveness of the engineering intervention tailored to control the airborne pollutant. Upgrade the controls until the desired outcome is consistently achieved.
5. **Monitor:** Select a suitable CRTM system to monitor the effectiveness of the engineering controls.
6. **Protect:** Create interventions to protect workers from exposure to the hazard and incorporate it into the protection logic.
7. **Review:** Include the procedures and criteria for review and refinement of the practice that are outlined in the Leading Practice Adoption Guide.

The CRTM consistently provides assurance of the sustained integrity of appropriate engineering controls tailored to mitigate airborne pollutants. These practice capabilities are indicators to:

- Run effective hazard protection programmes for affected workers.
- Detect working places or processes with unsatisfactory airborne pollution conditions.
- Find sources or causes of such conditions.
- Determine the effectiveness of airborne pollutant suppression methods or equipment.
- Upgrade control measures.
- Confirm that satisfactory conditions have been achieved following remedial measures.
- Endorse that satisfactory conditions are being maintained.
- Improve design of ventilation systems.
- Show trends of ambient conditions.
- Define risk levels through appropriate risk assessments.



#### RESULTS FROM THE CRTM SOURCE MINES

AngloGold Ashanti's Kopanang Mine (top) and Anglo American's New Vaal Colliery (bottom) – the source mines for CRTM – both showed a reduction of airborne dust after CRTM was introduced.

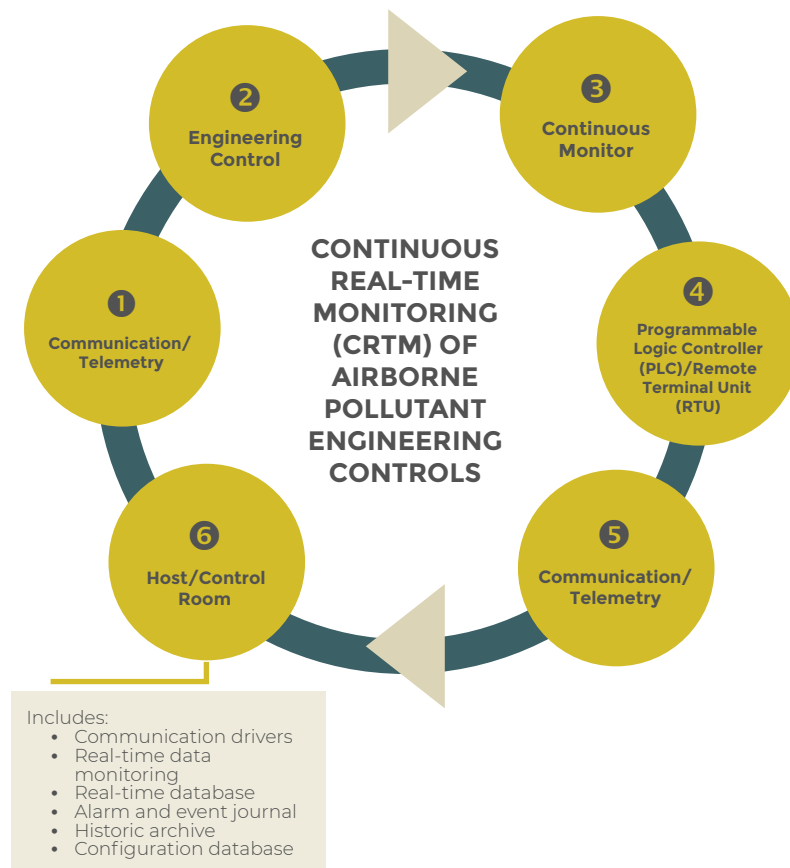
The bottom graph shows the average annual exposure to respirable coal dust. The improvement after 2010 is attributed to the introduction of Real-time Monitoring of the effectiveness of the dust controls at the Primary Tip. There was an 85% improvement between sampling results (annual averages) for 2010 and 2014.

The widespread adoption of CRTM by the South African mining industry is exercised through a Community of Practice for Adoption (COPA) whose members have supported adoption of CRTM in mining operations. During COPA meetings, members share their learning and experiences of the CRTM adoption journey until there are no newer learnings and the leading practice guiding document is updated accordingly. This ensures that similar challenges are not repeated.

The potential for adoption of CRTM is not limited to dust sources. It also has potential to be applied at engineering controls designed to mitigate other airborne pollutants.

In conclusion, CRTM is a paradigm shift from reactive to proactive airborne pollutant management. Although it is not an engineering control, or a silver bullet, it is a leading practice with huge significance in helping the industry achieve the 2024 milestones on elimination of occupational lung diseases.

For further information on the Leading Practice, contact the MOSH Dust Team at: (011) 498 7100 or visit our web site: [www.mosh.co.za](http://www.mosh.co.za)





Lesotho has embarked on a process to update its mine health and safety legislation, which was promulgated in 1981; the Mining and Minerals Bill of 2015 proposes the establishment of a Mine Health and Safety Inspectorate, and other changes.

Following an evaluation of Lesotho's mine health and safety laws, the Competence Centre Mining and Mineral Resources felt it was appropriate to include a profile of Lesotho's mining sector in its Mine Health and Safety publication. The profile concludes with an interview with the Lesotho Commissioner of Mines.



## CHAPTER 5

# THE MINING LANDSCAPE KINGDOM OF LESOTHO



## Liqhobong

Liqhobong Diamond Mine, which is situated at the head of the Liqhobong Valley in the Maloti Mountains has been operated by Liqhobong Mining Development Company since 2010. 75% of the mine is owned by Firestone Diamonds and 25% by the Lesotho government. The diamond resource currently extends approximately 520 metres below surface, totalling around 23 million carats at an average grade of 28 carats per hundred tonnes. There is potential to extend the mine life, as the resource is open at depth: the deepest vertical hole drilled to date terminated in kimberlite at 650 metres below the surface.

Liqhobong was commissioned in October 2016, with construction completed on time and within the 185.4 million USD budget. This included a processing plant capable of producing 3.6 million tonnes per annum and facilitating improved diamond value management by reducing breakages and enabling the recovery of intact stones in excess of 100 carats. Firestone's first diamond sales in February and March 2017 in Antwerp, Belgium brought proceeds of 13.7 million USD.

Firestone's review of its LOM plan included a revision of its production guidance for the year to 30 June 2018. Mining of the weathered kimberlite will be extended to access lower areas of the pit, which have historically yielded higher grade, higher value diamonds. Firestone plans to mine additional waste rock in the coming year to improve its long-term mining prospects.

In April 2017, a 110-carat diamond was unearthed at Liqhobong followed by the recovery of a 134-carat gem-quality light yellow diamond in October 2017 – the largest gem the company has recovered to date.

## Mothae Diamond Project

The Mothae Diamond Project near the southern edge of the Kaapvaal Craton comprises an estimated 8.8-hectare diamondiferous kimberlite pipe containing a resource of large, high-value Type IIa diamonds. Mothae is 30% owned by the government of Lesotho and 70% by Lucapa Diamond Company. Lucapa acquired Mothae in early 2017 for a sum of US \$9 million. Its erstwhile majority owner, Lucara Diamond Corporation, abandoned the resource in 2015.

Trial mining between 2008 and 2012 during Lucara's ownership yielded 23,446 carats, including 96 stones weighing more than 10 carats each, while three separate rough diamond sales fetched up to 41,500 USD per carat. Lucapa has a ten-year mining lease, with the option of extending this by another decade.

In October 2017, Lucapa announced a plan to maximise targeted diamond production and cash flow, and is expected to result in a 29% increase in gross project revenues and increase diamond production to 498,000 carats. It is also anticipated that the LOM will be extended to 13.5 years.

## Kao Diamond Mine

The owner and operator of Kao Diamond Mine, Storm Mountain Diamonds, is a subsidiary of London-listed Namakwa Diamonds, which holds a 75% equity interest, while the government of Lesotho holds 25%. At 19.8 hectares, the main kimberlite pipe at Kao is the largest in Lesotho and the fourth-largest in Southern Africa. Situated in the Butha-Buthe district, within a 20 km radius of the Letšeng and Liqhobong mines, Kao's total resource of 173 million tonnes contains about 12.6 million carats.

Commercial production began in March 2012, treating up to 300,000 tonnes per month and a plant expansion project to raise production to 400,000 tonnes per month was completed in 2016. Upgrading plant equipment has enhanced processing capacity and helped reduce damage to larger gems. Increased production volumes are achievable due to the large size of the kimberlite pipe. Mining flexibility in the open pit is an advantage, with a life-of-mine stripping ratio of less than one tonne of waste per tonne of ore. In addition to increasing the scope of mining in the pit, Kao's production horizon has been extended until at least 2035.

## Lemphane Project

The government-owned Lemphane Kimberlite Project is one of five known diamondiferous kimberlite pipes in the region, in close proximity to the Letšeng and Liqhobong deposits. Lemphane has the potential to yield large high-quality diamonds of up to 8.90 carats with values greater than 2,400 USD per carat having been recovered. Negotiations are underway to determine who will be awarded the lease for the operation of Lemphane, with government having short-listed three companies.

## Kolo Diamond Project

Operated by Reskol Diamond Mining, a subsidiary of French-listed Batla Minerals, the Kolo Diamond Project in Mafeteng has an estimated resource of 1.3 million tonnes of kimberlite and 110,000 carats. Reskol has a ten-year lease which expires in 2021. Trial mining was expected to be completed before the end of 2017 and has included Phase 1, consisting of setting up processing facilities and conducting a 60,000-tonnes pre-mining test, and Phase 2, involving capital investments to increase capabilities and process 50,000 tonnes per month.

## REGULATORY FRAMEWORK

Section 36 of the Constitution of Lesotho states: 'Lesotho shall adopt policies to protect and enhance the natural and cultural environment of Lesotho for the benefit of both present and future generations and shall endeavour to assure all citizens a sound and safe environment adequate for their health and well-being'.

The Acts applicable to mining are:

- Mines and Minerals Act, 2005
- Mine Safety Act, 1981
- The Town and Country Planning Act, 1980
- Historical Monuments, Relics, Flora and Fauna Act, 1967
- Labour Code, 1992
- Labour Code (Amendments and Schedules), 2002 and 2006
- Workmen's Compensation Act, 1997
- Land Administration Authority Act, 2010
- Water Act, 2008

Three types of rights apply to mining in Lesotho, namely:

- Prospecting license
- Mining lease
- Mining permit

The **prospecting license** is valid for a maximum of two years and the renewal period is a maximum of one year. The license is valid for an area less than 25 km<sup>2</sup> which is reduced to between 12.5 and 25 km<sup>2</sup> upon renewal. Holders of the license have a right to prospect for the specified mineral; drill, excavate and erect temporary structures; and, to transfer the license with the government's approval. Prospecting license holders are obligated to carry out prospecting according to a works programme; notify the Commissioner of the discovery of all minerals; Annually submit an audited report on expenditure ; maintain full and accurate results of prospecting (Submitted quarterly to officials) and not to remove minerals without permission.

The **mining lease** is valid for a period of 10 years and a maximum renewal period of 10 years. The maximum area covered is not specified, but may be enlarged contiguous to the existing area. Mining lease holders have a right to mine the mineral specified on the lease, erect the necessary plant and equipment, prospect within the lease area and dump waste, dispose of the mineral product and to transfer the lease, with government approval.

The **mining permit** is valid for a maximum renewable period of a year for an area of not more than 100 m<sup>2</sup>. Mining permit holders have the right to conduct small scale mining for a specified mineral (except diamonds); to erect temporary structures, to dispose of the mineral and to transfer the permit, with government approval.

Mining permit holders are obliged to carry out their activities using good mining and environmental practices; submit production and financial reports; submit a description of the plant, equipment and number of employees annually and not to carry out mining below a depth of two metres and using explosives or powered machinery (except for material loading purposes).

**Lesotho shall adopt policies to protect and enhance the natural and cultural environment of Lesotho for the benefit of both present and future generations and shall endeavour to assure all citizens a sound and safe environment adequate for their health and well-being.**

Constitution of Lesotho, Section 36



## Mine health and safety legislation in Lesotho

Mining safety is legislated under the Mine Safety Act of 1981. Its principal objective is 'to make provision for the purpose of preventing the occurrence of accidents at mines; for securing safety, health and welfare of persons employed at mines; and for connected purposes'. The Act defines the Chief Inspector, commissioner, inspector, machinery, manager, mine, mineral, owner, minister and serious bodily harm in an introduction. It regulates appointment of a manager to direct operations, gives powers to the minister to appoint inspectors and highlights the procedures for inspection and accident investigation. It also gives jurisdiction to the magistrates court to deal with offences and non-compliance.

## Minerals and Mining Policy

Through its new Ministry of Mining, the Lesotho government has spearheaded the development of a Minerals and Mining Policy, aligned to the Africa Mining Vision, and also operates within the scope of the country's Vision 2020 and the National Strategic Development Plan (NSDP) 2012/13–2016/17.

The policy incorporates the regional dimensions elaborated in the Southern African Development Community (SADC) Mining Protocol and the SADC Policy Harmonisation Framework. The overriding goal is to deliver lasting socioeconomic development gains centred on job creation from the exploitation of Lesotho's endowment in mineral resources, mainly diamond mining. The Minerals and Mining Policy provides a roadmap to guide the development of mineral resources in Lesotho for the foreseeable future.

## Minerals and Mining Bill 2017

The government is currently reviewing the country's mining legislation to ensure that legislation enables the mining sector to significantly contribute to the country's socioeconomic development. One of the laws under review is the Mines and Minerals Act of 2005. It could be replaced by the Minerals and Mining Bill of 2017 currently at the second stakeholder consultation stage. The bill includes new sections on the establishment of a National Mining Corporation, Mining Authority, Inspectorate of Mines and Lesotho Diamond Centre.



### INTERVIEW WITH LESOTHO COMMISSIONER OF MINES, MR PHEELO TJATJA

**Mr Gerard Mohapi (GM): What is the Ministry of Mining and what are its core functions?**

**Mr Pheelo Tjatja (PT):** The Ministry of Mining is responsible for the regulation of mining in the Kingdom of Lesotho. Its core mandate is to disseminate information on mineral resources, and to regulate and manage prospecting and mining activities. Furthermore, it is tasked with the development of the mining sector through the creation of stakeholder relations that ensure sustainable mining. The socioeconomic benefits from mining must be felt by the Basotho nation.

**G.M: What is your role within the ministry?**

**P.T:** I am the Commissioner of Mines, the equivalent of the Inspector of Mines in South Africa. I am responsible for overall administration of the Mines and Minerals Act of 2005.

**G.M: What specific elements of the act would you say are the most important?**

**P.T:** There are two aspects of my job that I think encompass the socioeconomic aspects of my job: tax and royalty collection, and health and safety and environmental protection.

**G.M: Please elaborate on each of the aspects in the context of your powers and their limitations as well as the responsibility placed on the mining companies.**

**P.T:** In terms of the laws of Lesotho, mines are required to submit audited financial statements to the Commissioner of Mines. The taxes payable are royalties, Diamond Sales Tax and Corporate Income Tax. Royalties are 10% of revenue for precious stones and 3% for other commodities. Diamond sales tax is 15% of the market value of the diamond. Corporate Income Tax is 25% for all mines.

**G.M: What is the responsibility of the commissioner's office in terms of health and safety?**

**P.T:** Primarily inquiries into accidents. Where a fatality or a serious bodily harm has occurred on a mine, the manager must report incidents to the commissioner. Other incidents to be reported are accidents related to explosives, ignition or fires, influx of inflammable or noxious gases, breakage of ropes used to lower persons and materials in underground workings, chains or conveyances, over-winding of cages, and premature collapse of any part of the workings. It is then the role of the commissioner to inform the minister. The minister will then appoint a person to conduct the enquiry.

**G.M: Environmental legislation is important because Lesotho's clean water is an essential contributor to the economy. What role does the commissioner's office play in this regard?**

**P.T:** Monitoring environmental management and compliance with environmental impact legislation is a function of the Ministry of Environmental Affairs. The mining law in its current form only gives powers to the commissioner on matters related to tax collection, issuance of prospecting and mining licenses and accident investigations. The law only states that the onus is on the mine to: preserve the natural environment, minimise and control waste or undue loss of or damage to natural and biological resources and, prevent and, where unavoidable, promptly treat pollution and contamination of the environment.

**G.M: From a safety perspective it seems the law is a bit thin compared to South Africa's legislation. There is no mining inspectorate, tripartite institutions, risk-based management approach or other statutory requirements that deal specifically with safety.**

**P.T:** True. The mining laws are a bit thin. However, the ministry has undertaken a process to review the mining laws through the drafting of the Mineral and Mining Bill of 2017. The bill in its current form is undergoing parliamentary processes and proposes establishment of a mine health and safety inspectorate, mining corporation and a diamond centre. The hope is that this will deal with some if not all of the shortcomings of the law in its current form.

**G.M: What effects will the new laws have on attracting investment? In particular, the ownership requirement of 30% Free-Carried interest for state and the 10% Basotho ownership? Will this not erode investor confidence and inadvertently contradict the aims of the mineral policy in attracting investment?**

**P.T:** The consultation process with all stakeholders will determine what the final stipulations are. It's important to note that the document is a work in progress and that given the criticism key aspects of it are being reviewed. Once the final document has been approved by parliament and signed into law, I am sure it will look very different.

**G.M: Thank you very much for the interview and look forward to the legislative changes in the country. It's a sign of a growing industry.**

**P.T:** Thank you sir. We look forward to further engagement with the SA–German Chamber.

1. <https://www.undp.org/content/dam/lesotho/docs/Other/Lesotho%20Mining%20and%20Minerals%20Policy%20Draft%20Green%20Paper%20-%20Full%20Version%20-%20English.pdf>
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