

## MODERNISATION AND TECHNOLOGICAL INNOVATION



### APPROACH

Sibanye recognises that radical transformation is necessary in the mining industry in order for mechanisation and modernisation to succeed. There is a need for generally higher levels of skill and a new way of thinking – the mining industry needs to have learning as the norm and to focus on improved rates of productivity. Sibanye is committed to seeking and achieving technological breakthroughs in mining processes, and believes there is the will and the ability to solve any technical issues, particularly when developing methods to bring about modernisation in deeper mines.

To achieve this, Sibanye participates fully in R&D in pursuit of technological innovations that could safely unlock the Mineral Resource and Mineral Reserve potential of its operations in high-grade remnants and pillars, current mining horizons and at depths in excess of current operations. Sibanye considers the development of technology as a fundamental strategy and has identified Safe Technology as a strategic imperative.

### PERFORMANCE

A dedicated Safe Technology function was established within Sibanye in July 2014 with the responsibility to explore ways in which to modernise the operations by using new technologies to improve working conditions and to make the working environment safer for employees while, at the same time, improving productivity and reducing costs. An interim strategy was developed, which considered ways in which new technology can have an impact on LoM projections, ore-body complexity, productivity profiles and cost pressures, as well as the growing portfolio of capital-expansion projects in order to improve productivity.

The three main strategy pillars are:

- **Legacy mining pillar:** reclamation of gold lost or left behind during mining operations in the form of fines, ultra-fines, crush and stability pillars.
- **Current mining process improvement:** reducing employees' exposure to danger areas while increasing output and decreasing costs.
- **Future-state mining methods:** facilitating a 24-hour mining cycle, maximising utilisation of assets, and facilitating the conversion of resource to reserve of deeper level and secondary ore bodies.

In early 2015, the interim strategy was reviewed, deemed appropriate and remains the cornerstone of the department. The strategy has steered the Safe Technology focus towards areas that could accomplish short- and long-term improvements in safety and efficiency in current mining operations and productivity – commensurate with innovation in new product development and gold-extraction methods.

Throughout 2015, the focus of the Safe Technology portfolio was to further refine its strategy, and progress immediate operational needs, namely:

- research into industry-leading practices and strategies
- obtaining insight from institutions such as universities or research organisations on potential progressive technological advancements
- regular counsel by original equipment manufacturers (OEMs) and selected industry technology experts
- engage with government through the Chamber of Mines Innovation team in order to leverage funding mechanisms in support of mining modernisation and innovation
- initiate micro and macro projects in line with the strategy.

The Safe Technology team capitalises on Sibanye's internal wealth of knowledge and experience in investigating, developing and driving innovation, and has established symbiotic relationships with counterparts in the industry, innovative developers and OEMs to ensure that safety technology adds value.



## MODERNISATION AND TECHNOLOGICAL INNOVATION CONTINUED

### MACRO AND MICRO PROJECTS

Safe Technology's endeavours are further categorised into macro or micro projects. Micro projects are generally in alignment with Safe Technology's current mining process-improvement strategy, initiated either by the Safe Technology department or put forward by the operations. These include smaller safety-enhancing and production-optimisation projects such as:

- roof-bolting optimisation and standardisation
- localised hydropower mining
- winch signalling
- automated cleaning methods
- continuous dust monitoring and suppression
- structural inspection and maintenance management system (SIMMS) optimisation
- diesel particulate matter reduction and control
- personnel locating systems.

Macro projects are aligned with Safe Technology's old-gold recovery and future-state mining methods, and are initiated and driven by the Safe Technology department with operational assistance from selected mining units. All macro projects represent a significant departure from conventional mining methods, and aim to incorporate industry and often world-leading technologies.

In line with the future-state mining method, a paradigm shift in hard-rock mining is required for Sibanye to remain competitive locally and globally. Sibanye has, therefore, embarked on a stope-mechanisation programme to enable it to reduce costs and pay limits with non-explosive, continuous production. Work includes facilitating the conceptualisation and design of two primary mining platforms, the MT100 and MT1000, and the commissioning of prototypes for delivery in the first quarter of 2016.

The MT100 is a multi-track machine, with four adjustable flippers, capable of carrying payloads of up to 200kg. The unit is supplied with two separate attachments. The dozing attachment will be used to perform cleaning operations, previously facilitated by scraper winches. The sweeping attachment consists of a rotary brush and will be used to perform ultra-fine sweeping in-stope.

The MT1000 is a multi-track with four adjustable directional flippers, capable of carrying payloads of up to 1,000kg. The unit will also be supplied with two separate attachments. The Multi-Drill attachment is designed with four hydropower drills and will facilitate rapid face drilling (90 minutes per 30m panel). The Drill-and-Break attachment consists of a hydropower drill, coupled and indexed with a high-powered rock breaker, which will facilitate a non-explosive mining method, enabling a 24/7 mining cycle.

Although referred to as prototypes, much time has been spent on industrialising the design, taking into account the supply of material and manufacturing processes required to produce these machines so as to greatly reduce production time should the trials be deemed successful.

Another example of a ground-breaking development is Sibanye's hybrid locomotive. Based on the original Sibanye locomotive, the unit will continue to use highly efficient asynchronous permanent magnet motors, with an increased voltage, enabling the use of smaller, less costly and more readily available motors that are capable of regenerating approximately 30% of the energy expended in a tramming cycle. Energy storage will be facilitated by lithium-ferrite phosphate (LiFePO<sub>4</sub>) batteries, which present reduced weight and substantially increased life when compared to the current lead-acid equivalent. A generator set will charge the batteries when required and thus alleviate the need for up to three lead-acid batteries per locomotive, presenting a substantial reduction in capital.

The locomotive is designed to be a direct replacement for conventional diesel locomotives without having to construct capital-intensive battery bays and associated infrastructure. The first hybrid locomotive will also be delivered in the first quarter of 2016.

Concurrently, Sibanye has continued to collaborate with its peers in the mining industry regarding technology development through inter-company, regulatory, administrative and institutional relationships as well as partnerships.

Other macro projects include:

- mechanised wide-raise development in production trials at Kloof's Ikamva Shaft
- mechanised and rapid infrastructure development using tunnel boring machines (TBMs) currently in the latter stages of establishment with operation expected by the end of Q2 2016
- production trials of strike-and-dip pillar reef-boring with positive initial results.



■ MT100 Sweeping Machine



■ Multi-Drill MT1000

## FUTURE FOCUS

In 2016, the focus will be on consolidating and refining successful projects so as to commercialise concepts for roll-out to the operations, and to deploy 2015's prototype developments for assessment and conclusion. Having already industrialised the design of MT100, MT1000 and the Sibanye hybrid locomotive, the next step is to qualify the technology, through a comprehensive testing process, for roll-out on a larger scale.

Furthermore, Sibanye will continue to design, develop and implement new innovative strategies and technologies in an attempt to reduce energy consumption at the operations through the use of energy-efficient technologies and, where feasible, reduce carbon footprint. These strategies include the use of renewable energy, such as solar power, methane gas and climate change-mitigation initiatives. Sibanye will also continue to concentrate efforts in the area of water-technology innovation to reduce consumption and environmental impact through increased recycling.