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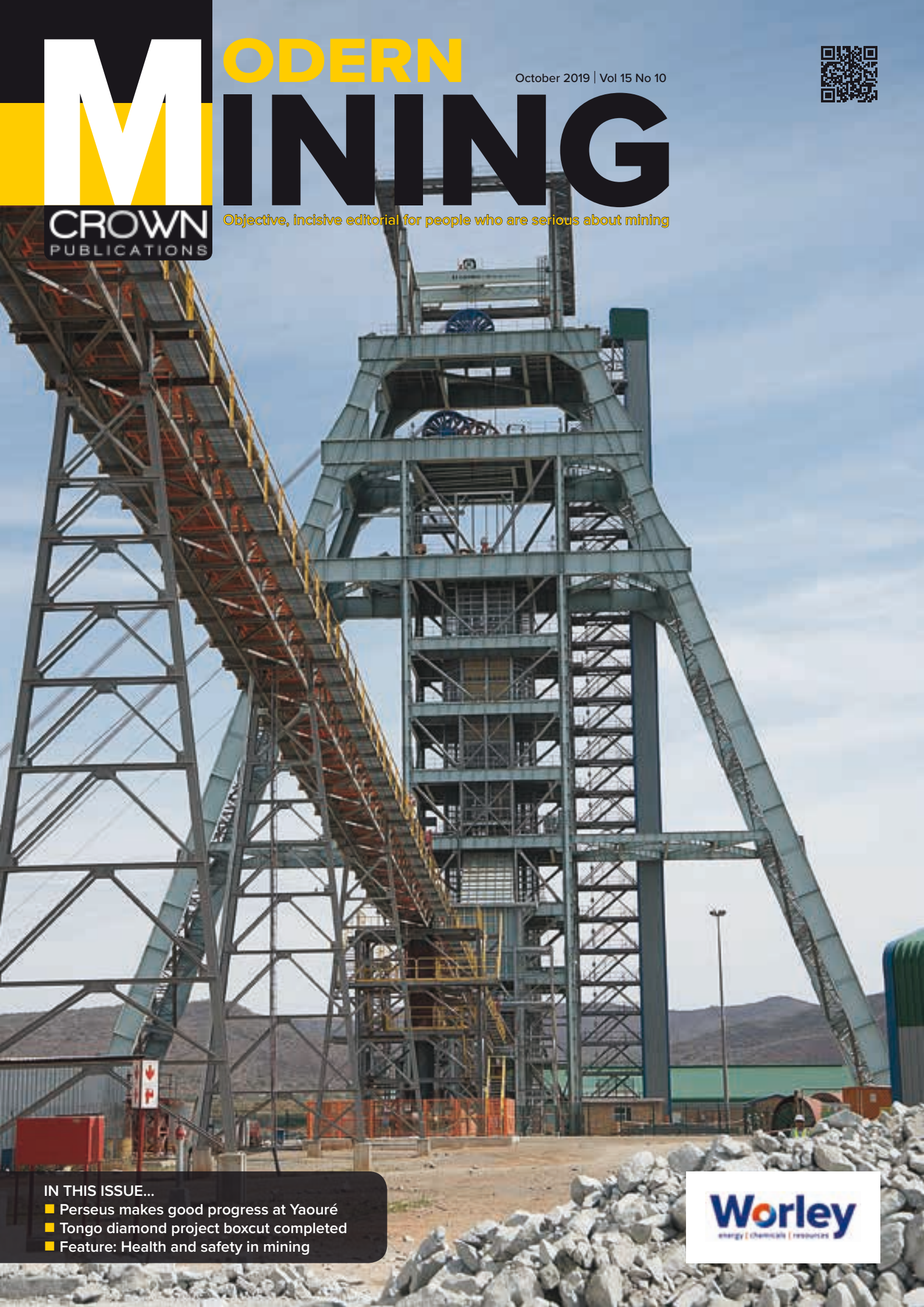

IN THIS ISSUE...

- Perseus makes good progress at Yaouré
- Tongo diamond project boxcut completed
- Feature: Health and safety in mining

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CONTENTS

ARTICLES

COVER

GOLD

EVENTS

DIAMONDS

GEOTECHNICAL

TECHNOLOGY

FEATURE: HEALTH AND SAFETY IN MINING

ON THE COVER

Headgear at Wesizwe's Bakubung platinum mine, a project with which Worley has been closely involved. Worley's global capabilities in mining are covered in our cover story on page 16 of this issue in which we talk to senior executives Nick Bell and Denver Dreyer.

REGULARS

MINING NEWS

PRODUCT NEWS

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SA mining – an industry in transition

Last month I devoted this column to the latest edition of the Minerals Council South Africa's *Facts and Figures* booklet. Since then PwC has released *SA Mine 2019*, the 11th edition of its annual review – based on data and information from 26 mining companies – highlighting trends in the South African mining industry. It gives a slightly different, more analytical, perspective than *Facts and Figures* and paints a picture of an industry in transition on a number of levels.

According to *SA Mine 2019*, mining companies have begun to enjoy some welcome relief in 2019, as gains in commodity prices, aided by a weaker rand, have brought the industry back into profitability, despite increased costs and weak production. Free cash flows doubled and EBITDA and dividends are at five-year highs.

"Shareholders can be cautiously optimistic with the mining sector outperforming the JSE All Share Index over the last two years, as it recovers from an extreme low base," says the review. Companies paying substantial dividends included Kumba Iron Ore (R12,5 billion, compared to R6,7 billion in 2018), Exxaro Resources (R5,5 billion, well over twice the 2018 figure), ARM (R2,4 billion) and Assore (R2,3 billion).

The market capitalisation of the industry increased to R884 billion in 2019, which compares very favourably with the figures for 2018 (R482 billion) and 2017 (R420 billion). Anglo American Platinum alone saw its market capitalisation increasing by R129 billion between June 2018 and June 2019.

While mining contributed 9,6 % of the country's GDP in 2011, this declined to 8,1 % in 2018 and dropped below 8 % in 2019. "It is unlikely that mining will again reach the levels seen in 2011 as the South African economy needs to grow on a diversified basis," says the review.

Confirming what many of us already suspect, *SA Mine 2019* notes that no substantial capital expenditure has been made in large-scale new projects. "Mining companies are taking a disciplined approach when considering their capital allocation. As large-scale investments require long-term payback periods, long-term stability is required. While more certainty was brought about by the finalisation of the Mining Charter in 2018, more needs to be done in terms of dialogue. The implementation of the Carbon Tax Act and additional environmental regulations adds significantly to the cost base and implementation uncertainty in the industry."

Sadly, the publication offers little hope for South Africa's beleaguered gold mining industry, which now accounts for only 4 % of global production. "Not even the significant rand gold price increase could save gold's terminal production decline, which was compounded by shaft closures and industrial action," says the PwC review. Although the country still has significant gold resources, the distances from existing shaft infrastructure, safety concerns and increased labour and electricity costs are putting pressure on margins. The review concludes that, in the absence of significant technological breakthroughs, South Africa will struggle to remain globally competitive in gold production.

SA Mine 2019 adds that the mining sector in South Africa is in transition from a deep level, labour intensive, conventional mining environment to a mechanised, shallower, technologically advanced industry.

Total revenue generated for the year ended 30 June 2019 by the mining sector was R529 billion, up by 6 % on the prior year. This was mainly driven by increased PGM, iron ore and manganese revenue. The PGMs had an increased revenue contribution following strong palladium demand pushing up the basket price and improved production in the sector since the prior year.

The review says that coal continues to be the mining industry's biggest revenue generator, despite the headwinds caused by changing global sentiment towards coal, and contributed 28 % of mining revenue for the year. It points out, however, that the coal industry is not really growing – in fact, production has largely remained flat over the last 15 years.

There was an 8 % increase in the operating costs in comparison to the previous year. The increased costs were driven by marginal increased production in the current year, higher electricity and labour cost and inflationary increase in consumables and mining supplies. Labour remains the largest cost driver in the sector and this seems unlikely to change, at least in the short to medium term, as labour cost increases remain above inflation.

Commenting on the findings of the report, Andries Rossouw, PwC Africa Energy Utilities & Resources Leader, says that in spite of an improvement in operating performance, both investor sentiment and the global attractiveness of the industry continue to erode with investors and consumers questioning whether the industry can create sustainable value for all stakeholders.

"More than ever, the speed of technological advancement, climate change, sustainable operations and changing consumer behaviour should be top of mind for mining companies," he says. "They need to find a balance between stakeholder needs and long-term sustainable operations in their capital allocation decisions."

Arthur Tassell

"Not even the significant rand gold price increase could save gold's terminal production decline, which was compounded by shaft closures and industrial action."

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All-modular build solution to be adopted for Molo

TSX-listed NextSource Materials Inc has reported the results of its 2019 Feasibility Study (FS) for its 100 %-owned Molo graphite project in southern Madagascar. The FS takes into account updated mine capital equipment and mining costs, as well as current 12-month rolling flake graphite pricing on a FOB China basis, supplied by UK-based battery mineral commodities research firm, Benchmark Minerals Intelligence.

The FS is based on a Front End Engineering and Design study (FEED) and subsequent Detailed Engineering studies.

In order to ensure that NextSource maintains a first-mover competitive advantage over the competition and to appropriately plan for future market demand, the FS was designed to provide a flexible mine development approach that comprises a unique, all-modular build solution yielding optimal cashflow and return metrics with suitable flexibility to enable a rapid response to the anticipated market demand for graphite.

It is envisaged that the plant will comprise 35 modules, which will be constructed offshore. Assembly of the modules on site will take approximately one month with the completed facility having a very compact footprint.

As previously reported to the market, NextSource has an off-take agreement in place with a prominent Japanese trader, who is a major supplier of flake graphite to Japan's largest battery processor and manufacturer of graphite anode material in lithium ion batteries (LiB) for electric vehicle applications. NextSource is currently in the process of formalising an additional sales agreement with a leading European trader. As such, the FS was undertaken to include two phases in order to account for off-takers' demand for NextSource's SuperFlake® graphite concentrate.

The first phase of production will consist of a fully operational and sustainable graphite mine with a permanent processing plant capable of processing 240 000 t/a of ore and producing approximately 17 000 t/a of high-quality SuperFlake® graphite concentrate.

A representation of the all-modular Molo plant.

The updated build cost of the fully modular process plant has marginally increased from the US$18,4 million reported in the 2017 FS to US$21,0 million due to equipment cost inflation.

Phase 2 incorporates the processing of 240 000 t/a of ore (producing 17 000 t/a of SuperFlake® concentrate) for the first two years of operation and then ramping up to 720 000 t/a of processed ore in the third year to accommodate additional sales, resulting in a total of 45 000 t/a of SuperFlake® concentrate being produced for a mine life of 30 years.

The costing for Phase 2 is based on the addition of two modules of the beneficiation plant with a proportional increase in mining and infrastructure costs.

The capital mine cost for Phase 2 (with contingency) will be US$39,1 million, for a total project cost (Phase 1 and Phase 2 with contingency) of US$60,1 million.

"Our Feasibility Study will greatly assist us in our current discussions with mine financiers, and reconfirms to the market the economic viability of the Molo project under current market conditions," comments Craig Scherba, President and CEO of NextSource.

"Our all-modular build strategy has low capital and operating costs, and a rapid build time. With our phased build-out, this will allow our graphite to be easily absorbed into the current market while

Trenching at the Molo project in Madagascar. According to NextSource, the mining setting is ideal with the graphite occurring immediately at surface. The waste to ore ratio (0,53:1) is negligible and the proposed mining area has a low population density (photo: NextSource).

maintaining NextSource's flexibility and competitive advantage to quickly penetrate the market and generate revenue, establish strong relationships with as many key buyers as possible, and verify our product for highly technical markets with production-run material."

The Molo project hosts a measured mineral resource of 23,62 Mt grading 6,32 % C; an indicated mineral resource of 76,75 Mt grading 6,25 % C; and an inferred mineral resource of 40,91 Mt at 5,78 % C.

It is envisaged that conventional open-pit mining activities will be carried out with small to medium sized mining equipment including 20-t dump trucks, a 2 m^3 excavator and an 8 m^3 front-end loader. The initial haulage distances for the tipper trucks are expected to be approximately 1,2 km from the open pit to the ROM tip and 2,0 km from the pit to stockpile areas.

The ore processing circuit consists of three-stage crushing followed by primary milling and classification, a flotation separation and concentrate upgrading circuit, and final graphite product and tailings effluent handling facilities.

Due to the substantially reduced tonnages for the project as envisaged, tailings will be dried and co-disposed with the waste rock generated as part of the opencast mining. Despite this co-disposal approach, a detailed design has been completed, complete with environmental and social impact assessment and closure, to allow for the upgrade to a more conventional cyclone facility, should the throughput be increased during the life of the mine. ■

Waterberg DFS details a world-class PGM mine

Platinum Group Metals, listed on the TSX and NYSE American, has announced positive results from an independent Definitive Feasibility Study (DFS) on the Waterberg project completed by international and South African engineering firms Stantec Consulting International and DRA Projects SA along with a large team of specialists.

The DFS was managed by Waterberg JV Resources (Waterberg JV) representing the owners of Platinum Group, Implats, Japan Oil, Gas and Metals National Corporation (JOGMEC), Hanwa Co Ltd and Mnombo Wethu Consultants. All of the partners contributed actively to the project through the technical committee and the board of Waterberg JV.

Highlights of the DFS include a significant increase in mineral reserves from the project's 2016 Pre-Feasibility Study (PFS) for a large-scale, shallow, decline-accessible, mechanised, palladium, platinum, gold and rhodium (4E) mine. Use of backfill in the DFS design lowers risk and increases mined ore extraction rates.

An annual steady-state production rate of 420 000 4E ounces is envisaged, which is a lower production rate than in the PFS. According to Platinum Group, this result is by careful design in order to reduce capital costs and simplify construction and ramp-up.

The project has an after-tax NPV of US$982 million, at an 8 % real discount rate, using spot metal prices as at September 4, 2019 (including US$1 546 Pd/oz). Using three-year trailing average metal prices up until September 4, 2019 (including US$1 055 Pd/oz), the after-tax NPV is US$333 million, at an 8 % real discount rate. The after-tax IRR is 20,7 % at spot prices and 13,3 % at three-year trailing prices.

The DFS estimates project capital of approximately US$74 million, including US$87 million in contingencies. Peak project funding is estimated at US$617 million. On site Life of Mine (LOM) average cash cost (inclusive of by-product credits and smelter discounts) for the spot metal price scenario equates to US$640 per 4E ounce.

The project's updated measured and indicated mineral resources total 242 Mt at 3,38 g/t 4E for 26,4 million 4E ounces (using a 2,5 g/t 4E cut-off). The deposit remains open on strike to the north and below an arbitrary depth cut-off of 1 250 m. Proven and probable mineral reserves total 187 Mt at 3,24 g/t 4E for 19,5 million 4E ounces (using a 2,5 g/t 4E cut-off).

"The DFS provides a clear outline of the world-class nature of the Waterberg palladium deposit and concludes that it can be one of the largest fully mechanised, low cost platinum group metals mines in the world," comments R. Michael Jones, CEO and co-founder of Platinum Group. "A large global team of approximately 100 independent professionals and specialists, as well as excellent participation from our partner Implats, have contributed to an optimised mining plan that reduced capital from the earlier plan and significantly increased the mineral reserves for a 45-year life, 420 000 4E ounce per year steady-state mine plan."

The Waterberg project will create approximately 1 100 new highly skilled jobs and a significant investment in local training and business opportunities is part of the benefits to stakeholders including local communities, shareholders, and provincial and national governments. The project includes an upgrade to the local water infrastructure under a current co-operation agreement with the municipality and a connection to the Eskom power grid.

The DFS mine plan models production at 4,8 Mt of ore per annum. The mine initially accesses the orebody using two sets of twin decline tunnels with mining by fully mechanised long hole stoping methods with paste backfill. Paste backfill allows for a high mining extraction ratio as mining can be completed next to backfilled stopes without leaving internal pillars. Maintaining safety and reliability were key mine design criteria. As a result of the scale of the orebody, bulk mining on 20 to 40 m sublevels with large underground equipment and conveyors for ore and waste transport provides high efficiency.

Following extensive test work at the PFS and DFS level, DRA based the plant designs, metallurgical recoveries and costing on a standard South African flotation MF-2 circuit. Additional metallurgical checks on mineral types and potential recoveries were completed at XPS Labs in Sudbury, Ontario.

Modelled recoveries were completed for the different recovered elements and zones within the Waterberg mining complex over the 45-year LOM and an average 4E recovery of 78,9 % is estimated. Copper recoveries are forecast at 83 % and nickel recovery is modelled at 48 %.

The DFS project timeline includes a formal construction decision to be taken following the granting of the Mining Right, expected in Q1-2020, with first production 3,5 years later with ramp-up to steady state by 2027. The LOM on current mineral reserves extends to 2066 and the deposit remains open at depth and on strike. ■

Ball mill secured for Theta gold project

The 2,5 MW ball mill purchased by Theta Gold Mines (photo: Theta Gold).

ASX-listed Theta Gold Mines (TGM) reports it has secured a quality, second-hand 2,5 MW ball mill for R5,5 million for the Theta gold project near Pilgrim's Rest in Mpumalanga, South Africa. The mill can process up to 820 kt/a and, says TGM, can readily accommodate future mining expansions.

During the completion of the Feasibility Study on the Theta gold project, the ball mill was identified as a long-lead item that could potentially delay project delivery.

In July this year, TGM identified the opportunity to acquire the ball mill. The mill was last operated by Glencore at its Rustenburg chromite mine. A dedicated inspection of the mill with plant engineers from METS South Africa (part of the UMS Group) indicated that the mill was in an excellent condition with all associated parts being well maintained.

In addition to the essential drive train components, the purchase includes two spare motors, two spare gearboxes, a seasoned ball charge and a full set of liners (with approximately 50 % life remaining).

There are also spare slipper pads and various miscellaneous spare parts including liners and bearings for gearboxes. The girth gear for the mill is still in new condition and has minimal wear. Furthermore, the purchase includes a full set of engineering and installation drawings which will serve to reduce installation costs.

TGM has commenced the identification of an appropriate engineering company to manage the removal and relocation of the mill. The mill is to be removed from the structure by mid-November and from site by the end of December this year.

TGM through its controlled subsidiary owns the TGME plant outside Pilgrim's Rest. The 240 000 t/a CIL plant, which was constructed in the mid-1980s by Rand Mines as a tailings reclamation plant, has gone through several changes in configuration through the years, including additions to allow for crushing, milling and flotation. Currently the plant is not operational as TGM plans to refurbish it after the current feasibility production profile is achieved.

TGM's goal is to build a solid production platform of over 100 koz/a of gold based primarily around shallow open-cut or adit-entry hard rock mining sources. The company has access to over 43 historical mines and prospect areas.

Commenting on the ball mill deal, TGM's Chairman, Bill Guy, said: "An equivalent new 2,5 MW ball mill with spare parts costs around A$5,5 million and would take up to 40 weeks from order to delivery. Instead, Theta has managed to secure a second-hand mill in excellent condition and with an inventory of vital spare parts for less than A$800 000 which can be relocated to the TGME processing plant by January 2020.

"The purchase also provides certainty of grinding capability for the mine and, being larger than initially planned for in the feasibility study, allows for future throughput increases. Securing this ball mill marks another key milestone towards first production." ■

AfriTin Mining announces maiden resource for Uis

AfriTin Mining, listed on AIM, whose flagship asset is the Uis tin mine in Namibia, has announced a maiden measured, indicated and inferred Mineral Resource Estimate (MRE), prepared in accordance with JORC (2012), for Uis. The resource totals 71,54 Mt of ore at a grade of 0,13 % tin for 95 539 tonnes of contained tin.

The company has also announced an inferred MRE of 71,54 Mt of ore at 85 ppm tantalum for 6 091 tonnes contained tantalum (spatially coincident to the tin mineral resource); and an inferred MRE of 71,54 Mt of ore at 0,63 % lithium oxide for 450 265 tonnes contained lithium oxide (Li_2O) (spatially coincident to the tin mineral resource).

"Confirming the historical data at Uis has always been a crucial step in the progression and development of our flagship asset," comments Anthony Viljoen, CEO of AfriTin Mining. "The additional down dip drilling confirmed extension and thickening of the orebody at depth, affirming our belief in the scale of this deposit and increasing the resource historically stated by SRK (1989) on the V1/V2 orebody."

He points out that the scale of this resource, from two pegmatites, places the tin inventory as one of the biggest of its kind in the world and encourages further development of the additional outcropping pegmatites identified within the mining licence area. More than 100 pegmatite bodies have been identified in the area.

"The addition of tantalum and lithium to the estimate further enhances the attractiveness of this globally significant asset and creates an exciting opportunity for other potential revenue streams," he continues. "Assays of the historical resource didn't typically capture other elements as there were no markets for these by-products at the time. However, with the advent of new technology and the battery metal boom, AfriTin has extended the inventory of potentially extractable metals at Uis to include tantalum and lithium."

According to Viljoen, the results now provide AfriTin with the confidence to move the Phase 1 mining operation forward towards a large-scale Phase 2 operation. ■

Anglo's Mark Cutifani inducted into SA Mining Hall of Fame

Mark Cutifani, Chief Executive, Anglo American, globally recognised as an extraordinary leader and trailblazer in industry innovation, was inducted into the Joburg Indaba's SA Mining Hall of Fame in Johannesburg recently.

The Joburg Indaba SA Mining Hall of Fame was launched in 2016 as a way of recognising and honouring some of the legendary individuals who have significantly influenced the South African mining industry over many years.

Many believe that Mark Cutifani's greatest contribution to the global mining industry has been to restore the fortunes of Anglo American. Significant business improvements have been delivered in areas ranging from safety and environment, sustainability, operations and innovation, capital discipline and project delivery, exploration through to financial restructuring and the positioning of the business as a leading major mining company.

Cutifani is acknowledged as a major industry innovator with a track record for the delivery of improvements across all facets of business performance and for repositioning mining to make it more relevant in the 21st century. He says: "Business purpose and meeting society's needs are not incompatible; companies play an essential role in meeting the needs of society; business should be much more than simply profits."

In addition to his operations and corporate experience, Cutifani has demonstrated exceptional marketing and commercial acumen in building new models for the marketing of commodities and downstream value-added products.

"The sand is shifting beneath our feet and if we cannot make significant contributions to society, our businesses are unsustainable; we need to demonstrate why we should be here for another 100 years by clearly stating what we plan to achieve."

Mark Cutifani (centre), Chief Executive, Anglo American, is seen here with Bernard Swanepoel, Chairman, Joburg Indaba, and Paula Munsie, CEO, Resources4Africa, founder and owner of Joburg Indaba (photo: Michelle Kalp).

Cutifani joins 13 other mining personalities who have been inducted into the SA Mining Hall of Fame. They are: Phumzile Mlambo-Ngcuka; Bobby Godsell; Con Fauconnier; Patrice Motsepe; Mark Bristow; Gwede Mantashe; Brian Gilbertson; Sipho Nkosi; Marius Kloppers; James Motlatsi; Ian Cockerill; May Hermanus and Barry Davison. ■

Further milestone achieved on Syama automation

In its September quarterly report, ASX-listed Resolute Mining, whose flagship asset is the Syama gold mine in Mali, says that a key focus of the quarter was the commissioning of the Syama automated mining system and the successful completion of site acceptance testing.

During the quarter, automated loaders successfully collected ore from the bottom of ore passes on the 1055 level and loaded automated trucks via a split-level loading facility. Additionally, automated trucks travelled up the underground decline under laser guidance before transitioning to satellite GPS guidance upon exiting the portal and continuing to dump the ore on the run-of-mine pad. The traffic management system, both on surface and in the Syama Underground Mine, was also successfully tested.

Collectively, these achievements marked a major milestone for Resolute as it commissions the world's most advanced automation mining system.

Gold production from Syama for the quarter was 103 201 ounces, comprising 33 074 ounces from the oxide circuit and 12 730 ounces from the sulphide circuit. ■

Young diamantaires visit Venetia diamond mine

De Beers hosted the Young Diamantaires Group of the World Federation of Diamond Bourses (WFDB) at its Venetia mine in Limpopo at the beginning of September.

The Young Diamantaires are an informal group of 250 individuals in the diamond and jewellery industry, founded by Rami Baron together with WFDB President, Ernie Blom. The purpose of the Young Diamantaires initiative is to stimulate a worldwide conversation with young diamantaires under the age of 45 on how to positively influence the diamond industry.

According to Frank Auger, De Beers Beneficiation Manager, De Beers Group facilitated the tour to showcase what a responsible, ethical and 21st century diamond mine looks like, as well as how the company is helping communities to access opportunities and thrive. The 25 visitors were a diverse group from eight different countries, namely Australia, Belgium, Germany, Israel, India, Singapore, South Africa and the UK.

A highlight from the trip was the visit to the Renaissance Secondary School in Musina, one of 19 schools that De Beers Group has helped to build in the labour-sending areas of Musina and Blouberg through its School Infrastructure Development Programme with the Department of Education.

At Venetia, the visitors were given a tour of both the open-pit and underground operations. The Venetia Underground Project remains the largest investment spend for both De Beers Group and Anglo American in South Africa. The project is entering its sixth year of development and is on track to deliver its first diamonds in 2021. Once completed, it will extend the life of mine to 2046. ■

The Young Diamantaires Group at Venetia. The headgears of the Venetia Underground Project are visible in the background.

Strandline reports "significant" discovery at Sakura

Strandline Resources, listed on the ASX, has reported a significant mineral sands discovery at its newly granted Sakura tenement, which forms part of its Tajiri mineral sands project in Tanzania. The discovery is situated some 10 km along strike from Tajiri.

The Sakura deposit shows the potential to materially expand the Tajiri resources, which currently stand at 268 Mt at 3,3 % Total Heavy Minerals (THM), containing 8,8 Mt of in-situ valuable heavy minerals.

The maiden drilling campaign commenced in August 2019 with a final drill density of 200 m centres on 400 m spaced lines over 5 km of strike. Drill samples were logged in the field based on visual estimates, showing widespread titanium-dominated mineralisation from surface to depths of 6 to 7 m, similar to that seen at other zones within Tajiri.

Strandline is now in the process of exporting samples for laboratory testing, which will be followed by mineral assemblage review and potential mineral resource estimation.

Strandline Managing Director Luke Graham said the Sakura discovery had strong potential to underpin a substantial increase in the already-large resource base at Tajiri.

"Tajiri is a world-class deposit with a rich titanium-dominated mineral sands content," he said. "These initial results from Sakura pave the way for further growth in the resource and reaffirm its development potential."

The Tajiri deposits are situated in northern Tanzania near the port city of Tanga, some 35 km to the north. The 100 %-owned tenements comprise a series of higher-grade mineral sand deposits along a 30 km mineralised corridor.

Mineralisation at Tajiri starts at surface, with no overburden, and contains large coherent higher-grade domains comprising mostly high-value titanium-dominated mineral assemblage, with elevated zones of zircon and occasionally almandine garnet. ■

Ramp-up of Kabwe's copper circuit on track

Jubilee Metals Group, the AIM- and AltX-traded metals processing company, has provided an update on its Kabwe project in Zambia.

Kabwe, combined with Jubilee's recently acquired multi-metal Sable Refinery (previously referred to as Sable Zinc Refinery), which acts as a central processing facility for third party material in the region, gives access to a current resource comprising an estimated 6,4 Mt (3,2 million JORC-compliant) of surface waste assets containing 356 843 tonnes of zinc, 351 386 tonnes of lead and 1,26 % equivalent vanadium pentoxide.

The existing copper leaching circuit has been brought on-line to process historical copper tailings as well as third party sourced run of mine material, targeting the first plated copper cathode metal production during early Q4-2019.

The ramp-up of the copper circuit remains on track targeting 250 tonnes of plated copper cathode per month during Q1-2020, before stepping up to reach 400 tonnes per month from Q2-2020, resulting in early project cash flows during the construction of the zinc and vanadium refining circuits.

The project continues to receive keen interest from small to medium mining operations offering third party copper material for further refining, which is in line with the vision of establishing Sable Refinery as a preferred regional refining hub.

The zinc and vanadium circuit is primarily constructed for the processing of the Kabwe tailings material, targeting the production of 8 000 tonnes of zinc and 1 500 tonnes of vanadium pentoxide per annum. Completion of the zinc circuit remains on track for Q2-2020 with the vanadium circuit following during Q3-2020.

"We have hit the ground running since acquiring the Sable Refinery and the commencement of operations is a major step towards the implementation of the project," says Leon Coetzer, CEO of Jubilee. "Kabwe represents an ideal example of where we can implement our bespoke multi-metal recovery processes to generate significant returns on capital investment, in tandem with addressing the environmental challenges caused by the historic tailings in the area."

The Kabwe mine operated continuously for 88 years until closure in 1994 and ranked as one of the most famous mines in Africa. The tailings from the processing operations were discarded at site, but without the proper containment infrastructure both from an air and ground water pollution point of view, which has created environmental problems for the surrounding population. This situation is ideal for the Jubilee team to exploit through implementing its processing operations to create value from the metal-rich tailings, while alleviating the environmental issues.

Jubilee has deployed a senior management team to the integrated Kabwe project to further strengthen its existing team of 110 employees at Kabwe. The company expects the team to grow to 200 individuals at full project capacities. ■

ZAC poised to grow anthracite market share

The processing plants at ZAC, one of which is seen here, have a combined processing capacity of 2,2 million tons per annum (photo: Menar).

Zululand Anthracite Colliery (ZAC), South Africa's sole producer of prime anthracite, is confident about the medium to long-term growth of demand for the product as it prepares to expand the life of mine beyond the remaining 12 years.

"We are confident about the future of the market both locally and internationally for ZAC's products," Bradley Hammond, investment company Menar's Chief Operating Officer, told a Southern Africa Coaltrans conference in Johannesburg in September.

"We are a 'One Stop Shop' for anthracite that has all the facilities to size and blend our products according to market needs, and we have sufficient capacity and access to rail for export and transport to local and international consumers. We are the preferred supplier to key industrial clients in the South African market and we plan to become a bigger player in the anthracite market worldwide," Hammond said.

"Our strategy of ensuring high tonnages, low cost and high-quality product is one of the main reasons why there is growing interest in our products from countries such as Vietnam, Brazil, the USA and Spain. We are therefore aggressively pushing to increase our marketing efforts to expand our global supply footprint," Hammond added.

Located in the district of Ulundi, in northern Kwazulu-Natal (KZN), ZAC has 12 million tons of reserves remaining, five underground sections and produces 1 million tons of anthracite per annum. It has processing plants on site which have a combined processing capacity of 2,2 million tons per annum. The product is washed to top qualities of 0,9 % to 1,4 % sulphur with extremely low ash content ranging from 8,5 % to 18 %.

The high-quality products are sized to customer specifications. They are critical components in electrode paste, calcium carbide and ferrochrome production, among other applications. About 80 % of ZAC's product is sold in South Africa as a cheaper option to manufacturers compared to higher cost Russian anthracite or coke from China.

Hammond noted that since acquiring the mine, Menar, ZAC's main shareholder, had overcome immense challenges and transformed it into a sustainable mining operation that contributes to the well-being of its host communities.

Until Menar acquired ZAC in September 2016, the mine was at different stages owned by BHP Billiton (from 1985), Riversdale Mining (from 2005) and Rio Tinto (from 2011). Menar turned the operation around and it is now on the verge of declaring a maiden dividend that will also benefit the workers and community who hold a combined 26 % stake.

The mine employs 1 350 people and participates in President Cyril Ramaphosa's job creation flagship project, the Youth Employment Service.

"We continue to invest in the mine to improve capacity and efficiencies and aim to expand our capacity in years to come," Hammond remarked. Plans for expansion of ZAC's operations to increase life of mine include bringing on stream new projects such as Riversdale Anthracite Colliery (RAC) and the Mfolozi project, which would be a combination of opencast and underground mining. Both projects are located in northern KZN. ■

Oriole Resources expands its footprint in Cameroon

Oriole Resources, the AIM-quoted exploration company focused on West Africa, is expanding its footprint in Cameroon following early success at the Bibemi and Wapouzé gold projects, where it is earning up to a 90 % interest through its partnership with Bureau d'Etudes et d'Investigations Géologico-minières, Géotechniques et Géophysiques SARL (BEIG3).

Oriole has formed a new 90 %-owned local subsidiary, Oriole Cameroon SARL, and has submitted applications for a district-scale land package of approximately 3 500 km^2 in the centre of the country.

Comments Oriole's Chief Executive Officer, Tim Livesey: "As we indicated back in May, our success to date in Cameroon has given us the confidence to build on our existing footprint in the country to capitalise on our position as first movers in this new frontier for gold exploration.

"During our technical review meetings in July, the team identified and ranked seven key areas within Cameroon where we felt the geological potential merited us staking new licences. We have now submitted eight new licence applications covering a district-scale land package in our highest ranked areas.

"Having attended the CIMEC conference in Yaoundé last month, where the Mining Sector Capacity Building Project (PRECASEM) presented prospectivity data from the first phase of the programme, I'm pleased to report that the results from regional geochemistry across our new licence areas have identified multiple strong gold anomalies. We look forward to exploring these further, following the completion of the licensing process." ■

New Luika drilling delivers positive results

Shanta Gold, listed on AIM, has reported positive surface exploration drilling results from its ongoing exploration programmes within its existing mining licences at the New Luika Gold Mine (NLGM) in the Lupa goldfield of south-western Tanzania.

Following a detailed review of the exploration portfolio over the last 12 months, new targets within the existing mining licences at NLGM were identified. Two with high potential are Bauhinia Creek (BC) North and Elizabeth Hill (EH) North where exploration drilling has intersected encouraging mineralisation with sizeable widths, suggesting significant potential for additional resources to add to the mine plan.

BC North is located approximately 300 m to the north of the high-grade BC deposit, which is currently being mined from underground at NLGM, and about 3 km to the west of the NLGM processing plant. A total of 19 drill holes representing 2 762 m has been completed over three phases. Results include Hole BNRC013 which intersected 4,00 m grading 8,38 g/t Au and 6,00 m grading 8,62 g/t Au; and Hole BNRC009 which intersected 4,00 m grading 8,94 g/t Au.

EH North is located about 4 km to the east of the NLGM processing plant. Delineation and exploration drilling at EH North involved completion of 24 infill RC drill holes totalling 2 316 m and was carried out in two phases.

The Phase 1 drilling programme at EH North was designed to infill the previously wide-spaced (60 m) drill fences aimed to test the down-dip continuity of the orebody at a 30-m vertical depth. The Phase 2 drilling programme was aimed at testing the mineralisation depth continuity at a vertical depth of 60 m.

Results include Hole CSR525, which intersected 9,00 m grading 6,62 g/t Au; and Hole CSR522, which intersected 9,00 m grading 5,56 g/t Au.

Strike lengths of the BC North and EH North mineralised structures are estimated to be 150 m and 350 m respectively and they remain open at depth.

Drilling is continuing at depth and along strike at both these targets and additional results are expected in Q4-2019. The results of this drilling campaign and the second drilling campaign in Q4-2019 will be combined and analysed, with an updated Mineral Resource Estimate and resultant life of mine extension expected within the next few months.

Eric Zurrin, Chief Executive Officer, commented: "With mine life extension at New Luika a continuing priority for Shanta, it is exciting to see these latest results from our focused drilling programmes. By prioritising exploration targets that can potentially be converted quickly and cheaply into mine plan ounces, our exploration budget is being spent with our production pipeline and mine life in mind.

"We would expect that these results and the next round of drilling will provide sufficient information for us to declare new resources at these targets in the near future and contribute as another source of ore to feed the NLGM plant."

Shanta expects a gold production of 80 to 84 koz at New Luika in 2019 at an AISC of US$740 to US$780 an ounce. ■

Petra recovers "exceptional" blue diamond at Cullinan

Petra Diamonds recently recovered an exceptional 20,08 carat blue gem quality Type IIb diamond from the Cullinan diamond mine. According to the company, the recovery not only demonstrates the quality of Petra's asset base, as the Cullinan diamond mine remains a significant source of rare blue diamonds, but again confirms the prevalence of exceptional stones in the Cullinan orebody, as well as the ability of the mine's plant to recover the full spectrum of diamonds.

Located near Pretoria, Cullinan is one of the world's most celebrated diamond mines. Although probably best known for producing the 3 106-carat Cullinan diamond in 1905, the biggest ever discovered, Cullinan has produced many notable stones since – in fact, more than 800 diamonds of plus 100 carats, of which more than 140 were more than 200 carats.

Production from Cullinan in FY-2019 (to 30 June 2019) increased 21 % to 1,65 million carats. This was mainly due to underground throughput increasing from 3,7 Mt in FY-2018 to 4,1 Mt in FY-2019, further supplemented by an increase in ROM grades from 35,9 cpht in FY-2018 to 38,6 cpht in FY-2019. ■

PEA on Nabanga gold project reveals attractive economics

TSX-listed SEMAFO Inc has announced positive results from a Preliminary Economic Assessment (PEA) for its Nabanga project in Burkina Faso.

Highlights of the PEA include a pre-tax NPV of US$147 million and an after-tax NPV of US$100 million, using a 5 % discount rate; a LoM gold production of 571 000 ounces at an AISC of US$760/oz and a gold recovery of 92 % during the eight years of operations. The project requires a pre-production capital expenditure of US$84 million, including 20 % contingency, and US$56 million in LoM sustaining capital.

According to Benoit Desormeaux, SEMAFO's President and Chief Executive Officer, the PEA highlights attractive economics for Nabanga including how the project can be developed with modest initial capital by combining open-pit and underground mining operations.

"The goal of the PEA study was to assess the initial economic viability and to identify areas for improvement to rank Nabanga within SEMAFO's development pipeline," he says. "We believe we can improve the project economics through additional work on mining cost optimisation for open-pit operations, underground operations, and underground capital development expenditures.

"Furthermore, there remains potential to extend resources through additional exploration drilling as some mineralised zones remain open and further exploration potential exists on the property. As we move beyond the PEA, we will be looking to maximise the potential to generate shareholder value."

The PEA envisions a combination of contract-operated open-pit and underground mining methods for the Nabanga deposit. The top portion of the mineralised zone is projected to be recovered by conventional truck-and-shovel open-pit mining down to a maximum depth of 60 to 70 m. Open-pit production is contemplated at a

Drilling in progress at Nabanga (photo: SEMAFO).

Mako Gold reports "excellent" metallurgical results

ASX-listed Mako Gold reports it has received excellent preliminary metallurgical results from the Tchaga prospect on the Napié project in Côte d'Ivoire.

Preliminary test work was carried out on 17 samples of primary and oxide mineralisation from Tchaga, where Mako is accelerating exploration. Samples were submitted to Bureau Veritas Mineral Laboratories in Abidjan for 24-hour, 0,5 kg direct cyanidation bottle rolls with residues analysed by 50 g fire assay. Samples were selected from five RC holes across the prospect area and from a variety of lithologies in order to test a representative suite of gold mineralised intervals.

Gold recoveries averaged 94,7 % for primary mineralisation and 94,3 % for oxide mineralisation. Results from the direct cyanidation bottle rolls are said to be extremely encouraging and indicate that both oxide and primary gold mineralisation at the Tchaga prospect is amenable to conventional cyanide extraction methods.

Mako plans a follow-up RC drill programme on the Tchaga prospect after the wet season, which usually ends in November in Côte d'Ivoire, with the near-term goal of advancing it towards a JORC-compliant resource. The objective of the programme is to add continuity to mineralisation by drilling along strike and below previously reported wide gold intersections, thereby adding confidence to the modelling of mineralisation on the prospect.

Drilling to date on the prospect has identified a strike extent of gold mineralisation of approximately 1 km with multiple broad and high-grade zones of gold mineralisation intersected in shallow drilling. Significant drill intersections include: 28 m at 4,86 g/t Au from 83 m in hole NARC057; and 25 m at 3,43 g/t Au from 53 m in hole NARC017.

"Many investors had asked about metallurgical testing after we announced the positive drill intersections on our Napié project," comments Mako's MD, Peter Ledwidge. "As a result, Mako commissioned preliminary metallurgical test work. We are very pleased with the results of the test work, which returned average recoveries of greater than 94 % in both oxide and primary mineralisation. This reinforces the strategy of advancing the Tchaga prospect quickly. These preliminary positive results de-risk the project one step further and increase confidence in the Napié project." ■

rate of 16 000 tonnes per day (t/d) for a total of 14,7 Mt of material, including 616 000 tonnes of mineralised material at an average grade of 6,45 g/t Au. Drill and blast will be required almost at the beginning of the excavation work because there is almost no overburden. The open-pit operation is planned over a period of 2,5 years, including the pre-production period.

Below the open pit, recovery of the mineralised zone is foreseen using an underground mining method (sublevel long hole stoping) with the use of cemented rock fill.

In the scenario presented in the PEA, development of the underground mine would commence in the second year of operations, starting from one of the small satellite pits located towards the central portion of the Nabanga deposit. More than 9 600 m of underground development are planned over the project LoM to unlock the different mineralised zones. Approximately 2,36 million tonnes of material with an average head-grade of 6,48 g/t Au are projected to be mined from underground operations at an average of 1 000 t/d during the seven-year projected LoM.

The Nabanga process plant will be based on a conventional crushing and grinding circuit, with the crushing circuit composed of a single-stage jaw crusher. Crushed ore will then be conveyed to the grinding circuit consisting of a SAG mill and ball mill. Following that, a flotation circuit is expected to recover some 80 % of the gold-bearing minerals, with the remaining 20 % treated in CIL leach tanks. The flotation concentrate will pass to the regrind mill to reduce the particle size, before being sent to an intensive leach reactor. The CIL stream will undergo pressure elution, after which both pregnant solutions will be sent to electrowinning cells for gold recovery.

A gold recovery of approximately 92 % is expected in fresh ore and 90 % in oxide ore based on metallurgical test results obtained by Orbis Gold in 2013 and 2014. ■

Drilling confirms quality of SPD mineralisation

ASX-listed Vanadium Resources has announced first drilling results from the reserve drilling programme at the Steelpoortdrift (SPD) vanadium project in South Africa.

According to the company, the results continue to show the high grade, high quality nature of the vanadiferous titanomagnetite present at Steelpoortdrift, which is potentially a saleable product and also provides an advantage in downstream processing due to being high in vanadium (~2,2 %), iron (> 55 %) and titanium (~12 %) and low in silica and alumina.

The short drilling campaign comprised 23 holes for 1 154 m and focused on the near-surface mineralisation within the conceptual pit shell used as the basis of the company's recent Scoping Study; 53,4 Mt of mineralisation is contained within this pit shell.

The current mineral resource stands at 612 Mt at an in-situ grade of 0,78 % V_2O_5 in the indicated and inferred categories. The resource includes a high grade, near surface component of 169 Mt at an in-situ grade of 1,07 % V_2O_5. ■

Portal to Kakula's south ventilation decline, which has been advanced more than 570 m toward the Kakula orebody (photo: Ivanhoe Mines).

Mark Farren appointed as CEO of Kamoa-Kakula JV

Robert Friedland and Yufeng 'Miles' Sun, Co-Chairmen of TSX-listed Ivanhoe Mines, have announced that Mark Farren, formerly Ivanhoe's Executive Vice President, Operations, has been appointed as the Chief Executive Officer of the Kamoa-Kakula Copper Joint Venture.

In two concurrent moves to further enhance Ivanhoe's development and operating capabilities, Louis Watum, Ivanhoe's DRC Country Manager, has been appointed President of the Board of Directors of Kamoa Copper SA and South African mining veteran, Warwick Morley-Jepson, has been appointed as Ivanhoe's new Chief Operating Officer, assuming the duties formerly held by Farren.

Kamoa Copper SA is the DRC operating company of the joint venture between Ivanhoe Mines, Zijin Mining Group, Crystal River and the Government of the DRC that is developing the Kamoa-Kakula project in the DRC.

"Louis, Mark and Warwick all have extensive experience in the development, construction and operation of underground mines in the region, and we have the utmost confidence in their abilities to assemble and lead the joint-venture team that will construct and operate the stage-one, six million-tonne-per-annum Kakula copper mine, while also advancing development efforts at our Kipushi and Platreef projects and fast-tracking exploration drilling on our 100 %-owned Western Foreland licences," said Friedland.

Farren joined Ivanhoe Mines in June 2014, assuming lead responsibilities for various engineering and development activities as Ivanhoe Mines' Executive Vice President, Operations. He also previously served a total of 22 years, in progressively more senior roles, in the South African operations of Johannesburg-based Anglo American Platinum (Amplats). His career with Amplats culminated in his appointment in 2009 as the group's Head of Mining.

Louis Watum joined Ivanhoe Mines in December 2014 as MD of the company's operations in the DRC. In March 2015, he was appointed to the additional role of General Manager, Kamoa Copper SA. He holds lead responsibilities for Ivanhoe Mines' mine development activities now underway at the Kamoa copper discovery and the Kipushi zinc-copper-silver mine.

Prior to joining Ivanhoe Mines, between 2010 and 2014 he successfully led the development and commissioning of the Kibali gold project by Randgold (now Barrick), which followed his work on the launch of Moto Gold Mines' Moto project from 2006 to 2009.

Joining Farren on Kamoa-Kakula's new executive management team will be Dr Yong Chen of Zijin Mining, as Chief Operating Officer. Chen has more than 25 years' management experience in mining operations, including his most recent role as Director and General Manager of Xinjiang Ashele Copper Ltd, a large-scale underground mining and processing complex majority owned by Zijin Mining.

"The executive management team will work closely with Mr Watum and senior Congolese management, our government partners and our host communities to help ensure that the Kakula mine is built on time and budget, and to the best international standards," added Friedland.

"The structure of the team reflects the strong degree of cooperation between the joint-venture parties, and we are confident that the individual expertise and leadership qualities of each member of this executive team will help ensure a successful start-up of operations at Kakula."

"This is an important stage of growth for Ivanhoe Mines, and I am honoured to lead the development of the tier-one Kamoa-Kakula project at such an exciting time," said Farren. "We are uniquely positioned to build Kakula into one of the world's greatest copper mines, and I am excited to be part of the team that moves this project forward to production."

The Kamoa-Kakula project is located approximately 25 km west of the mining centre of Kolwezi in the DRC. Based on existing mineral resources, Kamoa-Kakula has been independently ranked as the world's fourth-largest copper deposit and Kamoa-Kakula's copper grades are the highest, by a wide margin, of the world's top 10 copper deposits.

Kakula, the first of multiple planned mines expected to be placed into production at Kamoa-Kakula, is projected to have an average grade of 6,8 % copper over the initial five years of operations, and 6,4 % copper over the first 10 years – grades that are orders of magnitude higher than the majority of the world's other major copper mines. Initial copper concentrate production from the Kakula mine is currently scheduled for the third quarter of 2021. ■

Oxygen plant commissioned at Blanket

Caledonia Mining Corporation reports it has successfully installed and commissioned a new oxygen plant at the Blanket gold mine near Gwanda in Zimbabwe.

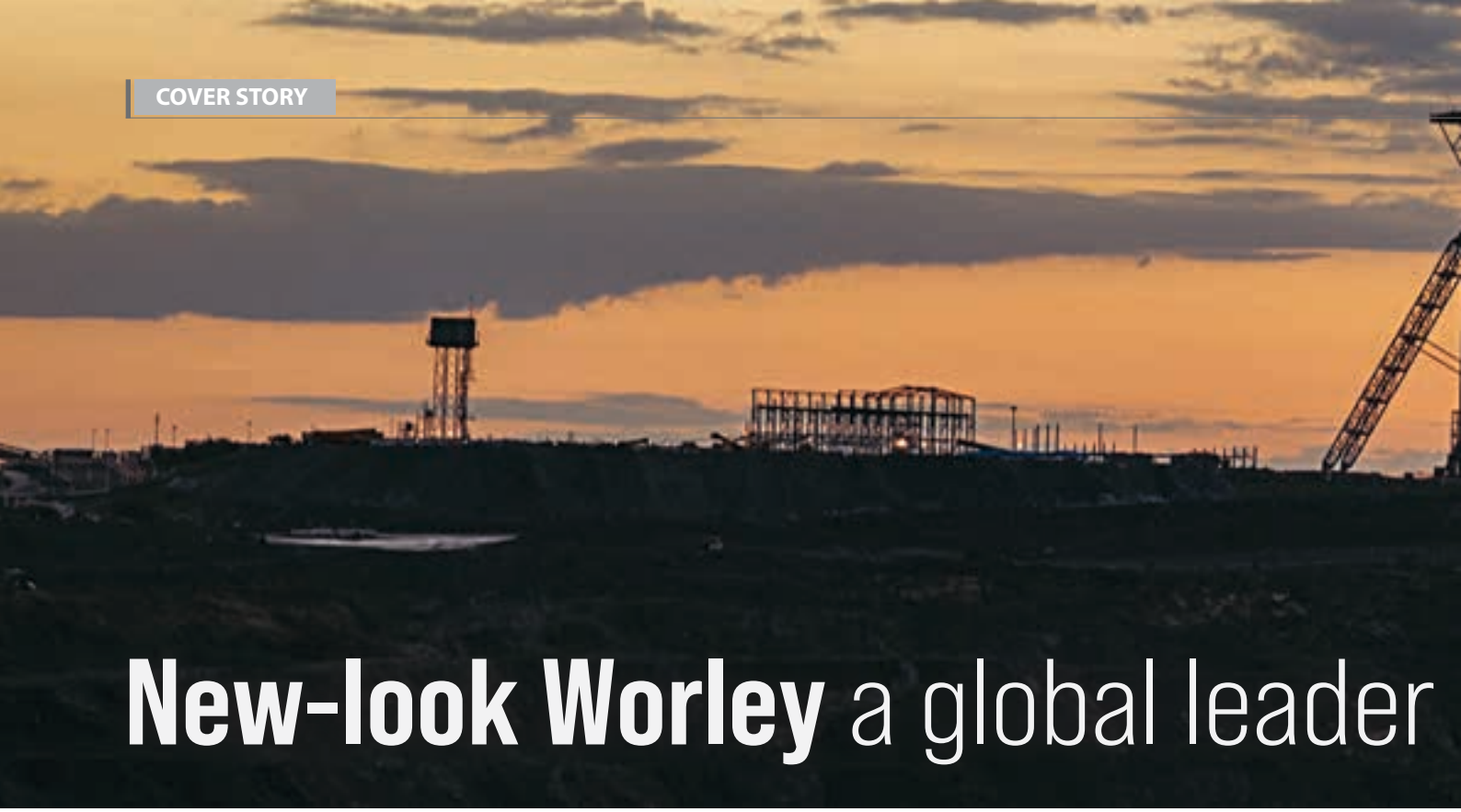
The plant is expected to improve metallurgical recovery and reduce cyanide consumption at Blanket. Based on test work conducted, it is anticipated that the plant will improve overall metallurgical recoveries at Blanket to approximately 94 %. Recoveries have averaged approximately 93 % in 2019.

Commenting on the successful commissioning, Steve Curtis, Caledonia's Chief Executive Officer, said: "We are pleased to have successfully commissioned the new oxygen plant at Blanket and look forward to improved operating efficiencies as a result. This marks the latest in a series of investments to increase production and improve operating proficiency at Blanket as we continue our growth trajectory to 80 000 ounces per annum by 2022.

"The new oxygen plant will provide up to six tonnes of improved oxygen supply to the Blanket Carbon-in-Leach plant which is expected to increase recoveries to approximately 94 per cent.

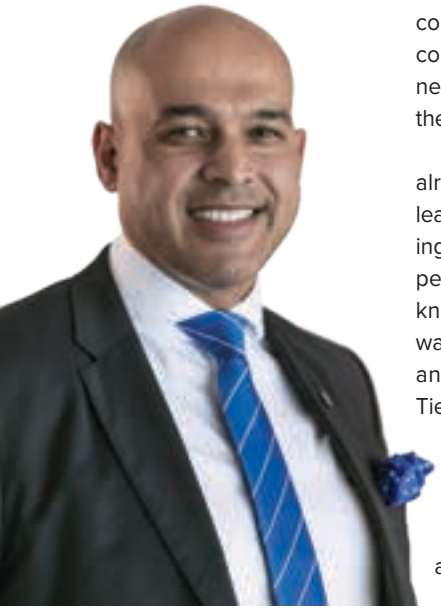
"We also anticipate that the oxygen plant will result in slightly lower operating costs as cyanide consumption is expected to be reduced as a result of the improved oxygen supply; and the operating costs of the new oxygen plant are predicted to be lower than those of the previous two tonne plant." ■

Blanket's plant showing the mill section. A new oxygen plant has been commissioned at the mine (photo: Caledonia).



New-look Worley a global leader

Nick Bell.



Denver Dreyer.

Worley's acquisition of Jacobs Engineering Group's Energy, Chemicals and Resources division (Jacobs ECR) in April this year has not only resulted in Worley (previously WorleyParsons) doubling in size but has also hugely strengthened what was an already formidable capability and footprint in the mining, minerals and metals space. This was a key point that emerged from recent discussions between *Modern Mining* and Worley's senior executives, Nick Bell and Denver Dreyer.

Bell, who is based in Brisbane, Australia and is Senior Vice President Business Development and Global Sector Lead Mining, Minerals & Metals (MM&M), says that the US$3,2 billion Jacobs ECR transaction has resulted in the Worley Group becoming arguably the pre-eminent global provider of professional project solutions and asset management services in the energy, chemicals and resources sectors, with a total employee complement of around 58 000 across more than 50 countries. He also notes that Worley's mining business is now about five times the size it was before the acquisition.

"Prior to the acquisition, WorleyParsons was already a major player in mining and a clear world leader in certain areas such as the design, engineering and execution of deep shafts," he says. "What is perhaps less well known is that Jacobs ECR, best known for its dominant position in petrochemicals, was also a formidable player in mining, with a strong and long-standing relationship with a number of Tier 1 mining customers. The combination of the two companies has now resulted in a mining business that is probably without equal in the world in terms of its capacity and capability."

Dreyer, Senior Vice President Mining, Minerals and Metals – Europe, Middle East and Africa, points out that the merger involved two businesses which were largely complementary in nature, particularly in respect of mining. "There was only a limited overlap between the mining businesses of the two parties when they operated independently. Geographically, WorleyParsons was strong in Australasia and Africa while Jacobs ECR had a well-developed footprint in the Americas and was clearly the dominant player in the Australian mining and minerals industry for major projects," he explains.

"Similarly, WorleyParsons had world-class expertise in areas such as shafts and underground development while Jacobs ECR was known for its experience in base metals concentrators and mass materials handling systems for both surface and underground operations, just to take a couple of examples. The combined group brings together all these skills and geographies under the Worley name." Dreyer adds that Worley's Johannesburg office (where he is based) remains one of the group's Global Centres of Excellence for mining.

While Worley services all areas of the MM&M market with its customers ranging from juniors through to the 'blue chip' mining giants, Bell sees the latter – the Tier 1 customers – as being critically important to Worley. "These are the customers with whom one can develop long-term relationships, becoming their partner in delivery over multiple projects across a range of commodities and minerals provinces," he says. "This has been a core part of

in mining

our business in the past and we see this continuing in the future."

One major trend that Bell identifies in the MM&M market is an ever-growing emphasis on sustaining capital investment as mining companies look to extend the lives of their mines, improve the efficiency of existing operations or replace assets which have reached the end of their lives. "We've seen this trend developing over the past several years and revenue from projects of this type now represents about 50 % of our global MM&M Services business – it's an arena that Worley plays in very strongly. An example of what I'm referring to is the Pilbara region in Australia where the major iron ore companies are building new mines to replace operations that are no longer economic. They're not producing more tonnage – they're investing to stay in business."

Bell adds that the work generated for Worley

The Venetia diamond mine at sunset showing the two headgears of the VUP (photo: De Beers).

Impala Platinum's 20 Shaft on the Western Limb of the Bushveld Complex, just one of many deep-shaft PGM projects that Worley has been involved with over the past 15 years (photo: Implats).

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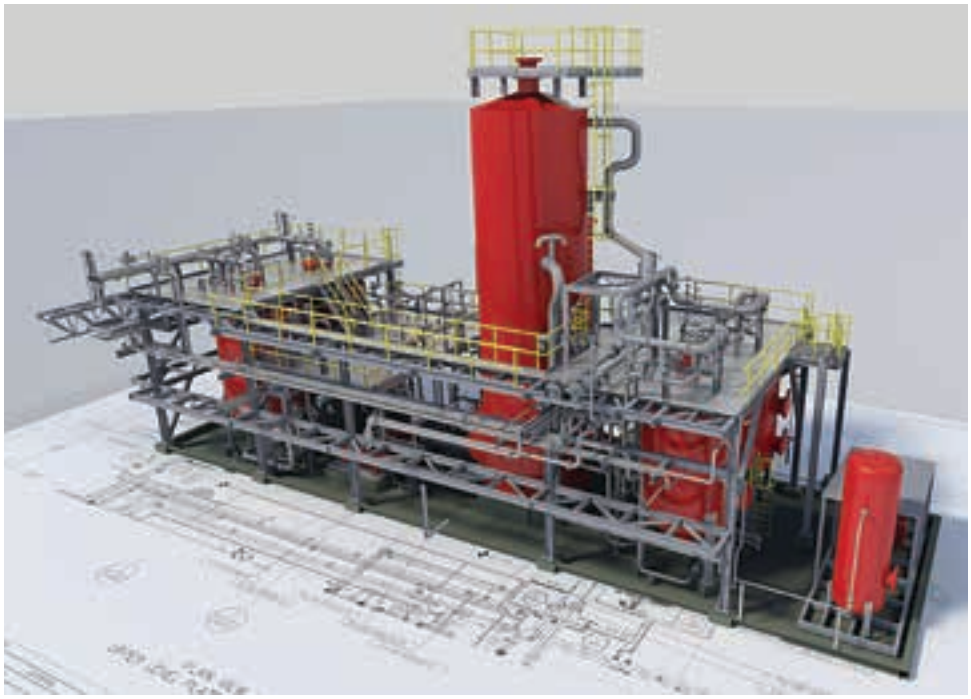
by sustaining capital investment by mining companies lacks the 'glamour' associated with the implementation of new greenfield capital projects but nevertheless provides a steady – and growing – revenue stream and the opportunity to build sustainable relationships with customers.

A second trend that Bell identifies as an opportunity for the company is the 'migration' of open-pit mines to underground operation as surface resources are depleted. "Essentially, what we're talking about is the development of large-scale block caves and sub-level caves. Examples of projects of this type are the Venetia Underground Project (VUP) in South Africa, the Chuquicamata underground copper mine in Chile and the Cadia East mine in Australia, in all of which we're involved. We have been able to bring our global resources to bear on these projects, which are notable for their size and complexity."



Worley is one of the world leaders in the application of digital technology to process plant design and mine development.

According to Dreyer, the global footprint of Worley – now further enhanced by the merger – has been hugely beneficial to the South African operation. "Activity in South Africa's mining sector has been subdued over the past several years, but we nevertheless remain extremely busy, providing support to Worley's execution projects globally," he says. "This involvement is also extremely positive for our people, who have the opportunity to participate in major projects around the world."

On the subject of expansion into the African mining market, Dreyer is of the view that the continent has the potential to be a major growth area for Worley. "We are keen to operate throughout Africa. We are already active in many African countries and we would like to further grow our footprint across the continent. We see particular opportunity in commodities such as lithium, nickel and graphite which are going to be increasingly in demand as the global transition to 'greener' sources of energy gains momentum," he says.

Interestingly, Worley's two biggest current or recent mining execution projects in Africa are at opposite ends of the continent. In South Africa, the company is the EPCM contractor on De Beers' VUP, which is taking the Venetia diamond mine underground, while in Morocco it has just completed the Beni Amir phosphate beneficiation plant for the OCP Group. This is a complex project which has not only involved the construction of a 190 km long pipeline which is the longest of its type in the world but also has linkages to upstream and downstream projects being executed in parallel.

Although the MM&M line of business only accounts for about 10 % of Worley's global revenue, the African operation, controlled from Johannesburg, is still mainly engaged with the mining market. "Mining is the source of about 80 % of the revenues generated by the Johannesburg office," states Dreyer. "This is changing, however, and energy, chemicals and petrochemicals will be increasingly important to the African business. We've already scored some big successes in these fields in Africa, including the 310 MW Lake Turkana Wind Power (LTWP) project in Kenya, the largest in Africa, which has just been officially launched. Worley was responsible for both the project and construction management."

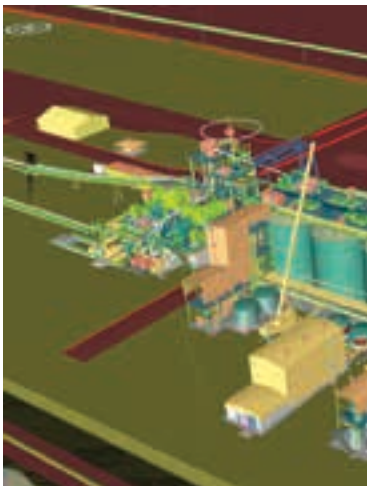
Dreyer makes the point that high ethical standards and transparency are core values of Worley and mentions that the group is working closely with Transparency International (TI) to develop more transparency at the front-end of the mining process, especially in emerging economies. "We're rolling out workshops both here in South Africa and globally which will address this issue, highlighting some of the experience we've gained over the years," he says.

Finally, and moving to the subject of the digital transformation of mining, Dreyer notes that Tier 1 mining companies are increasingly demanding digital platforms to plan, engineer, construct and manage their projects. "Fortunately, Worley is one of the world leaders in this field, in part due to the efforts of the Johannesburg office, which has been one of the pioneers of the concept of the virtual or digital mine," he says. "We can now offer our clients truly cutting-edge technology. We see this digital ability giving us a clear competitive edge as we move forward." ■

"We are keen to operate throughout Africa. We are already active in many African countries and we would like to further grow our footprint across the continent."

As can be seen here, the Yaouré site lies close to the southern shore of man-made Lake Kossou. The Kossou hydroelectric power station is situated 6 km east of the project.

Yaouré project well into the development phase



West African gold producer Perseus Mining, listed on the ASX and TSX, is moving fast on construction of its new Yaouré gold mine in central Côte d'Ivoire. The company formally committed to developing the mine in May this year and has since made impressive progress. The mine will be the third in Perseus's portfolio and will transform the company into a 500 000 ounce per year gold producer by 2022.

Perseus reported in September that the construction camp at the Yaouré site was complete and that the earthworks contracts had been awarded with most earthmoving equipment already on site. In a presentation on the project, it said clearing of the permanent camp and Tailings Storage Facility (TSF) sites was underway while the plant site was 100 % cleared with the Process Plant Management Team (PPMT) establishing on site. The power line survey was complete, the transformer and sub-station contracts let and the line construction tender issued. Ball and SAG mill fabrication was also well advanced.

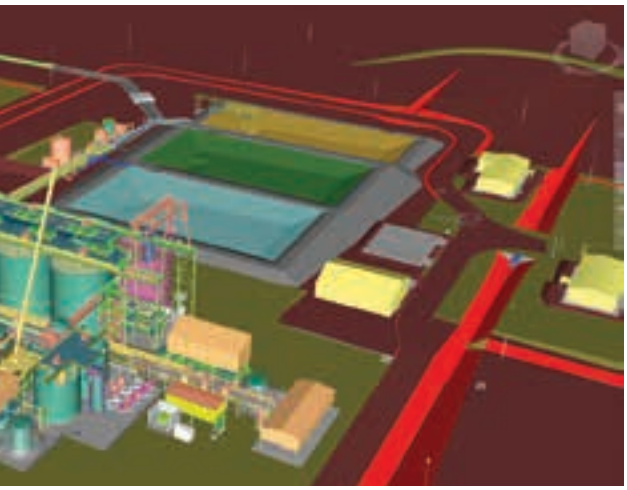
The project is being undertaken by the same teams (Perseus's own in-house team and Lycopodium) that delivered Perseus's second mine, Sissingué in northern Côte d'Ivoire, ahead of time and on budget. Under the terms of Lycopodium's contract, first gold is due to be poured at Yaouré by 23 January 2021, although a 'stretch target' involving an earlier gold pour in December 2020 is being pursued and is currently thought to be achievable.

Yaouré, which was acquired by Perseus in 2016 as part of its acquisition of Amara Mining, lies within the eastern half of the informally named Bouflé greenstone belt. It is located in a rural area on the southern edge of Lake Kossou, 260 km north-west of Abidjan. The Kossou hydroelectric power station is 6 km east of the project.

A DFS was completed on Yaouré in November 2017 that detailed a US$265 million development producing 215 koz/a of gold at an AISC of US$759/oz over the first five years of operation. Life of mine production will be 1,4 Moz at an AISC of US$759/oz over 8,5 years.

As detailed in the DFS, ore will be sourced from two open pits, CMA and Yaouré, and historical heap leach stockpiles. Mining will be by conventional open-pit mining methods utilising hydraulic excavators and trucks. In ore, mining bench heights will be 5 m with 2,5 m flitches to minimise ore loss and

The construction camp has been completed.



The ore will be processed in a conventional plant consisting of single-stage crushing, SAG and ball milling, gravity and CIL recovery.

waste rock dilution. Waste blocks adjacent to ore will be mined on 5 m benches while waste more distant to ore will be mined on 10 m benches.

During the DFS a competitive 'Request for Quotation' involving five mining contractors currently operating in West Africa was completed. The equipment selected by the mining contractors consisted of between 24 and 30 trucks in the 100-tonne capacity class and a combination of 100-140 tonne excavators for mining in ore and 200-300 tonne excavators for mining in bulk waste.

The permanent mining services contract is due to be awarded in the December quarter this year in time for the successful contractor to mobilise new equipment to site to commence pre-stripping of the CMA pit in the second half of 2020. A mix of local and international mining contractors have tendered for the work and eight credible offers have been received by Perseus. These are currently being assessed.

The ore will be processed in a conventional 3,3 Mt/a plant consisting of single-stage crushing, SAG and ball milling, gravity and CIL recovery. The ore is particularly hard and careful consideration was given to the design of the comminution circuit in conjunction with the mine drilling and blasting. The optimum grind size of 75 µm was determined from extensive metallurgical test work at a range of grind sizes to optimise cost and recovery.

According to Perseus, the project has strong community support and the company anticipates that this will strengthen as development progresses and greater benefits flow to the local population. The successful model for community engagement employed at Sissingué will be implemented at Yaouré.

Perseus believes there is plenty of scope for the existing mine life of Yaouré to be extended given the company has a highly prospective 360 km^2 land package in the area. In addition, the company announced in November last year that a preliminary inferred mineral resource had been estimated for a potential underground mining operation to supplement the CMA open pit.

A scoping study on the underground resource – which totals 3,0 Mt at a grade of 6,2 g/t gold for 595 000 ounces of gold – has indicated that it appears amenable to extraction using mechanised underground room-and-pillar mining methods. Underground access from the CMA pit combined with the selected mining method will significantly reduce the capital development requirements should underground mining go ahead in the future.

Photos courtesy of Perseus Mining

The ore is particularly hard and careful consideration was given to the design of the comminution circuit.

Africa's miners meet in Gaborone

The fifth annual Africa Mining Summit was held in Gaborone, Botswana, on 24-25 September this year. The event, which was opened by Eric Molale, Botswana's Minister of Mineral Resources, Green Technology & Energy Security, attracted over 250 delegates from around Africa, including Ministers and Deputy Ministers of Mining and senior officials from 14 African countries.

Organised by GRV Global, the Summit was held under the auspices of – and in partnership with – the African Union Commission and the Ministry of Mineral Resources, Green Technology & Energy Security of Botswana, with the goal of advancing the 'Africa Mining Vision'.

Held now on a yearly basis, the event brings together suppliers who are looking to sell to the mining corporates, mining corporates who seek investment, investors who want to strike deals and government ministers who engage all groups to discuss new opportunities in their countries. A highlight of each conference is an extended session devoted to pre-arranged, 15-minute, 'match-making' meetings.

Keynote speakers this year included Boubacar Bocoum, Lead Mining Specialist at the World Bank; Professor Fred Cawood, Director of the Wits Mining Institute; Dr Gavin Andersson, Director, Andersson Afrika; and Lira Ralebese, Deputy Principal Secretary of Lesotho's Ministry of Mining. The welcoming address was given by Hussien Hassan of the African Union Commission.

The Summit included sessions on the Africa Mining Vision; mining and finance; energy; junior mining; innovation; the supply chain; and the 'Future Revolution' (which looked at issues such as the Fourth Industrial Revolution and its impact on African mining).

In his opening address, Minister Molale pointed out that a long history of minerals exploration had largely failed to benefit the African continent's development. He emphasised that minerals had to be extracted with the full consent of communities and also noted that countries in Africa needed to look

Pictured here are the participants in the first panel discussion on the Africa Mining Vision. They are from left: Conference Chair James Campbell; Hussien Hassan, African Union Commission; Peter Lokeris, Minister of State for Minerals Development, Uganda; Eric Molale, Minister of Mineral Resources, Green Technology & Energy Security, Botswana; Polite Kambamura, Deputy Minister of Mines and Mining Development, Zimbabwe; and Naana Eyiah, Deputy Minister, Ghana Ministry of Lands & Natural Resources.

beyond a dependence on their mineral resources and move towards being 'knowledge-rich' economies.

Boubacar Bocoum in his address to delegates dealt with the key drivers for a compliant mineral rent collection administration. He noted that minerals represented about 70 % of Africa's total exports and 20 % of its GDP but questioned whether the continent was getting the returns it should from its minerals endowment, given that many African countries did not have adequate systems and capacities to drive compliant minerals payments.

In his presentation on junior mining, Charles Siwawa, CEO of the Botswana Chamber of Mines, pointed out that many mineral deposits discovered in recent years were often small in scale and of inferior grade and were not regarded as attractive by the large mining houses.

"The junior mining companies are suitable for this type of mineral exploitation with their abilities to reduce overheads and focus on the technical portion of the mining value chain," he said. "Indeed, there is scope to suggest that the legislative authorities should look at provision for applying differential operational structures in the running of junior mining companies as opposed to large corporates without compromising safety and environmental considerations. This will to a large extent reduce overheads and make operations more sustainable."

Although the Summit did not focus to any great extent on specific mining projects, several junior miners provided updates on their activities. Speakers included Cedric Sam, GM of Mupane gold mine, Botswana's only active gold mine; Vivian Stuart-Williams of Deep South Resources, holder of the large tonnage Haib copper project in southern Namibia; Nchakha Moloi of Motjoli Resources, a junior resource company founded in 2004 with a significant project footprint in South Africa; and Dr Tony Harwood of Montero Mining, which is exploring for lithium in Namibia.

The conference was very ably chaired by James Campbell, MD of diamond explorer Botswana Diamonds (which is active not only in Botswana but also South Africa where it is focused on its Thorny River project in Limpopo Province). Summing up the Summit, he described it as a "unique, intimate, African conference" offering in-depth networking and a line-up of high-quality speakers. He noted that the 2018 Fraser Institute study had rated Africa the second least attractive continent for investment and said the Summit way had gone some way towards proposing solutions that would make the continent more investor friendly.

The next Africa Mining Summit, the sixth in the series, will be held on 2 and 3 September 2020, with the venue again being Gaborone. ■

Photos by Arthur Tassell

The 'match-making' session at the Africa Mining Summit.

James Campbell with (from left) Roger Key of Kalahari Key Mineral Exploration Company; Dr Alkaly Yamoussa Bangoura, Advisor to the President on Mining affairs, Ministry of Mines & Geology, Guinea; and Simon Tuma-Waku, President of the DRC Chamber of Mines.

Progress at Tongo diamond project on multiple fronts

ASX-listed Newfield Resources has reported excellent progress on its Tongo diamond project (Tongo Mine Development) in eastern Sierra Leone. The drilling, blasting and excavation of the boxcut which will give access to the planned underground mine has been completed and Newfield has also concluded a lease agreement for mining equipment. In addition, a new drilling programme has begun with the aim of expanding the project's resource.

The Tongo Mine Development combines kimberlite dyke-hosted diamond resources on two adjacent mining licences that cover over 134 km^2 and host 11 identified diamondiferous kimberlites. It is subject to a Tribute Mining Agreement between the two mining licence holders, these being Newfield's subsidiary company, Sierra Diamonds Limited, and Octéa Mining's subsidiary company, Tonguma Limited. Newfield has full management and operating control of the combined Tongo Mine Development.

Only four of the identified kimberlites are incorporated in the current JORC-compliant indicated and inferred diamond resource estimate of 7,4 million carats. Of this resource, a 1,1 million carat probable reserve has been declared for just two of the kimberlites, Kundu and Lando.

A FEED study on Tongo was commissioned by Newfield following its acquisition of Stellar Diamonds in early 2018. The study was completed by Paradigm Project Management (PPM) of Johannesburg in April 2019. Other key contributors to components of the FEED Study were MPH Consulting, Z-Star Mineral Resource Consultants, SRK Consulting and Datamine.

Based on the reserves only model from the FEED study, the Tongo Mine Development is expected to deliver a mining operation with an initial eight-year life. Total diamond production of 1,1 Mct is forecast with a peak diamond production of 260 000 carats in Year 5. A US$222/ct realised price is expected while the forecast unit opex is US$115/ct. The estimated capex for the project is approximately US$29 million.

Mining will be exclusively by underground methods with single portal access to Kundu and Lando being provided from the boxcut, which is located approximately midway between the two kimberlites. The selected mining method is traditional shrinkage stoping (with an 85 cm stoping width), a method commonly used in similar kimberlite dyke mining operations in South Africa.

The single decline to Kundu and Lando will commence with a 6 m x 4 m portal entry and continue at the decline slope angle of 8 degrees for a distance of 149 m, whereafter it will split into two separate declines of 4 m x 4 m dimensions towards Kundu and Lando respectively. The joint decline will take approximately four months to develop and equip before the split. Thereafter, the 4 m x 4 m declines will continue at a slope of 8 degrees and spiral down to Level 5 (48 masl) which is the basis of the current mine plan.

Boxcut development at the Tongo diamond project.

To complete the boxcut excavation, five blasts were undertaken and some 52 000 m^3 of blasted granite have been removed to the waste dump stockpile, where Newfield has recently established a crushing plant to produce aggregate for the mine construction. The boxcut is now at the elevation required based on the geotechnical studies to ensure that the portal entry for the decline to access both the Kundu and Lando kimberlites can be drilled and blasted.

A consulting rock engineer has visited the site and undertaken a geotechnical study to make recommendations on the required support for the boxcut and the initial

development of the portal and decline to ensure a safe working environment.

Newfield also reports it has entered into a finance lease agreement with ASX-listed BauMart Holdings for the lease of mining equipment that is required for the initial stages of the Tongo underground mine development. The equipment comprises two drill rig jumbos, two haul trucks and two LHD loaders with an aggregate value of US$2,8 million. Procurement of capital items to support the boxcut and commence the portal opening and decline development will now be made, in advance of the expected arrival of the rock drills, loaders and haul trucks in late December.

In respect of processing, the FEED study envisaged using the former Koidu 50 t/h production plant, which Newfield acquired from Octéa Mining as part of the Tribute Mining Agreement. As part of an optimisation programme following the FEED study, Newfield assessed options for potential rapid expansion of processing capacity and diamond production rates. This review included weighing a single enlarged plant design against planned refurbishment of the existing 50 t/h plant coupled with investment in a standalone 25 t/h processing plant at the Tongo Dyke-1 site. The outcome of this review is that it is more efficient, in both capital investment and operating terms, to implement a modular 100 t/h plant design from the outset of mine development.

Various key components of the 50 t/h plant can be used in the development of the 100 t/h plant. The aggregate capital investment with the expanded capacity is only marginally higher than the original 50 t/h refurbishment approach. The detailed design of the 100 t/h plant has been completed and earthworks excavations for plant civils have begun.

As part of the ongoing resource development work at Tongo, Newfield has commenced further drilling and diamond assays on the Panguma kimberlite, which is located to the west of the Kundu and Lando kimberlites. The objective is to declare an initial resource for Panguma, which will also increase the global Tongo Mine Development resource.

A drilling programme at Panguma is currently in progress using an in-house diamond drill rig and is providing a better density of drilling along strike of the kimberlite, and thus a higher confidence geological model. So far eight holes (for 574 m) have been drilled, with all holes intersecting the kimberlite. It is envisaged that a further four holes will be drilled and then samples of kimberlite core will be sent to the Saskatchewan Research Council (SRC) for further microdiamond analysis and grade estimation.

Two separate samples of the Panguma kimberlite, totalling 329,95 kg, were collected as part of the current work programme and were consigned to the SRC for caustic fusion (microdiamond analysis). Combined, these samples yielded 962 diamonds, weighing 1,69 carats. Some 28 diamonds were classified as >0,85 mm in size, with the largest stone measuring 5,5 mm x 4,7 mm x 3,0 mm (0,79 carats in weight).

View of the boxcut looking east towards the Tongo camp.

Commenting on the progress at Tongo, Newfield Executive Director Karl Smithson noted that the boxcut has been completed with zero safety incidents. “Work is now focused on providing the necessary support of the boxcut and shaping of the haul road to attain the right angle of entry into the decline,” he said. “With the recent signing of the lease agreement for the mining equipment, which is due to arrive on site at the end of this year, we look forward to commencing the opening of the portal and driving down the decline towards the Kundu and Lando ore reserves from January 2020.

“As part of the mine design optimisation work, it became clear that an opportunity exists to develop the Tongo D-1 kimberlite from 2023 in parallel with planned mining of the Kundu and Lando kimberlites. The decision has therefore been taken to adopt a plant design enabling rapid modular expansion from 50 t/h to a nameplate 100 t/h capacity. This provides the potential for significantly expanded production rates from 2023 and also delivers the flexibility to further increase production from existing and other kimberlites that are not yet in the broader mine plan.”

Photos courtesy of Newfield Resources

Rockfall protection solution proves itself at open-pit mine

Specialised geotechnical services contractor Marshall Developments, with the assistance of Maccaferri, was recently instrumental in designing and installing a rockfall protection solution at Foskor's open-pit mine in Phalaborwa. The system was put to the test earlier this year when it successfully handled a fall of ground incident involving about 20 tons of material.

Foskor was founded by the Industrial Development Corporation (IDC) in 1951 and is currently the only vertically integrated producer of phosphate ore, phosphoric acid and granular fertiliser in South Africa.

As one of the world's largest producers of phosphate and phosphoric acid, unceasing production is key and any disruption to mine productivity results in significant financial loss. This means the mine must constantly monitor the open-pit slopes for activity or movement to provide warning of potential rockfall events.

When these events do occur, loose debris or rocks can detach and fall from the face of the slopes, posing a risk to infrastructure, plant and employees, and potentially leading to production stoppages.

A fall of ground occurred in May 2017 in the main pit of the mine. Although there were no effects on operations, no injuries and no equipment damage, the hazard remained alarming and required the necessary attention.

Solution

Pro-active management by Foskor identified the need for rockfall protection along the permanent ramp as a long-term solution, and areas where the jointing and geological disturbances were intense were identified. Foskor subsequently indicated which solution it would require on two identified areas.

The solutions proposed were a simple drapery mesh (4 500 m^2) on the one area and a 500 kJ rockfall barrier kit (150 m) on the other. Marshall Developments was appointed to implement the proposed solutions and approached Maccaferri SA to submit a proposal for rockfall mitigation measures.

With geological and topographic information and properties provided by the client, the slope to be covered with a simple drapery mesh was modelled

RMC050 ICAT/2 Plus rockfall barrier kit installed to protect the main haul road.

Completed simple drapery system using Steelgrid HR 50.

by Maccaferri SA using its rockfall design software, MACRO Studio. This was done to obtain the strength requirements of the mesh and to dimension the anchors and cables needed to implement the simple drapery solution. Steelgrid® HR 50 was proposed to the mine and was deemed to have satisfactory strength properties to contain debris that might detach from the face and safely guide it to the toe of the slope. The mesh transfers the stresses from the falling rocks to the crest cable. The cable then in turn transfers the stresses to the anchors, where they are ultimately absorbed by the in-situ material.

The other area called for the installation of a rockfall barrier kit in order to intercept rocks before reaching the ramp where there are vehicles (including heavy machines) and employees moving while conducting the daily mining activities. The rock engineering department of Foskor performed a rockfall trajectory analysis and determined that a 500 kJ barrier of 3 m height would be sufficient to intercept the blocks expected to come down the slope should an incident occur.

Maccaferri SA proposed the use of a RMC050 ICAT/2 Plus barrier which the mine deemed suitable for this application.

Both rockfall protection systems that were installed are classified as passive systems. Passive systems permit loose rocks and other debris falling down the slope to be intercepted and contained. As the purpose of these structures is to control superficial instability by catching and stopping falling rocks, their design must consider global rock sizes; the level of energy to be absorbed; and the most suitable location on the slope.

Passive systems are regularly maintained by removing loose rock caught in the system and repairing as required.

Steelgrid® HR system

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with anchor plates, U-bolts and mesh connectors. The Steelgrid® HR mesh is a composite of double twisted steel wire hexagonal mesh, with high tensile strength steel cables woven into the mesh during the manufacturing process. The high-level corrosion protection for the steel wire mesh (Class A Galvanised), ropes (Class A Zn 95 %-Al 5 % Galfan) and accessories make the system ideal for rockfall protection in all environments.

Maccaferri SA produces Steelgrid® HR in South Africa with locally sourced high strength steel. It is easy to handle and does not require extensive modification of existing method statements or installation techniques. The inclusion of the steel ropes greatly enhances the transfer of loads from the mesh into the anchorage system thereby increasing the safety, capacity and durability of the mesh as a complete system. The mesh does not unravel if a wire is cut, has a high punching resistance and is CE certified.

Rockfall barrier kit

The RMC050 ICAT/2 Plus rockfall barrier installed to protect the main haul road can withstand the impact of a rock block with energy levels in excess of 500 kJ. It is manufactured using components provided with specific coatings to increase the corrosion resistance when the kit is installed in particularly aggressive (marine, industrial) environments.

The 'Plus' type barrier is supplied with steel mesh and cables coated in Galfan (Zn 95 %-Al 5 %) class A (EN 10244-2, EN 10264-2). The 'Plus' type is furthermore provided with hot-dip galvanised anchor bars and shackles according to EN ISO 1461, fasteners (bolts and nuts) according to EN ISO 10684 and hot-dip galvanised or non-electrolytic zinc flake coated U-bolt wire rope grips.

No upslope bracing cables are required which makes the installation of this barrier not only rapid, but also ideal for any profile, especially on rugged slopes. Due to the system geometry and layout, the lateral bracing cables require smaller pull out resistance. Shorter anchor lengths are therefore needed to restrain the cables.

The system is easy to install, even under severe environmental conditions, and the installation can be accomplished in a short time span. It requires minimal maintenance.

Installation and performance

Installation of the rockfall systems by Marshall Developments commenced in April 2018 and was successfully completed during July 2018, in compliance with the installation manual provided by Maccaferri SA. The careful and efficient installation ensured that there were no risks and effects on the mining production levels and the Steelgrid® HR system was installed making use of rope access techniques, which allowed normal mining activities to continue during the installation process.

The rockfall barrier kit after the fall of ground.

A fall of ground occurred in January 2019 where the rockfall barrier system was installed on the main access road into the pit. Approximately 20 tons of material collapsed from the slope and was safely arrested by the rockfall barrier system. It is believed that rainwater from the previous night triggered the fall of ground.

This incident was anticipated based on the past experience of falls of ground in the same area. Foskor's rock engineering highwall monitoring system had also shown movements of this part of the highwall and it had been monitored over time.

There was no effect on operations, no injuries to personnel and no equipment damage as the failure material was arrested by the rockfall barrier system.

The falling material resulted in minor damage to the barrier, which was easily reinstated after the material was removed. Further back analysis will be done by Maccaferri SA to calculate the kinetic energy absorbed during the impact. After the impact, the elongation and residual height of the barrier was within acceptable values.

The Steelgrid® HR system was installed making use of rope access techniques, which allowed normal mining activities to continue during the installation process.

Conclusion

Open-pit mine safety and operations can be threatened by rockfall hazards, which can cause serious disruption to mine productivity and result in significant financial losses. This problem should be addressed with a targeted approach, as each specific site requires an analysis of its particular natural and anthropogenic risks that are also informed by good appreciation and understanding of the geotechnical characteristics that govern the area prone to rockfall risks.

Acknowledgements: Thanks are due to Nkosi Nene, Chief Rock Engineer, Foskor, and Dries Swart, Contracts Manager, Marshall Developments, for their assistance in preparing this article.

Move to 'digital mining' picks

Convincing mining companies of the virtues of adopting digital technology used to be a hard sell for mining equipment suppliers but this is no longer the case. Mines need to find more efficient – and safer – ways of extracting ore and are now actively seeking out digital solutions. This is the view of senior Sandvik executives Niel McCoy, Andre Blom and Saltiel Pule, who recently sat down with *Modern Mining's* Arthur Tassell to discuss developments in this fast-moving field.

Globally, digital mining – which encompasses both information management systems and equipment automation – has taken off with Sandvik Mining and Rock Technology (Sandvik Mining) having over 400 items of equipment operating autonomously around the world, including at mines in Canada, Sweden, Finland, Ireland, Chile, Argentina, the USA, India, the Philippines, Australia and several countries in Africa. In addition, the company has provided information systems to nearly 50 sites.

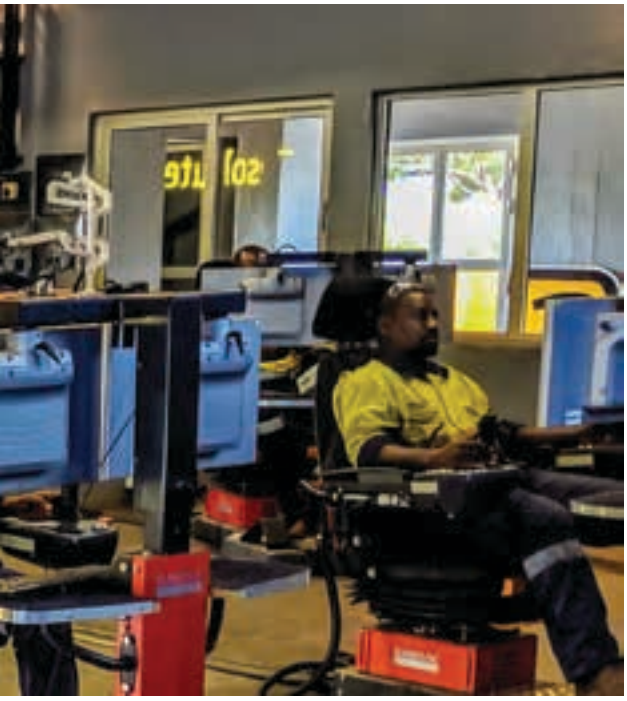
Says McCoy, who is Business Line Manager Automation for Sandvik Mining and Rock Technology Southern Africa: "Our reference base is starting to build up rapidly and some of the installations – such as at Resolute Mining's Syama gold mine – are truly impressive. Our automated machines have now run over 2,5 million hours cumulatively over 15 years without a single Lost Time Injury (LTI) being recorded."

Sandvik's two prime offerings in the digital arena are its OptiMine® and AutoMine® systems. OptiMine® is a modular information management and data analytics solution that offers a real-time view of underground mining operations while AutoMine® is a product family that covers all aspects of automation from tele-remote or autonomous operation of single pieces of equipment through to the autonomous operation of entire fleets of trucks, drill rigs and loaders underground or drill rigs on surface.

While the take-up of both of these systems locally has lagged behind some countries, South Africa did in fact host one of the first commercial AutoMine® installations in the world – the pioneering autonomous trucking loop at the Finsch diamond mine in the Northern Cape, which was commissioned in 2005 and operated through till last year. It was preceded in 2004 by an AutoMine® installation at a copper mine in Chile but this controlled only LHDs.

In the rest of the African continent, digitalisation – after a slow start – is now starting to make impressive strides, with probably the flag-bearers being the Kibali gold mine in the north-east of the DRC, which has LHDs running under AutoMine®, and Resolute's Syama Underground Mine project in Mali, which is being developed as the world's first purpose-built, fully automated sub-level cave gold mine.

Syama is a flagship project for Sandvik Mining, which – as Resolute's technology partner – is delivering both its OptiMine® and AutoMine® systems to the mine for planning, analysis, process optimisation and automation. OptiMine® modules being deployed include the 3D Mine Visualizer, a valuable tool for



up pace

operations planning, analysis of problematic areas and the tracking of mine development over time, and Drill Plan Visualizer, an easy-to-use tool for production and rock support drilling.

The Sandvik fleet on site includes Sandvik TH663i trucks, LH621 loaders, LH514E electrical loaders and DL421 autonomous drills. The collaboration between Sandvik and Resolute is an on-going exercise but already the first machines are working in the sub-level cave, with Resolute having announced

Above: The cab of the DI650i down-the-hole (DTH) drill rig. The DI650i is available – like all the i-series rigs – with a host of intelligent on-board options.

Above left: The Automation Control Centre at Resolute Mining's Syama gold mine in Mali.

Left: The Sandvik TH545i is a high performance 45-tonne articulated underground dump truck. It features a wide range of integrated technology, such as Sandvik Intelligent Control System, My Sandvik Digital Services and automation compatibility as standard.

Another view of the Syama Automation Control Centre. According to Resolute, Syama has the most advanced mining automation system in the world.

the successful commencement of sublevel caving at Syama on time and on budget in December 2018. A world first is the use of autonomous trucks to haul ore to surface.

"The Syama project is the most advanced of its type in the world. New mines planned in the Southern African region, such as Venetia Underground, the Platreef underground mine near Mokopane, the Waterberg PGM project north of Mokopane and the Kamoa/Kakula copper project in the DRC, are all projected to be highly mechanised and automated as well," says McCoy.

Apart from economics, a key driver of the move to automation, says McCoy, is safety. "Autonomous operation removes operators from dangerous areas and generally reduces the number of workers underground, as machines can be operated from control centres on surface. It cannot be applied in all mining environments but where it is applicable it can have a dramatic impact on safety performance."

Saltiel Pule, Business Line Manager Underground Drills for Sandvik Mining and Rock Technology Southern Africa, notes that digitalisation in mining encompasses a range of options, not all of which involve full automation of the type being pioneered by mines such as Syama. "We have a range of 'intelligent' rigs, for example, which still have operators but that nevertheless offer a range of automatic drilling functions which allow significantly improved productivity and reduced costs. Vedanta Zinc International (VZI)'s Black Mountain Mining (BMM) operation in the Northern Cape, to take one instance, uses our 'new generation' DD422i drill rig, which can drill part of the face automatically."

BMM's mining operation comprises two underground operations – Deeps and Swartberg – producing mainly zinc and lead and the associated flagship Gamsberg operation. VZI is currently in the process of adopting OptiMine® at BMM, making it one of two mines in South Africa to use the system. The other is a surface coal mine in Mpumalanga.

Sandvik, of course, provides full support and training for all its systems and equipment and an exciting recent development has been the introduction of an operator training simulator for the DD422i and some of its sister machines. "It is highly mobile as it weighs less than 50 kg and has a wheeled carrying case, so we can easily take it to our clients on site," Pule says. "It has the same 'dashboard' and utilises the same software as the rigs themselves, so it provides a totally realistic experience."

Andre Blom, acting Business Line Manager Surface Drills for Sandvik Mining and Rock Technology Southern Africa, points out that the intelligent features of Sandvik's underground drills are also present on its i-series surface rigs. "Mine owners and drilling contractors are really keen on the new technology," he states. "Not all users require full automation so we scale the automation features to their needs but all these new machines can be operated remotely using the AutoMine® Surface Drilling package, which allows a single operator in a control cabin to operate several machines simultaneously."

One of the newest i-series rigs to be deployed in South Africa is the Leopard™ DI650i, which was launched globally at last year's Electra Mining Africa show in Johannesburg. The first unit was bought by mining contractor Moolmans for use at VZI's Gamsberg open-pit mine near Aggeneys, where it is reportedly acquitting itself very well. According to Blom, it is a firm favourite with drill operators who vie with each other to use it.

The DI650i is a down-the-hole (DTH) drill rig designed for high-capacity production drilling applications in surface mining, as well as large-scale quarry applications. Pipe sizes range from 89 to 140 mm, depending on the size of the hammer, while the maximum hole depth is 53,6 m when utilising the carousel option with pipe sizes from 89 to 102 mm.

The DI650i is available – like all the i-series rigs – with a host of intelligent on-board options which include TIM3D drill navigation with wireless transfer, fleet monitoring through the My Sandvik service, and full cycle drilling automatics, which merges functionalities such as uncoupling, feed auto aligning and feed auto positioning into a single efficient sequence.

Pule and Blom both agree that automation will not lead to job losses but can, in fact, have precisely the opposite effect, as it contributes to the overall health of the mining sector by cutting costs and enhancing

productivity, allowing mines to operate successfully in economic climates which could see the demise of conventional operations. They also point out that it allows mining to go into areas that were previously regarded as either unsafe or uneconomic or even a combination of both.

McCoy adds that automation helps address another important issue which is looming ever larger for mining companies – the reluctance of many new recruits to the mining industry to accept the labour intensive work traditionally associated with mining. "The only way around this challenge is to have high levels of mechanisation and, where appropriate, automation as well. Having been brought up in the age of the cell phone and the internet, youngsters today, of course, are totally at home with the digitalisation of mining."

As a final point on the benefits of automation, McCoy emphasises the beneficial effect it has on maintenance costs and machine life. "Machines operating autonomously work in a constant and predictable cycle and are not subjected to the same conditions they experience when manually operated," he says. "This was proved at Finsch where the trucking loop delivered a 30 % reduction in maintenance costs and a 35 % increase in the service life of equipment over its life. This experience has been repeated at other sites and we're confident that the new systems going in at mines such as Syama will show similar savings, particularly since many of these new mines have been – or will be – designed from the ground up for digitalisation, including automation. We believe that digitalisation is here to stay and that it will revolutionise the mining industry over the next few years."

Photos courtesy of Sandvik and Resolute Mining

A Sandvik AutoMine® operator station.

Booyco's fourth generation PDS

Chief Executive Officer at Booyco Electronics, Anton Lourens.

The pace of change in the PDS (Proximity Detection System) business has been exponential over the past couple of years in terms of technology and customer expectations. This is the view of Anton Lourens, founder and MD of Booyco Electronics, a Jet Park-based company which is thought to be the PDS market leader in South Africa. "To stay ahead of the field, we invest a huge amount in research and development (R&D) and we have recently introduced the fourth generation of our flagship PDS, which sets new benchmarks in pedestrian safety and collision avoidance," he says.

Booyco has shown steady, and in some years spectacular, growth, ever since being founded in 2006, assisted by demand from a mining industry which is ever more aware of the need for safe operations. Around 55 000 workers and 6 500 vehicles have been equipped with its PDS and the system has notched up more than 200 million hours of use on machines and 2 billion man hours on pedestrians, a track record which the company believes is unmatched by its competitors.

"No one can equal our 'footprint' in the market," says Lourens. "We now have more than 100 direct mining customers, as well as many mining contractors, in our client base, mostly in South Africa although we do have some mines across border using our PDS. What makes us unique is that we operate in both the underground – in either hard or soft rock – and open pit sectors. Our PDS is also intrinsically safe and can be used in the 'fiery' environments found in coal mining."

He adds that over the past year Booyco has increased its complement of service technicians by 30 % and has added two branches to what was already an extensive network of service centres. "We now have eight centres countrywide serving all the main mining areas while the number of technicians supporting customers numbers around 160," he says. "Mines make a significant investment when they install a PDS and they rightly expect a high level of backup – which is exactly what we provide. On some big mines which have service level agreements (SLAs) with us, we could have up to two full-time technicians providing support on every shift."

A cap lamp equipped with two-way RFID tag to warn pedestrians when entering a danger zone.

He says that SLAs include monthly reports based on the data logging capabilities of the PDS. "All interactions are recorded and analysed and the information can be used to improve safety behaviour and monitor efficiencies," he says.

Booyco's fourth generation PDS was released in the first quarter of this year. One of the main changes is the adoption of the Controller Area Network (CAN) bus protocol in place of an older communication protocol, while technology has also been added that allows software for the PDS to be uploaded using a mobile device. "The idea is not to change hardware in the future," says Lourens. "Instead, everything will be driven by software updates."

Developed in collaboration with German company SELECTRONIC but assembled locally, Booyco's PDS employs very low frequency (VLF) wave transmission. Pedestrians are equipped with two-way RFID tags – generally installed in

sets new benchmarks

Booyco Electronics' PDS system is assembled and tested locally at its head office in Jet Park.

their cap lamps – while vehicles are fitted with VLF antennae which create stable fields of a predetermined size and shape around the vehicle. The size of the field can be determined by customers to suit their specific operating environments and address identified risks. The system can detect as many as seven trackless mining machines (TMMs) and 20 pedestrians at once in the underground environment.

When a pedestrian enters the zone in which the field is established, the tag is activated and a warning signal – which consists of a light and sound alarm – is triggered and simultaneously the operator of the vehicle is also warned that a pedestrian has entered the danger zone. If equipped and configured appropriately, the vehicle can also be slowed down at a certain distance from the pedestrian, and similarly brought to a slow stop. The accuracy of the system ensures that there is sufficient reaction time after warnings are given for the operator to act, reducing the possibility of a collision.

According to Lourens, the use of VLF technology is what sets Booyco apart from most of its competitors. "When we started the business, the focus was on underground pedestrians," he notes. "That's when we identified VLF as the best route to follow. VLF signals can propagate through the rock mass underground, which allows a pedestrian, for example, to be warned of an approaching vehicle even if it is around a corner and out of sight."

He adds that in 2015 Booyco added GPS technology to its PDS for vehicle detection on surface. "Since introducing our surface offering for vehicles, it has proved very popular and now accounts for a major part of our sales. Our underground and surface systems are compatible with each other and we have customers whose underground vehicles interface with their surface equipment. All units have the same controller, which we call a Booyco Host Unit or BHU."

On the subject of legislation, Lourens points out that regulations gazetted in 2015 as amendments to South Africa's Mine Health and Safety Act put the onus on employers to take "reasonably practical measures" to ensure that pedestrians are protected from injury.

"In essence, mine owners must undertake risk assessments and mitigate against significant risk – which in practical terms means that if there is an assessed risk they will have to install a PDS," he explains. "The regulations further stipulate certain requirements regarding warning systems to pedestrians and TMM operators, including automatic means of retarding speed and braking on TMMs. The regulations already apply to all electrically driven machines while diesel-operated machines will need to be compliant by 2020."

Lourens acknowledges that the legislation has been a driver of sales in recent years. "For many

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years now, the goal of zero harm to workers has been the highest priority for mines so we've never really had to work too hard to convince them of the benefits our systems provide. From the time we first started up, they've been receptive to the concept of a PDS. But there's no doubt that the new regulations have provided a 'tail wind' for sales and allowed us to continue growing our business, even during periods when the mining industry in South Africa has been depressed," he says.

Booyco Electronics' GPS surface offering is compatible with underground vehicles.

One major trend in the PDS market that Lourens identifies is a move towards common standards. "When we first established Booyco, the industry was a free for all, with no standards in place to guide either developers such as ourselves, the manufacturers of TMMs, whose machines have to be able to respond to PDS interventions, or indeed the mining companies when putting out tenders or inquiries for proximity detection systems," he states.

"This has now changed, due in major part to the efforts of the Earth Moving Equipment Safety Round Table (EMESRT), an industry forum first established in Australia in 2006 by a number of global mining houses, which has developed a set of specifications which details the key elements of vehicle interaction systems and the functionality which proximity detection systems need to have. There is still work to be done but we are finally seeing some order being brought to what was previously a chaotic field."

Lourens says that Booyco has fully embraced the work of EMESRT, whose guidelines have been adopted as 'best practice' in South Africa by the Minerals Council South Africa.

Looking ahead, Lourens sees further strong growth for Booyco. "The legislative requirements should result in the South African PDS market remaining buoyant but beyond this there is huge scope for growth in the rest of Africa, where the take-up of proximity detection systems has been slow, mainly due to the lack of appropriate legislation, and also in overseas markets, which have also, for the most part, lagged South Africa. We are a world leader in the PDS field and believe we are well placed to take advantage of the opportunities opening up as PDS becomes the norm in all mines worldwide.

Photos courtesy of Booyco Electronics

feature

Minerals Council pursues **the goal of Zero Harm**

The Minerals Council South Africa has formally launched the Khumbul'ekhaya initiative, a CEO-led strategy on health and safety, developed and led by the Minerals Council CEO Zero Harm Forum. The aim of the initiative is to drive and sustain the mining industry's pursuit of Zero Harm, with a particular emphasis on eliminating fatalities.

Significant strides in improving industry safety and health performance in recent years have been possible through the collaborative efforts of employees and unions, the support of the Department of Mineral Resources and Energy (DMRE), and mining companies.

Collaborative initiatives – such as the Mine Health and Safety Council (MHSC) 2014 Occupational Health and Safety Summit Milestones and the Centre of Excellence, the establishment of the MOSH Learning Hub, the work being undertaken by the Mandela Mining Precinct, and the CEO Zero Harm Forum – have made important contributions. All these efforts have helped to contribute to an 88 % decrease in the number of fatalities since 1993 as well as reductions in occupational health-related deaths. However, the industry takes the view that no fatality is acceptable, and their incidence needs to be eliminated.

The increase in fatalities in 2017 – the first regression in a decade – resulted in deep introspection among CEOs. It prompted the Minerals Council Board to urgently initiate several measures to address this trend, including intense scrutiny of the major causes of accidents, research conducted through the MHSC and the launch of the National Day of Safety and Health in Mining 2018. A massive combined effort by companies, unions and the DMRE in mid-to-late-2018 saw a gratifying improvement. In addition, a facilitated workshop involving 34 industry CEOs in January this year provided the impetus for a revitalised strategy – Khumbul'ekhaya.

Khumbul'ekhaya is a Nguni word for "remember home", and recognises the devastating impact that work-related deaths have on families. It intends to drive home an enhanced safety and health message.

Khumbul'ekhaya, which is complementary to and supportive of existing initiatives, has four critical drivers:

- ❑ the industry's continued commitment to Zero Harm;
- ❑ a two-year focus on the elimination of fatalities as a result of both safety and health incidents;
- ❑ adopting a holistic approach, recognising that fatalities are usually the result of a complex set of circumstances;
- ❑ learning from incidents, from each other and from other industries.

Themba Mkhwanazi, Chair of the CEO Zero Harm Forum, speaks at the launch of Khumbul'ekhaya. Seated (from left) are Roger Baxter, CEO of the Minerals Council, Zanele Matlala, Vice President of the Minerals Council, Matthew Grant from AMCU and David Msiza, Chief Inspector of Mines (photo: Arthur Tassell).

Speaking at the launch in Johannesburg on 1 October, Themba Mkhwanazi, Chair of the CEO Zero Harm Forum, said: "At the centre of it all is the recognition that the quality of safety and health in the industry starts with us and depends on us, the industry's leadership."

Minerals Council CEO Roger Baxter said he wanted to give full recognition to the mining industry's social partners and the positive contributions they had made and he made a point of mentioning the regulator, in particular the Chief Inspector of Mines, and the unions.

Matthew Grant, from AMCU, speaking on behalf of the unions, said: "We welcome the Khumbul'ekhaya initiative, especially the strides made by the CEO Zero Harm Forum over the years. But, while we are doing well, we are not doing well enough, particularly in

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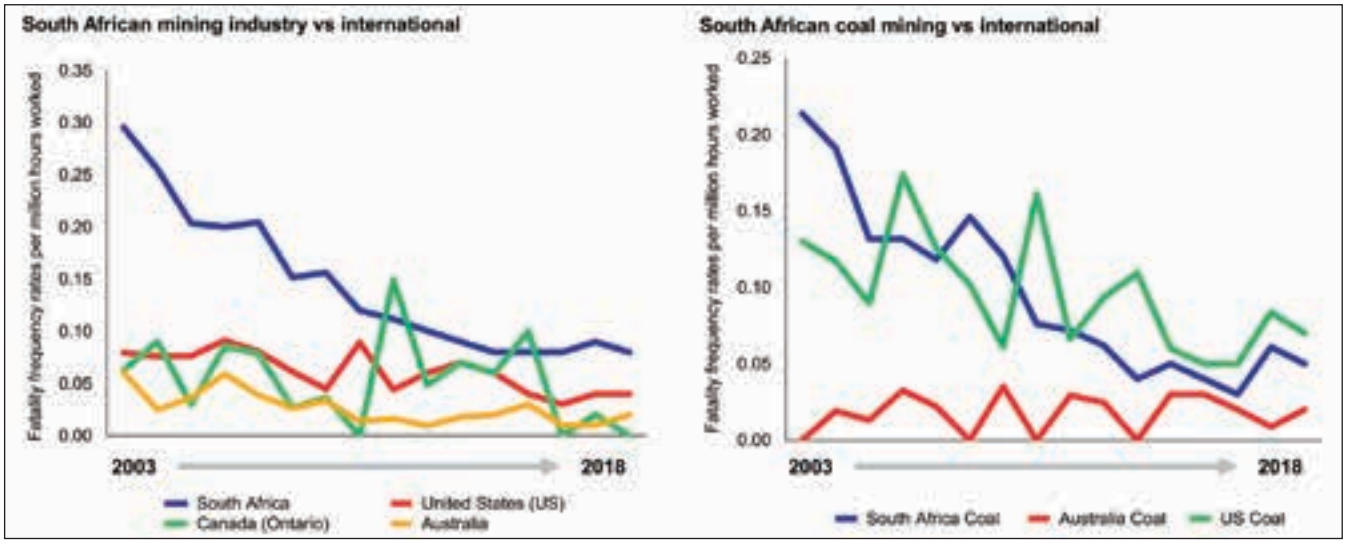


As these graphs indicate, the South African mining industry's safety performance has shown considerable improvement in recent years and is starting to match that of its international peers. (The graphs are taken from a presentation given by Minerals Council President Mxolisi Mgojo at the Joburg Indaba.)

respect of falls of ground as a priority. Profitability can be achieved through the imperative of health and safety. We know our role as organised labour, and we will play that role."

"We shouldn't lose sight of where we have come from," commented David Msiza, Chief Inspector of Mines and the Chair of the MHSC. "Decades ago, no one believed that Zero Harm was possible. If we maintain the reduction we have had, this will be the safest year ever." He noted the significant challenge of safety issues related to women in mining and at home, and indicated that the MHSC would be focusing on this.

Speaking at the Joburg Indaba a day after the Khumbul'ekhaya launch, Minerals Council President Mxolisi Mgojo updated delegates on the initiative. He acknowledged that thousands of workers had died at work over the past 100 years but also said that there had been an "almost uninterrupted improving trend since the advent of the democratic era", during which time the number of deaths due to mining accidents had fallen by 87 % from 1993 to 2018, and the fatality rate (measured in relation to the number of hours worked) by 80 %. "In 2019, as at 23 September, there had been a further significant improvement, with 35 deaths having been reported in accidents compared with 63 in the same period the previous year," he said.

In the health sphere, he noted improvements in dust incidence trends which address the most serious occupational health challenges. He also noted the recent silicosis and TB class action settlement and progress towards its implementation, as well as the successes of the multi-stakeholder Masoyise Health Programme, whose goal is to bring tuberculosis incidence in the industry to or below the national average.

In the coming months, Minerals Council member companies will be hosting their own Khumbul'ekhaya launches as they hold their own health and safety days, with CEOs intent on leading these programmes. ■

Jet Demolition secures redundant mine shafts

Redundant mine shafts are becoming a growing risk for large mining houses due to a sharp spike in illegal mining activities. Demolition specialist Jet Demolition is offering a turnkey service that provides an effective solution to the problem.

"The fact is that illegal mining is born from desperation. People are willing to risk their lives by going underground to try and recover pockets of unmined material, as well as copper cable and steel shaft infrastructure. They can be armed, which poses a huge risk. It is not uncommon to witness extreme violence or intimidation in these areas," says Jet Demolition Contracts Manager André Botes.

The most effective way of ensuring that redundant shafts are protected from occupation by illegal miners is to seal them permanently below natural ground level (NGL), typically after filling the shaft barrel. This is where Jet Demolition can play a vital role.

Its turnkey service offering for the mining industry includes backfilling shaft barrels, designing permanent caps, installing caps at a defined depth below NGL, and recording the final position and depth of caps, followed by the backfill and reinstatement of the natural material over cap tops.

Mining houses typically require such a turnkey service for two main scenarios: firstly, to seal the shaft permanently as a mitigating factor, thereby preventing unauthorised access by illegal miners or, secondly, to rehabilitate the mining footprint fully, rendering the area safe for public use.

Installed rebar cage ready for concreting.

Another challenge is that various shafts are often interconnected, such as a live shaft and a redundant shaft linking together hundreds of metres below NGL.

"It is thus critical to ensure that we understand the network we are operating within, so that our capping and sealing activities do not influence or adversely affect miners underground in a neighbouring shaft," Botes stresses.

The main requirement for permanent shaft sealing and capping projects is to ensure full compliance with the Mine Health and Safety Act, and the provisions of the Department of Mineral Resources, the approved Environmental Management Plan, as well as any client-specific requirements.

The natural surrounding environment also has to be taken into account, paying special attention to natural water courses and stormwater management. This could mean rerouting natural water courses slightly, while ensuring there is no subsequent negative downstream effect. All material used to fill shafts must be clean and uncontaminated. This is vital to ensure that no groundwater contamination will occur after sealing.

"We have also sealed a few shafts that had to be equipped with monitoring access points as part of the Acid Mine Drainage (AMD) project in the Western, Central and Eastern basins of the Witwatersrand Goldfields. These access points will be used to monitor the quality and volume of subsurface water in the foreseeable future," notes Botes.

Jet Demolition pays particular attention to health and safety, especially when working over an open shaft that could extend a few kilometres underground. "It is absolutely critical to protect plant and personnel from falling," Botes stresses. Hence certified lifelines are installed prior to any work commencing, providing personnel with anchoring points during shaft sealing. Larger machines are also typically used for increased reach. ■

Positioning of precast concrete cap sections over a shaft.

feature

ConCourt ruling boosts the use of saliva testing

With the recent ConCourt ruling of legalising cannabis for personal usage, it is essential for employers to find the right drug testing equipment that can safeguard the lives of their employees whilst at work. According to ALCO-Safe, the ruling has resulted in its Oratect saliva drug test growing in popularity as it allows employers to accurately determine whether an employee is under the influence of the drug when he or she arrives at work.

There are a variety of drug testing kits available including both urine and saliva tests and each has its pros and cons. According to Rhys Evans, MD at ALCO-Safe, which specialises in drug and alcohol testing solutions, companies need to go back to basics and look at creating well-structured policies on drug use. Employees, he says, need to be educated on the risks of consumption whilst at work and regular drug testing needs to be implemented.

He adds that with the recent legalisation of 'dagga', companies need to be able to test their employees to find out if they are under the influence rather than just detecting if they have ever consumed the substance before.

Evans says that ALCO-Safe focuses on delivering alcohol and drug testing solutions as well as services such as training and calibration. The company embarks on a journey with its clients from formulating policies through to providing support at CCMA cases once the necessary equipment and procedures are in place. This is particularly important in the heavy-duty industries such as mining and construction as it assists in not only reducing the risk of accidents but also improves productivity. Response rates are slower when drugs such as cannabis are consumed, and reflexes are dulled. It is therefore vital for companies to implement regular drug testing.

Traditionally, conducting urine tests was common in the workplace. These test for the metabolite of the drug which in many cases can show up in urine for a number of days after the drug was last used. As a result, it is a trusted and accurate method for verifying the extended use of any drug.

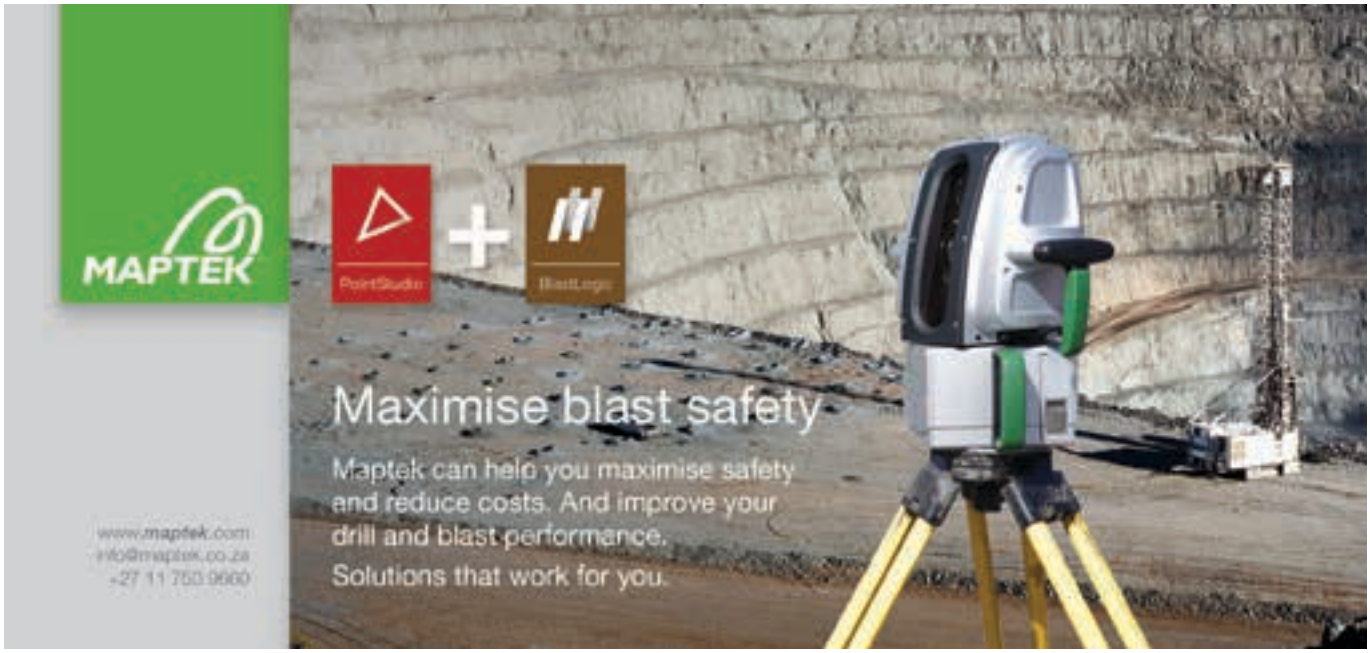
"However, there is a big movement, due to the recent change in laws surrounding cannabis use, to use a saliva test," Evans explains "Saliva tests detect the primary or psychoactive compound and therefore have much shorter detection windows. This is better when trying to confirm if an employee is under the influence of cannabis at that point in time.

The Oratect disposable saliva test.

"With saliva tests a drug can be detected after consumption within as short a period as one day ago. Consequently, the usage of saliva tests has increased when compared to urine testing attributed to the fact that saliva tests have the main benefit of a short detection window thus increasing the accuracy of drug use results."

The Oratect saliva drug test from ALCO-Safe delivers a fast, accurate 'pass or fail' result within five minutes. Employers can now test for marijuana usage quickly and easily and detect if an employee has used cannabis in the last three to eight hours. The Oratect saliva drug test is a stick that can also detect a number of other drugs such as cocaine, methamphetamines, amphetamines, opiates and benzodiazepines.

"With the increase of marijuana use due to its recent endorsement, it is more important than ever to engage with a company that understands the unique challenges to specific industries – i.e. a company that understands that cannabis usage is not necessarily the 'problem' but rather if employees are under the influence. They should also be involved in assisting organisations to develop their policies, ensuring they are fair and reasonable, whilst assisting in educating the workforce," Evans concludes. ■



Gravelotte emerald project uses De Beers XRF sorter

Adapting one of its X-ray fluorescence (XRF) diamond sorting range of machines, De Beers Group Technology has created a secure and efficient sorting solution for emeralds.

According to De Beers Group Technology head Gordon Taylor, the company's sorting technologies have been applied to a range of minerals apart from diamonds, and these include gemstones like rubies as well as lower value commodities such as manganese and coal.

De Beers Group Technology diamond X-ray sorter applied in an emerald sorting application.

"We are always on the look-out for new applications for our sorting equipment, which also employ X-ray luminescence, X-ray transmission, laser, magnetics and ultra-violet technologies," says Taylor. "So we were excited by the opportunity to collaborate with Magnum Mining and Exploration on their Gravelotte emerald project in Limpopo province."

In its trial mining and processing phase, Gravelotte has been gathering data to confirm the historic grades previously recovered at the Gravelotte project. In operation for much of the 20th century, total recorded production from this area was estimated at nearly 113 million carats. It was reportedly the world's largest emerald mine of its type in the 1960s, employing over 400 sorters.

The general manager of operations at Gravelotte, Wessel Marais, says that the traditional manual method of sorting carried an associated security risk and also led to recoveries that were not optimum.

"Various mechanical sorting options are available on the market today," states Marais, "and Magnum approached De Beers Group Technology to determine whether their diamond sorting technology could be adapted to emerald sorting."

Marais says that testing of samples provided by Magnum was highly successful. "This led to Magnum leasing an XRF machine from De Beers Group Technology for the duration of our trial mining, and the results to date have been very encouraging. With the machines now deployed in the operational environment, research and development work is continuing in conjunction with De Beers Group Technology to refine the process."

Taylor notes that constructive collaboration with customers is often an important element in extending the application of De Beers Group Technology's equipment.

"On this project, we were able to conduct some fundamental investigation on the properties of emeralds to guide us in developing the most effective solution," he says.

Nico van Zyl, De Beers Group Technology marketing and new business development manager, agrees. "You really need a partner who is willing to cooperate with you, as there is considerable effort that each has to contribute," he says. "Our team is always enthusiastic about exploring new applications, and has the expertise and experience to know what is possible and how to achieve it."

The De Beers Group Technology emerald sorting machine can make a potentially significant contribution to the success of the Gravelotte operation, with its high recoveries combined with excellent processing security. The project aims to reach a target of around 3 million carats a year as its initial production rate.

Before the run-of-mine material reaches the De Beers Group Technology XRF machine, it is crushed to -30 mm and put through a trommel screen for cleaning and further size reduction. After material containing emeralds is ejected from the material stream by the sorter, it is further sorted by hand and graded.

"De Beers Group Technology is constantly pushing the boundaries where our equipment can be applied, and has had significant successes in non-diamond commodities. Whether removing the value product or the waste from the process stream, our sorting technologies can be the game-changer in the viability of many projects," Taylor concludes.

De Beers Group, website: www.debeers.com

Powermite sees growth potential in Zambia

Powermite boasts a solid presence in the Zambian mining, crane and processing plant sectors through its agent, F.S. Musonda Trading Limited. This collaboration sees customers across the region gaining access to Powermite's world-class range of electrical and mechanical equipment for moving machinery.

"As part of the prominent Hudaco Group of Companies, we are extremely proud to have made our mark on Zambian soil through our valued agent," states Donovan Marks, Director at Powermite.

With several strong sectors such as mining and industry, along with Powermite's solid relationships with several local mining houses as well as distributors, Zambia plays an essential role in the company's business strategy and perfectly aligns to its growth opportunities.

"It is vital to have a local representative in a country to oversee our interests and to ensure sustainability; we are therefore constantly on the lookout for local agents to represent us in various regions as we feel this is the best route to market," notes Marks.

When deciding to appoint a local Zambian representative, it became apparent that F.S. Musonda Trading was the best agent for the role as Powermite has been doing business with this electrical and mechanical product and service specialist for many years.

"Through F.S. Musonda Trading, a wholly owned Zambian company established in 1990 and based in Kitwe, we are able to showcase our excellent product and service portfolio to both existing and potential Zambian customers," adds Marks.

Powermite's smart and specifically designed product and service portfolio includes mining cables and connectors, together with a comprehensive materials handling range.

Looking to the future, Marks says that the opening of a Powermite branch in Zambia is not off the table. "Hudaco is currently in the process of developing regional plans for Africa and once these have been finalised, the company will have a better idea of where these regional offices will be located to enable the group to expand into Africa," he states.

Powermite, website: www.powermite.co.za

New products enhance flotation recovery

FLSmidth has released two major products that advance flotation recovery. They are the mixedROW™ flotation system and a Froth Recovery Upgrade Package.

Flotation systems are a vital technology in minerals processing and extraction. But despite their overall effectiveness, particles of valuable ore still get disposed of along with waste material. Additionally, the energy consumption that flotation systems require to function effectively is high. So while flotation systems are necessary when recovering ore, making them more sustainable and energy-efficient has been a challenge.

The **mixedROW**™ flotation system features a design that combines two machines – nextSTEP™ forced air and WEMCO® self-aspirating technologies. It provides the solutions to challenges presented by older flotation systems by combining these two cells to produce a system that is much more than the sum of the individual parts. In short, says FLSmidth, mixedROW™ provides boosted productivity, a reduced environmental footprint, and higher profits.

The nextSTEP™ machines are placed at the beginning of the row. Because of this positioning, the mixedROW™ lowers energy consumption by between 15 and 40 % and increases recovery by up to 5 %.

The WEMCO® machines are placed at the end of the row, which increases both coarse and fine particle recovery, as they are capable of treating a wide range of particle sizes. The elevated rotor position within the machine also reduces energy consumption, as the froth only has a short distance to travel.

The **Froth Recovery Upgrade Package** allows customers to have more control over the froth recovery process. The Upgrade Package finds solutions to flaws found in original froth recovery technology. Its features include actuators which control the position of the improved dart valves inside the flotation cells and a level sensor with no moving parts that is used to sense slurry levels accurately. It also incorporates radial froth crowders. These are designed for greater flexibility and control; they are used to reduce top-of-froth surface area and to increase froth movement to the nearest radial launder, allowing for either deeper froth or faster froth removal.

The mixedROW™ flotation system features a design that combines two machines – nextSTEP™ forced air and WEMCO® self-aspirating technologies.

FLSmidth, website: www.flsmidth.com

Pit dewatering requires site-specific solutions

Pit dewatering remains a vital activity for all opencast operations, as ground water not only poses an operational challenge but can also become a safety hazard if not attended to appropriately.

Interestingly, it is not a simple case of one pump fits all dewatering application requirements and it is advisable to deal with a reputable pump supplier to ensure that the most appropriate solution is selected.

Lee Vine, MD of Integrated Pump Rental, explains that there is no such thing as a standard pit dewatering system as each instance requires a site-specific solution.

"There are numerous options available in terms of the actual pump and ancillary equipment, as well as the choice between rental and outright purchase," he says. "The differentiator that our team offers is the ability to assess a given application and provide a pit dewatering solution with the correctly sized pump."

Integrated Pump Rental offers a turnkey dewatering installation.

There are several factors that can have an impact on the pump selection, and these include available power sources, the volume of water to be pumped, and the condition of the dirty water including size and type of particles in the water.

"What adds complexity to pit dewatering applications is that, and in many cases, the need to dewater a pit can be urgent and customers are forced into making an incorrect pump selection or tying themselves into a contract that does not work in the longer term," Vine says.

He says that while the decision to hire or purchase is an important commercial one, so is the actual selection of the pump itself. "If the pump is not sized correctly for the dewatering application at hand, it will not perform as required. This, in turn, leads to further operational challenges including production losses and sometimes even the need to change the pump resulting in further costs."

One of the most important factors to consider is the available energy source, and, if there is no access to power, options such as diesel-driven or pumps fitted with hydraulic power packs must be explored.

When selecting the pump, it is also important to understand the specifics of the water ingress conditions and whether this is a long-term issue or simply a short-term challenge. This scenario will dictate the pump size, its rated output and what ancillary equipment is required.

As an example, Vine points to a recent dewatering application on a mine in Lesotho where a constant flow of water into the mine's pit area demanded that water be urgently and reliably pumped out.

Over time the pit depth had increased, and the groundwater level had been exacerbated by the winter snowfall in the highlands of Lesotho. As a result, the total dynamic head for the duties of the installed dewatering pump installation had changed and the mine required an urgent solution.

Initially a Sykes XH150 diesel-driven pump was deployed, pumping at 120 litres per second at 150 metre head. Subsequent to this, a second Sykes pump was dispatched to site to ensure that the level of water remained at an acceptable level.

With the two Sykes pumps on site, the mine was assured of sufficient pumping capacity, should the groundwater level increase.

Integrated Pump Rental, website: www.pumprental.co.za

Emerging contractor opts for SANY excavator

A small contractor running a chrome-mining operation adjacent to the Twickenham mine near Burgersfort in Mpumalanga, Kgagamela Project CC, has acquired a SANY SY335 medium excavator from Goscor Earth Moving (GEM). This is a harsh mining application and perfectly suited to the ruggedness of the machine, GEM Sales Consultant Murray Leith comments.

"This is a particularly tough mineral, and it makes for a rough mining environment. All equipment has to be highly durable, which is where SANY's philosophy of only using world-class components like Isuzu engines and Kawasaki hydraulics comes into its own," Leith explains. The SY335 was delivered to site in August, and is already hard at work.

The Burgersfort area is serviced from the GEM Nelspruit branch, which has all necessary spares and technical support to assist its customers for their routine maintenance and any emergency breakdown requirements. It is this fast turnaround and 24/7 responsiveness that distinguishes GEM in a highly-competitive business environment, says Leith.

Kgagamela Project CC represents a new type of emerging contractor seeking to make inroads into the local mining industry. With a relatively small operation at the outset, it has its sights set on sustained expansion in the future. GEM believes it is critical to establish a long-standing relationship with such clients, not only from the standpoint of equipment supply but also in terms of offering its experience and expertise.

"Emerging contractors such as these are always looking to take on new equipment, which is where our access to Goscor Finance is a major advantage for us. It is our responsibility to meet our clients' requirements with the best solutions possible," states Leith.

The SANY SY335C medium excavator features an auto deceleration system that reduces fuel consumption by 5 to 10 %. When an operation stops for 3,5 seconds, the engine speed drops automatically to idle level and maintains this idling state.

The strengthened structure makes it an efficient and robust machine for a range of applications. The dual-pump, dual-circuit constant power control system means that the Isuzu engine outputs a continuously strong operating force.

Goscor Earth Moving, website: www.goscor.co.za

Kgagamela Holdings Chairman Norman Mahabe and GEM Sales Consultant Murray Leith with the SANY SY335C.

Rewind by M&C yields 'best ever' test results

Marthinusen & Coutts recently provided a solution to an irregularity that occurred in the stator of a large 36 MW compressor motor deployed at Sasol's Secunda plant.

The results of final tests, conducted by H.V. Test Field Services on the stator after M&C had completed all the necessary repairs on it, were found to be the best among many such tests conducted on similar equipment over a period of several decades.

Initially a Sasol maintenance team discovered during a routine inspection in January 2018 that the flux shield mountings on the stator were faulty, whereupon Sasol awarded M&C a contract to identify the cause of the irregularity and offer a remedy.

"We tested the stator winding, which we found to be fine, but confirmed that there was a defect in the flux shield and recommended that it be repaired, as there was a risk of it damaging the winding if left to continue operating in its existing condition. To repair the flux shield meant also having to remove the winding and perform a rewind on the stator," said Rob Melaia, M&C's engineering and technical executive.

Sasol accepted M&C's recommendation and in August last year assigned it to perform the required repairs. "In addition to replacing the old bars with new bars purchased from a reputable coil manufacturer in the US, we did a very specific modification to repair the flux shield to prevent a recurrence of the defect in the future," Melaia stated.

"On investigating the defect, we found that the electrical current, instead of flowing only in the flux shield as it ought to have done to prevent the core from overheating, had started flowing in the mounting bolts, so causing wear by electrical arcing in the mounting holes and the mounting studs," he explained.

The solution M&C's repair team provided was to fit copper braid straps from several points on the flux shield to the stator body to reroute the current in such a way as to prevent a repeat of the damage as witnessed. To confirm the effectiveness of the solution, M&C arranged to have the refurbished stator tested by local independent test authority H.V. Test Field Services.

Melaia said the test results were the best ever to be achieved among the numerous machines on which HV Test has conducted tests of this kind.

"We have every reason to be proud of this outcome as it says volumes about M&C's expertise in this field, both in terms of correctly diagnosing and repairing faults in a wide range of large rotating equipment, as well as providing the appropriate and most effective solutions for them," he concluded.

M&C undertook specific modifications to repair the flux shield.

Marthinusen & Coutts, website: www.mandc.co.za

Transformer fluid is fire-safe and biodegradable

Cargill, which supplies FR3® natural ester fluid for electricity transformer applications in the mining, power, utilities and other industries, has appointed a Country Manager for South Africa.

Cargill has been supplying its fire-safe and biodegradable FR3 natural ester fluid for several years through exclusive agents Wilec.

Valdir Baraldi has been appointed as Country Manager for Cargill's Bioindustrial Group in South Africa. He is based in Johannesburg to guide transformer manufacturers and end users in the application of FR3 for local markets, following his relocation from Sao Paulo, Brazil, where he worked for Cargill for the past 12 years.

According to Baraldi, Cargill will increase its investment in South Africa to meet Eskom's and the DTI's goals of replacing transformer fluid, typically mineral oil, with fire-safe and biodegradable natural ester fluid for the electrical grid. "We will extend our drive to also meet the needs in the mining and industrial markets for safe and green transformer oils," he says.

"As the global leader in the production and supply of natural ester fluids and the original producer of FR3, Cargill brings its technological expertise, years of research since the mid-1990s, and vast experience – with over 2 million transformer installations worldwide – to the South African market," he adds.

The main benefits of replacing mineral oil with FR3 natural ester fluid in transformers include improved fire safety, extended transformer insulation life and increased load capacity. Hand-in-hand with these benefits is the protection of human lives and the environment, as well as financial savings.

Valdir Baraldi, Cargill Bioindustrial division in South Africa, e-mail: Valdir_Baraldi@cargill.com

TOMRA sorters show their worth at Renard

Stornoway Diamonds is a leading Canadian diamond exploration and producing company. It owns and operates the Renard mine, in commercial production operation since 2017.

Conditions at the mine presented Stornoway with particular challenges that required an innovative approach. "Due to the geology of our ore, meaning we produce very high yield, we have lots of material that we need to sort through. At times, we have the possibility of losing some of those very expensive diamonds due to inefficiencies," explains Marie-Claude Hallé, Marketing Operations Manager for Stornoway Diamonds.

She also points out that Renard's orebody contains a high level of internal and external dilution called country rock, a significant issue as it can make up to 30 to 40 % of the feed to the plant. "With that comes very, very high energy costs from crushing all this waste material that is not diamond bearing," she says. "It causes a tremendous amount of wear and tear on our equipment from screening conveyors through to diamond recovery equipment, and on a dollar-per-tonne basis we spend a lot of money processing non-diamond bearing material."

TOMRA sorting machines installed at Renard.

TOMRA analysed the situation and worked closely with Stornoway Diamonds' team to design and install a kimberlite pre-concentration plant. The specific conditions at Renard meant that the traditional DMS method could not provide an efficient and cost-effective solution. It required an innovative approach, which TOMRA delivered, making Renard the first diamond mine to incorporate ore sorting into its processing plant.

TOMRA developed a solution with four key objectives for the ore sorting plant: minimise diamond breakage by removing hard rocks from the crushing plant feed; upgrade the quality of the material to the process plant by increasing the proportion of kimberlite to waste rock; reduce the energy required for crushing by removing the harder rocks; and improve circuit efficiencies throughout the plant.

TOMRA's solution features five PRO Near Infrared (NIR) sorters in its ore sorting circuit. This technology is particularly well suited to enable discrimination between the various ore and waste materials that need separation at the Renard mine, based on their different chemical composition.

TOMRA also provided a COM XRT 2400 sorter, which uses X-Ray Transmission (XRT) technology to separate material according to its specific atomic density in the plant's large diamond recovery circuit.

"The implementation of this plant proves that TOMRA waste sorting technology can successfully be used to upgrade lower grade ROM and that sensor-based sorting can be used to further improve value recovery for our clients on lower-grade resources," comments Geoffrey Madderson, Diamond Segment Manager at TOMRA.

TOMRA Sorting Mining, website: www.tomra.com/mining

thyssenkrupp develops mobile HPGR test unit

thyssenkrupp Industrial Solutions South Africa (tkISSA) has streamlined the sample testing process with the recent development of a mobile containerised High-Pressure Grinding Roll (HPGR) test unit. By enabling customers to test samples on site, this eliminates the costs, time delays and complex logistics related to the transportation of samples for testing purposes.

The inspiration to create this distinctive containerised laboratory was spurred on by a customer who required the pre-crushing of uranium ore causing various dilemmas in ore processing and transportation logistics as well as handling of radioactive material. Taking all these factors into consideration, the company came up with a game-changing idea: bring the test laboratory to the customer. The mobile laboratory consists of a semi-pilot scale HPGR fully enclosed in a 20-foot container.

"The HPGR was developed in Germany, but we have adapted the design for manufacturing in South Africa," says Gerhard Van Wyk, Process Manager: Minerals Processing at tkISSA. When installed in the container, the unit features a ground-breaking plug-and-play configuration; customers only need to supply a main power connection.

Depending on customers' needs, the capabilities of the containerised laboratory include the ability to run single pass tests on numerous different material types. "This would be required to determine the HPGR's specific performance parameters," explains Van Wyk.

In addition, this versatile lab is also able to process large quantities of sample through the unit, ready for downstream processing. "In fact, our very first unit, which we rolled out to a customer in Africa in Q2-2019, was used for the crushing of a massive 700 tonne sample, bearing testament to the success of our locally adapted design."

This unit was subsequently returned to the original installation in thyssenkrupp's test facility and the first test campaign since its return has already been completed.

This containerised lab offers a host of benefits; the fact the machine is deployed at the rock face at the customer's mine removes the need for sample transportation which leads to increased uptime and enhanced productivity for lowest total cost of ownership for the customer. tkISSA will also configure the machine into the customer flowsheet if required.

"Not only are we responsible for the manufacture of the machine but, given the fact that it remains on the customer's site for a relatively short period, we are also responsible for operation," notes Van Wyk. He also points out that the company will provide an additional process engineer if the customer requires specialised tests. In the event of longer durations, thyssenkrupp will train the site personnel and empower them to operate the machine themselves.

thyssenkrupp has already received enquiries from America, Australia and Europe for this solution. Based on the experience gained by operating the unit, thyssenkrupp plans to develop Container Version 2.0 which will incorporate Industry 4.0 equipment as well as a wide range of upgrades.

thyssenkrupp Industrial Solutions (South Africa)
website: www.thyssenkrupp-industrial-solutions.com

Weba assists Mexican mining operation

As part of a significant investment to improve its processing facilities and enable the recovery of 40 % of the gold that currently sits in its tailings as waste, a mining operation in Mexico called in a leading transfer point and chute systems OEM to conduct a thorough assessment of the functionality of existing chutes in the plant.

Leveraging its in-depth knowledge of material behaviour in chute systems, Weba Chute Systems & Solutions was tasked with establishing the feasibility of introducing filtered tailings at a rate of 1 200 t/h onto the existing transfer system currently handling waste with a nominal size of 400 mm at a rate of 5 000 t/h.

Alwin Nienaber, Technical Director at the company, explains that while the intention is for the filtered tailings to be conveyed when the waste rock is available, it would still mean that the same chutes would need to function transferring completely different material.

"Optimally, one should be able to assess a working transfer chute handling the actual material; however, in the case of a feasibility assessment this is not possible, and we therefore started with a review of the test work and studies prepared by independent qualified professional materials handling experts."

This was done by Weba Chute Systems & Solutions by calibrating the material conditions and behaviour using Discrete Element Method (DEM) software.

"Use of DEM allowed our technical team to model the interaction between individual particles and boundaries and, in so doing, to accurately predict the bulk solids behaviour," Nienaber explains.

A simulation showing material flow from the front.

Access to DEM software allows engineers to predict bulk material flow patterns and flow rates, as well as velocity patterns and dead zones within the transfer system. It also provides accurate information on particle distribution in segregation and blending and the impact forces on particles and boundary surfaces, showing wear patterns.

The feasibility assessment included the transfer of sedimentary dry tailings, sedimentary filter cake, Breccia dry tailings and Breccia filter cake. DEM modelling was done considering material on its own and conditions where blended material would be conveyed. In total, there were four conveyor transfer points that had to be assessed. These included an in-line transfer point, a 90 deg transfer point, a transfer from conveyor to radial spreader intermediate conveyor and then onto the spreader boom conveyor.

Weba Chute Systems & Solutions, website: www.webachutes.com

Becker to upgrade PLC infrastructure

Becker Mining South Africa's energy division has been awarded a contract to upgrade the Programmable Logic Controller (PLC) infrastructure at a leading coal producer's underground operations.

"This project comprises the design, manufacture and installation of 15 different PLCs, where each controller will monitor separate divisions underground. This new system will control the run and stop commands of conveyor belts and also manage safety signals," explains Nico de Lange, Vice President: Operations & Systems, Becker Mining South Africa. "All PLCs will be linked to the mine's SCADA system, with accessibility to control functions remotely from the control room.

"This advanced system, which has been custom-designed by Becker Mining, is expected to enhance productivity, reduce energy consumption and improve safety on the mine.

"The controllers are currently in production at Becker Mining's manufacturing facility in Alrode to meet the mine's exact specifications. Our project team will be responsible for removing the existing system and replacing it with the new controllers, without any loss of production time to the mine. The Becker Mining team will also carry out the commissioning of the new system."

The new enclosures have front and rear access, with a glass window on the front outer door for clear visibility of a 17-inch display fitted on the inner door. The units have an IP65 rating to guard against the ingress of dust and water.

Becker Mining South Africa, website: www.za-becker-mining.com

Robust mobile impact crusher introduced

The high-performance I54Rv3 impact crusher in a typical application.

New to HPE Africa's range of McCloskey crushing and screening plants is the recently updated, high-performance I54Rv3 impact crusher, which is an advanced version of the I54Rv2 machine.

This robust mobile impact crusher operates efficiently in various applications, including asphalt and concrete recycling, rock crushing, construction, mining and demolition.

"The I54RV3 impact crusher – which was showcased in April by McCloskey International at bauma 2019 – has new production-boosting features, including a new main conveyor, an impactor transfer chute, a pre-screen with a steeper bottom deck for enhanced material flow and a simplified rear profile for the impactor chamber," says Rasheel Sukdhoe, McCloskey Product Manager, HPE Africa – exclusive distributors locally for McCloskey International.

"The radial return conveyor of the I54Rv3 features full-length dust suppression control, allowing operators to re-circulate oversize material from the screenbox back to the feed hopper or to radial a complete 90° while running."

Other features include an open chassis for easy access during maintenance, an optional full-length main conveyor, an optional under-pan under the crushing chamber conveyor, a hydraulic adjustable magnet and a large double-deck pre-screen for more efficient fines removal. The larger crusher pre-screen (1 204 mm x 2 360 mm) maximises crusher efficiency and delivers screened product via a straight chute to an 800 mm wide side conveyor.

Wide main and side conveyors accommodate a larger volume of pre-screen discharge material and enable improved discharge from the crushing chamber. The stockpile height from the main conveyor is 3 743 mm.

This 1 200 mm x 1 335 mm impactor, with a 380 kW power rating, has a 1 360 mm x 950 mm feed opening and a 530 to 640 rpm crusher speed.

HPE Africa, website: www.hpeafrica.co.za

Passport 360 impresses Master Drilling

Master Drilling, a leading global expert in drilling solutions for a range of mining clients, including Anglo American and Exxaro, has been a long-standing client of the complete Passport 360 solution.

Established in 1986 by Danie Pretorius, and headquartered in Fochville in Gauteng, Master Drilling started off with a single machine. It has since grown into a global giant and is listed on the JSE.

With over 2 000 employees both locally and internationally, and a range of projects in multiple regions, the company has a high demand for cutting-edge internal processes and procedures. Master Drilling Senior SHERQ Officer Trevor Booysen explains that its association with Passport 360 began in 2014 with Kumba Iron Ore.

"Our initial exposure to Passport 360 impressed us as a good contractor management system – to the extent that we have subsequently implemented the full functionality of the complete solution," Booysen comments. Even though it has project sites where Passport 360 is not deployed, the company has adopted the system for its own internal use.

"We have evaluated alternative apps and systems over the years, but Passport 360 is definitely one of the better ones, particularly because it is paperless and therefore extremely easy to use." Booysen adds that, if any operational issues are encountered, a handy 'live chat' function supplements good client support.

A particular highlight of Passport 360 from a SHERQ perspective is that it gives advance notification of when any medical or safety licences are about to expire. This removes the burden of allocating an employee to manually verify these and issue reminders, which is both time-consuming and potentially error-prone. Instead, Passport 360 automates such a critical process effortlessly and efficiently.

"The major benefit of such advance notification is it assists us with our own planning, especially with regard to training, which by nature is complex, as it cannot interrupt operations, and must include all relevant personnel," Booysen explains. Another feature of the solution is that it is readily configurable, with the Passport 360 team on hand to develop and implement any specific requirements.

"This definitely places Passport 360 a cut above the competition. Its willingness to configure its solutions, and the fact that such flexibility is inherent, together with full back-up and support, is critical to us as a global company," says Booysen.

Passport 360's pioneering health and safety cloud-based platform allows organisations to optimise their administration, health and safety, procurement, and compliance requirements in an integrated online environment.

Passport 360, website: www.passport360.co.za

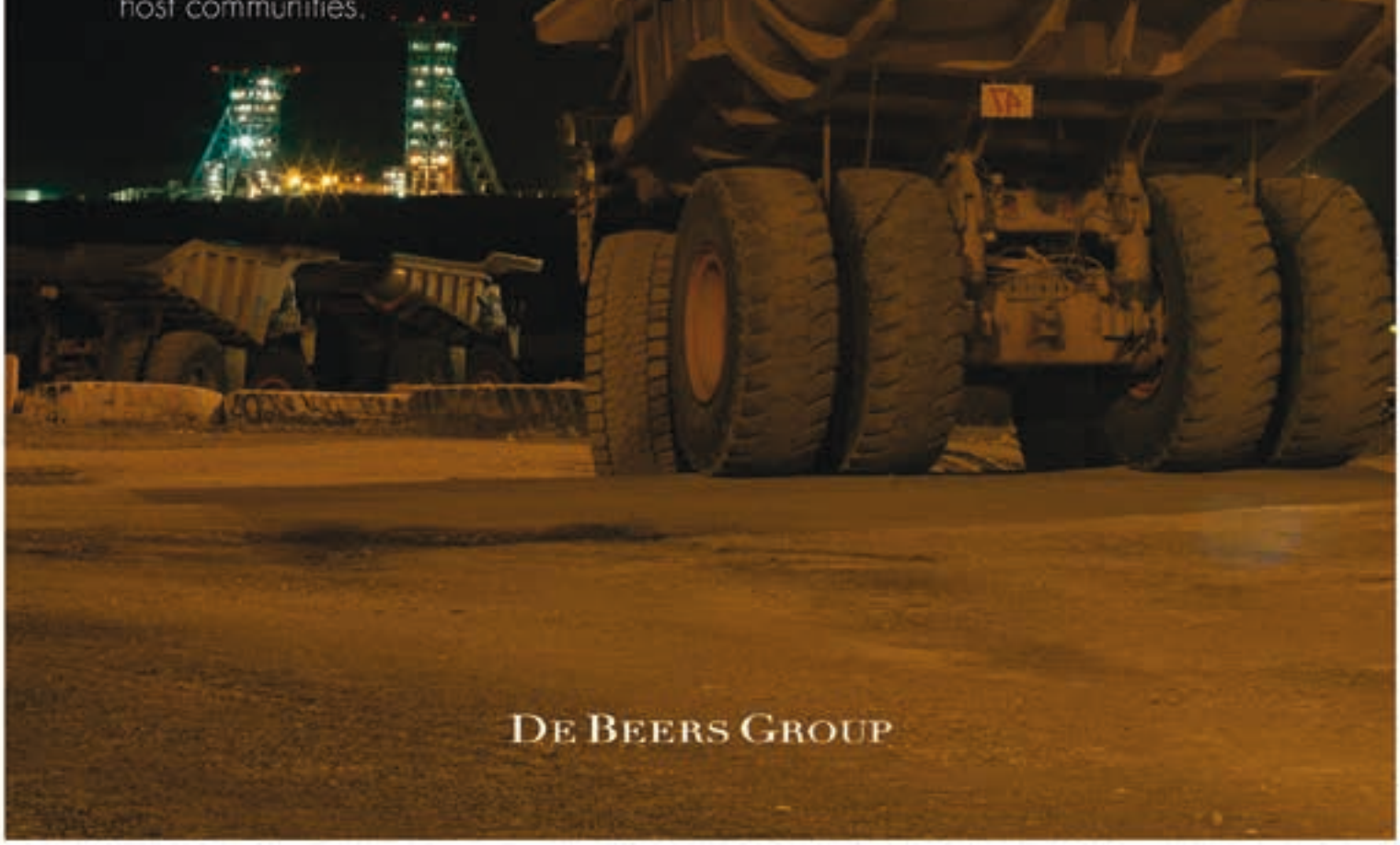
Index to advertisers

VENETIA UNDERGROUND PROJECT

The future of South African diamond mining.

The new US$2 billion Venetia underground mine ranks as the biggest single investment by De Beers Group in the South African diamond industry. Excavation work for the underground extension got under way in 2013, the year De Beers celebrated its 125th anniversary. Production is scheduled to begin in 2022, climbing to full production in 2025. Over the course of its life, the underground mine will treat about 132 million tonnes of ore containing an estimated 94 million carats.

The underground project will extend the life of Venetia mine to 2046, securing the future for our host communities.



DE BEERS GROUP

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